JIA 107 (1980) 1-9

ALFRED WATSON MEMORIAL LECTURE

THE SOCIAL IMPLICATIONS OF ADVANCING TECHNOLOGY

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[An edited version of the lecture delivered at the Institute on 22 October 1979]

I AM going to look at the social implications of advancing technology, and my technique will be one with which you are familiar. I shall look at what has been happening in the past and try to extrapolate into the future.

What, very simply, were the past relationships between technical change and social change? One thing is fairly obvious. Most of the technical change is fairly recent, and I mean by 'recent' the last couple of hundred years, and the rate of change is speeding up.

We started with canals, railways, textiles—that great block of changes 200 years ago which dominated the next 50 years. Then there came electricity, with all that that meant; expansion in certain parts of the chemical industry, the motor car, radio, leading on to television, and I suppose computers. All the time like a thread running underneath those very well-known changes was the considerable improvement in the efficiency of agriculture. It was quiet, but it was there. It was that improvement in agriculture which we should not forget because it enabled the world to support a much bigger population and with such a diminishing proportion of the labour force working on the land.

IBM produced a chart some time ago which showed the time it took for each of these changes to become part of ordinary everyday life. It was quite impressive because you could see the time between the conception, the inventor as it were, the development and the spreading. 150 years ago the process was measured in half centuries; some of our technical changes now are measured in a fraction of that time. There can be little doubt about the speeding up process.

But what are the social or other changes which have accompanied these changes? The first thing one must always remember is that these important technical changes are accompanied by the biggest change in the standard of living ever seen in history, and of course the speeding up both of technical change and improvements in the standard of living over the last 25 years have been quite remarkable. When you consider the rate of improvement, even in this country which is not exactly in the lead, and compare it with what happened when we thought we were leading the world in the mid-nineteenth century, there is no doubt about the faster rate of technical change, and the faster rate in the standard of living. That is a good thing, and implies that we must not be too scared about technical change.

The second thing that one can say fairly clearly is that this rate of technical

change has not taken place at the expense of increased unemployment. That is to say, despite a very great increase in population, and despite an increase in women coming into the labour force to be employed there instead of working at home, we have had fast technical change, fast improvement in the standard of living, and the whole thing being kept in balance in the sense that unemployment did not increase. In fact, until the mid 1970s it fell. So we start from those basic facts about technical changes in the past which ought to stop us getting too scared, as it were, about technical change in the future.

Unemployment has not been a major social accompaniment of technical change but I want to identify three major changes which to me characterize the last 25 years, namely: communications, changes in the family structure, and increased interdependence.

First, communications; one must never forget how recent is the improvement in communications. There was not a great deal of improvement between the time when the Romans built the roads from north to south, and the time that Adam Smith put his pen down at the end of the *Wealth of Nations* in 1776. Cambridge where I live was still the outer limit of one day from London: I commute from there now. Edinburgh was at best 4/5 days from London in 1776. Most people in Britain now expect a foreign holiday. It used to be Majorca, but the cost of travel is so reduced that small changes in exchange rates will make people go very long distances and change their pattern. Florida, and even Hawaii are now alternatives to the Mediterranean. There has been a quite remarkable change in the last 25 years--not all good in my opinion. Like many people I regret the death of the passenger liner, since it is now very hard to fit 4 days peace crossing the Atlantic, into a working year.

Secondly, there are the motorways, which have greatly increased the distances that people will now go. At the same time there is the accompanying decline of the railways. These days, with the exception of commuter traffic, railways provide a tiny part of the total number of journeys by passengers, or even by freight. If one took all the freight off the railways, it would only be equivalent to two years' growth of freight on the roads.

Then there is that change from radio to television, a communication change that has had such an impact on our society. The immediacy of television, the dramatic 90-second shot which can have an effect on the government of even such a big country as the United States. It also has had an effect in bringing together the culture of the nation. The fact that we all tend to look at the same television programmes means that the topics of conversation of people over a wide range of social classes the next morning tends to be broadly similar. Lastly, the growth of the Telex has made the world virtually one market in commodities and currencies.

A communications change which began with the canals, increased through the railways, and then with the motor car, and has dramatically gone faster since 1945.

Turning to changes in family structure, there has been a sharp contraction of

the gap of take-home pay of most people. That is to say, there is not all that difference between people 25% up from the bottom of the take-home pay scale and people 25% down from the top. The second change that has taken place is the decline of help at home. Up to 1870 domestic service was the biggest single employment outside agriculture. These two changes mean that the way of home life of most people is not very dissimilar. Most people take part in do-it-yourself repairs, decorations, gardening, cooking, and so on, and the difference of role between men and women has greatly contracted. There is still some difference in who cooks, but not in much else. We are liable to find both husband and wife doing the gardening, the decorating, and even going out on Saturdays shopping. There has been a radical change.

Another and very important form of 'togetherness' is the very high proportion of women who now go out to work. Some go out part time, but the proportion going out for nearly full time is growing, and Britain has a higher proportion of women who go out to work than anywhere else in Western Europe. That obviously has a major effect on family and social life. It has difficulties: there is the problem of baby minding, latchkey children and the strain on the women to know what to do when there is sickness or school holidays, etc. There are also family problems such as vandalism and increased shoplifting which seem to grow in spite of the increase in the standard of living.

The third change I call the interdependence of production units; the tendency towards the large-scale or integrated plant. This, and the multinational sourcing of components means that in many areas we are finally dependent on what is happening somewhere else in the country and that can be interrupted by comparatively small groups. This interconnected vulnerability is the third of the aspects which constitutes a social change in the last 25 years.

In a rich democracy in the western world not only is the production system vulnerable but, except in times of war, society is apparently not able to take a great deal of pressure. It gets upset if there is any interruption of the electric power system or even in the supply of petrol. We have become both more vulnerable and, as it were, politically sensitive; much more so than poorer developing countries. When the going gets rough, they have no foreign exchange and there are component shortages, they still have a flexibility to make the best of it (botch up and do without spare parts) which our more advanced economies seem somehow to have lost.

In our rich countries there is a big contrast, of course, between the big integrated plant and the small firm of which, I suppose, the extreme is the farm. As you well know the number of workers on a farm is tiny, and in those small units, to some extent self-sufficient though relying on outside input such as petrol and fertilizers, you do not have anything like the difficulties of inter-relationships and vulnerability of the large integrated plants.

That is the past; what of the future? One could begin to speculate over a wide range of possible technical change, genetic manipulation, new plastics, new fibres and so on, but I have only the time to choose two. One I can almost dismiss and

concentrate on the other. The one I want to dismiss is the effect of the 'energy crisis' on technical change, and therefore on social relationships. I want to 'dismiss' it because if there was a change in the cost of energy (of, say, double in real terms between now and the year 2000) and if it happened reasonably smoothly and if people expected it to happen and adjusted accordingly, that is not too difficult to deal with. A change of 3½% a year in real terms one can adjust to. What is quite different is the short, sharp shock of a big increase in the oil price, or a shortfall in supply, which has repercussions around the system. These do have important effects on inflation, unemployment and political disorders and even war. But if we planned on the assumption that energy prices would double, we would take very strong energy conservation measures which at the moment we have only done half-heartedly, and have a real go at alternative sources to carbon fuels: the obvious one is nuclear, but the problem there is not so much technical but social acceptability. If you do all that there will be some shift in technology, and perhaps some reduction in the world rate of economic growth. There will be a shift in incomes of those who produce these energy sources, OPEC particularly. But I do not see that this would necessarily result in major social effects. So I would not relate technical and social change in the next 20 years to what is likely to happen to the average price of energy. But of course we are extremely vulnerable to the short, sharp change which has characterized energy prices since 1973.

Something which has now become a hardy annual of comments about the future, but which has really only come about in the last 5 years, is the micro-processor. 'Chips with everything' is a nice slogan, but unlike many slogans it is liable to be nearly right. This very tiny, thin piece of silicon is incredibly small and rugged. It does not go wrong as happened with the complex computers and transistors, or before that valves. It is incredibly flexible and cheap and the price is still falling. It is as though in 15 years the price of the Rolls-Royce had come down to that of a bicycle, and will soon come down to the price of a pair of roller skates. It is the only device in history in which that rate of fall in real cost has taken place. Canals, railways and electricity took a long time to become effective. But the chip has an economy of size, use of power, with flexibility, ruggedness, and a fall in price which has never been seen before. At first I was sceptical but, when I realized its breadth of application, I became converted. It *is* revolutionary.

What will be its effects in the area of production and the area of communications, and what will these two areas of change mean on the social front?

In the area of production what it can do and will do is to make life a lot more pleasant for people in some of the nastiest sections of industry. You can get remote control very cheaply; and also remote monitoring.

We shall find improved safety and reduced unpleasantness in the 'nasty' areas of mining, the steel industry, the chemical industry, paint shops in car assembly plants, in textile sheds. Of course, many technical changes since the industrial revolution have taken labour away from the nastiest, more dangerous and more

health hazardous parts of industry. The chip will continue that process much more rapidly and in a much more flexible manner.

One of the changes which will take place as a result of the use of the chip is a shift in skills. This has a training effect and it has a social effect. Let us run through one or two of the effects on skills on the shop floor or in the office.

One of the most obvious is robotics. I imagine all of you have seen that beautiful television advertisement of the robot assembly line at Fiat—computer-aided manufacture—which means that the workers will not be tied to the assembly line. You will not need so many people for routine tasks. A much wider area is in the clerical field where a great deal of routine tasks will be carried out much more quickly and effectively by applying chips to record keeping. As well as keeping people away from routine clerical tasks the work will be more interesting because they can themselves call up information and help the customer.

Another area where the chip has a big effect is in drawing-office work, where a computer-aided design reduces the routine drawing and reduces design mistakes. Or to take the medical profession; one can see some of the diagnostic uses of the chip. Either the general practitioner can call up information for which he would normally have to send to the hospital, or a medical auxiliary can take a case record using a machine. All these changes will shift the balance of skill requirement subtly but in important ways. There is nothing new in this. The balance of skills has always been shifting throughout production history whenever technical change has taken place. But these new changes will take place over a wider area, through the professions, through the production line, through people in offices and shops, with a much wider effect on skills than any other technical change.

What is the effect on the demand for skills? Obviously, there will be an effect on trades unions. Some unions will find their membership dropping and others rising. There is also an effect on training requirements, because you get a new distribution of skill requirements. Not so many completely unskilled, not so many crafts people. You get two different demand humps. One for the very highly skilled people, and the other of the modestly skilled people who can be taught how to operate one of the new machines. The second is not very difficult, particularly when you see the skill with which people learn to play gambling machines. The kind of skill which is displayed every day in the pub or in filling in the rather complex football coupons is the kind of skill required.

So far I have been discussing the chip on the production side. There is going to be a bigger effect in communications. The things you can do with a combination of your telephone socket and a television set are major examples. Tele-conferencing, a much more elaborate photocopying system which will have an enormous effect on the delivery of letters and also newspapers in the long run. You can have an interactive system whereby you can select, say, gardening, and more and more information and detail, which is continually updated, is called up on your screen.

This is what the French call 'Telematics', meaning the chip plus the tremen-

dous improvement in the carrying capacity of telephone lines plus satellites. A large increase in the number of satellites, each with greater capacity, adds point to the recent World Administrative Radio Conference in Geneva which tried to settle the distribution of radio space for the next 20 years. There was a great deal of argument, particularly between the advanced countries and the less-developed countries, as to who gets what. Satellites, plus the tremendous increase in the traffic which can be sent through one telephone connection by optical fibres and pulsing will make a tremendous change. There will have to be a very complex switching system in consequence, and a transfer from our electro-mechanical switching system to electronic switching.

This development of communications, this telematic development, is much more all-pervading than the effects on production to which I referred earlier.

Turning to the social effects accompanying these changes let me try to deal with the one which causes most worry, that is, what is the effect of all this on unemployment? Well, you cannot be sure. The pessimists, and there are quite a number of them, stress the immediate impact effect of a radical change of technology at the point at which change takes place. You can see it and you can even measure it. If you change over from Post Office switching by electro-mechanical means and go to electronic means you can measure the number of people who will be unemployed, or the reduced number of people you need to operate the new type of switching. Or, more dramatically, in Fleet Street you could actually measure the number of people you actually require to set up newspapers if you had complete freedom. The second thing the pessimists point to is foreign competition, particularly from the new industrialized countries such as South Korea and Taiwan, which may use the new technology.

What do the optimists say (and I count myself among them)? They say look back, as I tried to look back at the beginning of this lecture, at what actually happened with technical change in the past. It did not cause unemployment. Adjustments did take place. There was an ability to reconcile technical change, a rising standard of living, and stable levels of unemployment. Again, look at the worries people had when computers came into the banks and into the Civil Service. There was a great fear that this would cause a reduction of the labour force, but it did not. The load of work rose more than to compensate. A vast increase in productivity as a result of adopting this new technology is there. Sectors with the fastest rise in productivity usually do best in terms of employment. Fast, rising productivity means increased jobs and not the reverse.

The optimist would point out that the new chips put a great weight on the skills of the thinkers, the software specialists. They do not put a great weight on cheap labour, and in fact the advantage lies with the older industrialized countries for a while at least. That is the debate. But what is accepted by both sides is that there is no way in which this technical change can be halted, and the slowest will go to the wall.

The speed of reaction will be vital. You have no doubt seen the 'awareness

programme' of the Government, which is aimed particularly at medium and small firms where awareness is probably less than among the big firms. Over the three-year programme it is hoped that something like 50,000 'decision-takers' in small and medium firms mainly will get some kind of awareness presentation.

There is a need for retraining, mainly of course by the Manpower Services Commission and polytechnics, and in the longer term for changes in the educational programme with concentration on mathematics and technical subjects, including design. There are very widespread effects, both on production and communication, and the interesting point is that these chips are so cheap that the decisions are not mainly big decisions by big firms. There are hundreds of thousands of little decisions made all round the country by the smaller firms.

The main influence on unemployment in this country will not be the chip, but demographic (the size of the labour force), social (women coming into the labour force), vocational (the social services are not recruiting the labour they were previously), and monetary (the level of the pound relative to competing currencies).

I turn now to look at the three factors I talked about earlier—communications, the family, and integration.

In looking forward what do you think can happen? The most important difference in the communications field will be the boost given to small-scale operations—and a most beneficial effect this will be. The bigger firms can use these technical changes to decentralize their operations if they wish, and to allow the man at the periphery to call up all the information he wants on production, stocks, accounts, personal records, and take decisions there. But the great thing is not that the new technology gives the large firms the ability to centralize or to decentralize, but that it gives the small firm capacities which previously only the large firms had within their grasp. The big firm used to have a 'monopoly' of computer power and data banks. That will no longer be so.

Next, what is the likely effect on families? The new system of communications, means that it will be possible to work at home much more than at present, with probably increased efficiency. It also makes the two-career family of husband and wife easier.

The next social effect is a worry that people living alone will be more isolated. The postman might not call so often if these new communications do away with letters. There may not be so many post offices because it is likely that payments will be made automatically. The meter reader may not come round if all the meters are read along a wire, and so on. On the other hand, there are reasons to think that it will go the other way, in that people will be connected to the outside world by a TV system and instead of just receiving things can call out. One will be able to respond to a call for people to come on a coach party, come to play cards, and so on. I would have thought, therefore, that the dangers of isolation may be equally counterbalanced by bringing people together.

The third social worry is the invasion of privacy. One of the side effects of the chip is an improved bugging device, but it is the vast amount of personal data

which is collected and can be accumulated in one place which worries most people. They are also worried about the increasingly dangerous practice of using credit cards, and the fact that since these computers will all be linked up together, there will not only be an exact record of all the things on which one spent money, but of the actual moment one spent it. You will buy a ticket at King's Cross and by the time you get to Peterborough the police will be waiting for you! All I can say is that files themselves, on pieces of paper, can have legs of their own. Files are not proofed against being looked at, and it is possible to encode data in computers so that it becomes more difficult to get at than a file.

These are the main changes looking forward 20 years. First there is the effect on production at the workplace, skill, training, the uncertain effect on unemployment; some quite big effects on the family and social contacts, worries about privacy, and one great push towards small scale rather than towards large scale.

Finally, please do not exaggerate the likely rate of change: there are many bottlenecks in the way, not by way of resistance to technical change, but bottlenecks such as the telephone switching system, and the inescapable fact that most of our buildings will be the same in 10 or 15 years' time.

ABSTRACT OF THE LECTURER'S REPLIES TO QUESTIONS

Asked to comment on the effect of technological changes on working hours and leisure activities Sir Kenneth Berrill replied that there had historically been a continual reduction in working hours. Although the overtime habit is heavily ingrained on the production side in the United Kingdom there was a steady tendency towards a reduction of hours. People had a trade-off in respect of what they wanted insofar as it was a part of a faster rising standard of living. As to leisure, the thought that greater progress would be made in such areas as learning foreign languages on tapes and cassettes—if that could be called leisure—rather than in television games with which people rapidly became bored.

In reply to a further question on the effects on education he said there would be a considerable premium on the sort of application and intelligence required to master, say, the kind of games played in pubs. That meant a certain physical skill, a certain intelligence skill, and also a certain literacy. That kind of education skill was not very hard to acquire and people would have to go on short courses of, say, three weeks, to learn to use the visual display box in the shop or in the showroom, answering questions at the social security office and so forth. At the top end of the software it was a very different story: that represented the élite.

Asked whether a country could be held to ransom by the threat of operators going on strike he admitted that we were at the mercy of the big computer installation at the moment. Undoubtedly, that situation would encourage the breaking down of the large units into smaller ones to reduce this vulnerability. Of course, all electronic machinery ran on electricity, and electrical power was virtually the basis of all production, so we were still vulnerable to that.

Questioned about the likely effects on employment the lecturer commented that although we had a rate of unemployment which no one wanted, the social unrest that had resulted had been much less than expected. There were pockets of real difficulty, but the average level had been accommodated surprisingly well. But the chip was not the most important factor. The spectre of higher unemployment came from a different direction. Looking at the figures of UK imports, manufacturing, and so on, it was to the OECD countries that we had to look for competition for a long time ahead rather than to further afield.

Asked what would happen if a battery were discovered powerful enough to run all appliances in a household for one year Sir Kenneth Berrill thought that we should not overestimate the extent to which our energy was consumed by household appliances. Such a battery would be marvellous, but it

would not make a fantastic difference to the energy situation, particularly in view of consumption in industrial use and traction. If there was something which would heat a house for a year, or run lorries and cars, that would be different.

In reply to a question on the effect on collective bargaining he said that there would obviously be shifts in the skill requirements which would have effects on particular trade or professional groups. The main effect will be to give the small companies equal status with the large companies. Most trade union problems occurred in large plants, and if there was decentralization of vulnerability in large computing firms then some of the problems of the last 20 years should be eased.