Some educational implications of the microprocessor revolution

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SOME EDUCATIONAL IMPLICATIONS OF THE MICROPROCESSOR REVOLUTION

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ABSTRACT

The development of the microprocessor has enabled a whole new generation of sophisticated electronic devices to be produced. Microprocessors are cheap to make, versatile in their range of application, and can be used to produce powerful computers and sophisticated pieces of control apparatus, which are being widely deployed in industry and commerce. They are also cheap enough to be used in a variety of household devices, from washing machines to videogames. This thesis examines some of the effects which the microprocessor might have on people's lives in the future, and the educational implications of their proliferation.

From the educational point of view there are, perhaps, two broad areas of interest; firstly, direct effects arising from the introduction of microprocessors into educational establishments and, secondly, the indirect effects arising from changes in society. Before attempting to predict future changes in the educational system it is useful to review some current areas of interest and, therefore, some aspects of educational theory which may be relevant are examined.

One widely accepted view of the microprocessor revolution is that it will lead to massive unemployment, and the validity of this view is examined. Some of the predictions of job losses which may ensue are also considered, together with some of the possibilities for occupying increased leisure time which may result. The concept of "education for leisure" is examined vis-a-vis possible changes in employment patterns.

The direct role of microprocessors in schools is considered, together with future implications for teaching and learning. Possible consequences on the curriculum are discussed.

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DECLARATION

The work in this thesis is the result of my own research except where reference is made to other published literature. It has not been submitted to this, or any other, University in fulfilment of the Regulations for a higher degree.

William Cochrane.

WILLIAM COCHRANE, June 1983.

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SUMMARY

In the last ten years there has been an explosion in the availability of sophisticated and cheap microprocessor units which have spawned a whole new generation of electronic devices. Microprocessors have a wide range of applications and can be used in many industrial and consumer goods. They are also at the heart of the microcomputer. These products are already having considerable impact on our society and it is expected that, in the future, their influence will be even greater. It therefore seems worthwhile to examine some of the consequences of the proliferation of devices based on the microprocessor and to relate them to their educational implications.

From the educational point of view, there are perhaps two broad areas of interest; first, direct effects arising from the introduction of microprocessors into educational establishments and, secondly, the indirect ones arising from changes in society. Before attempting to predict future changes in the educational system, it is useful to review some current areas of interest and relevant aspects of educational theory which are of relevance.

One important consequence of the microprocessor revolution is that virtually every school in the country now has a microcomputer. Putting these devices into the schools is very creditable, but their full potential will not be realised unless the teachers who supervise their use are adequately trained. This does not simply imply learning the rudiments of writing a computer program, but should include an understanding of the relevant philosophy and learning theories involved.

A widely accepted, contemporary view of the microprocessor revolution is that it will lead to massive unemployment, and it was thought useful to investigate this viewpoint. Some predictions of the possible job losses involved are examined, together with some of the leisure opportunities and problems which may arise. The concept of 'education for leisure' is examined vis-a-vis possible changes in employment patterns.

When the direct and indirect effects of the microprocessor revolution are considered together, it is possible to examine how they may influence the curriculum. In order to do this, it is necessary to consider present views of the curriculum in relation to possible future needs of a society which is likely to be increasingly influenced by developments in microprocessors.

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INTRODUCTION

One of the most important industrial developments for many years has been the development of very small and complex pieces of electronic circuitry, which are known as microprocessors. The microprocessor is based on the silicon chip and, because it is so small, is often referred to as the microchip. For many people, the importance and significance of these devices was first brought home by the B.B.C. Horizon programme "The Chips are Down", which was screened in 1978. The implications of the microchip have become more apparent since then, and it has become an important topic in books, articles in newspapers and learned journals. This has culminated in 1982 with a government announcement that the year is to be designated "Information Technology Year", and there is even to be a Minister for Information Technology. Information Technology is a relatively new term which has been coined to describe the goods and services connected with computers and communications; this includes computers, telecommunication and database services such as Prestel.

Man's industrial progress has been marked by a number of major technological advances, such as the discovery of fire, the wheel, and the ability to smelt copper and tin to make bronze. These great steps were followed by the ability to smelt iron and the harnessing of the power of steam. The latest technological breakthrough which would appear to be likely to have equally profound effects may be the development of the microprocessor.

The microprocessor is a combination of many circuits mounted on a material known as a semiconductor; the most common semiconductor

used is silicon, but it is by no means the only semiconductor material which is available. By combining together electronic circuitry which incorporates microprocessors it is possible to make small but powerful computers; it is these computers which lie at the heart of the so called microprocessor revolution. The first device which could be classed as a "computer" was the mechanical calculating engine, designed by Charles Babbage in the nineteenth century, but the history of computers as we understand them today - electronic devices - is rather short. During the Second World War an early electronic calculator was designed at Bexley Heath to help break German codes produced on the "Enigma" machine. This British device, known as the "Eniac" machine was based upon the technology of the valve. A machine such as this, used thousands of valves and many miles of insulated cable. As well as being extremely large, the "Eniac" machine used large amounts of energy, produced a lot of waste heat and was somewhat unreliable.

The vacuum valve was replaced in the 1960s by the transistor which was the first commercially useful semiconductor device. Transistors provided a direct replacement for the valve but had superior properties. These devices were smaller, used less power, generated little heat, were cheap and reliable. The effect of transistors on domestic appliances was dramatic with radio sets becoming truly portable and the size and weight of televisions being greatly reduced. The mainframe computer of the time was based on the transistor and they became smaller, cheaper and more reliable than they had been previously. This led to an increase in the deployment of computers in the industrialised

areas of the world, particularly in the United States. In 1955 it was estimated that there were about two hundred and fifty computers in the world but, by 1965, there were twenty thousand and this figure had risen to over eighty thousand by 1975 (Marsh 1981).

The mainframe computer of the 1960s and early 1970s was still a large and expensive machine, and its use was restricted mainly to large commercial organisations, government agencies, centres of higher education such as universities and the like. Machines of this time were relatively sophisticated and well suited to handling large numerical manipulations and able to handle large amounts of data, kept in secondary stores, such as paper tape, paper cards or on magnetic tape or discs.

A new class of computers, known as "minicomputers", appeared in the 1960s but, by present standards, were still quite large - about the size of a refrigerator - and tended to cost between fifteen and thirty thousand pounds. The minicomputer greatly extended the market for computers and made them a feasible proposition for smaller industrial and commercial undertakings, but penetration had not reached the domestic market. Microcomputers, which are built up from several microprocessor units, have now reduced the size and price of computing facilities to a point where they can be used in small businesses, schools, and in the home. The microprocessor itself is small, cheap, reliable and adaptable to a wide range of applications, not just in data processing, but in industrial settings to control machines; this latter application is perhaps the key to industrial changes which are now beginning to appear.

The microprocessor has extended the scope of the computer in that a sophisticated form of machine intelligence is now available; when this is coupled with a relatively low unit cost, high reliability and low running costs, their potential for industrial and commercial application is massive.

In commerce, the microprocessor can perform many of the clerical tasks which have traditionally been performed by people, but with increased speed and accuracy. Book-keeping, bill production and data retrieval systems using microprocessors are becoming increasingly popular. Their industrial application includes controlling robots and stock, as well as whole industrial processes such as steel making or car fabrication. Very few jobs are safe from the blight of the microprocessor.

Microprocessors are cheap enough to allow them to be used in household devices such as washing machines, ovens, televisions and video recorders. Microcomputers based on the microprocessor are now so cheap that they are available to small businesses and for people to use them in their own homes.

This dissertation sets out to examine some of the effects which the microprocessor will have on people's lives and the educational implication of the changes associated with its proliferation.

When considering the educational implications of the microprocessor revolution there are several important areas which can be studied to help one understand the possible educational responses to changes which may occur. Before attempting to predict changes in the educational system which may

occur in the future, it is helpful to look at some aspects of the present situation and to look at the work of some of the educational theorists who have contributed to our current educational thinking. Two major areas of input are the works of those concerned with the philosophy of education and those who have considered some of the sociological aspects of the educational process.

From the point of view of this dissertation it is not intended to complete an exhaustive survey of educational philosophy and sociology, but to look at certain aspects which are relevant to an understanding of our current position in education and changes which may occur in the wake of the microprocessor revolution. Education can be considered as a preparation for life. In life there are two major elements, work and leisure, and it is important to consider the relationship between education on the one hand and work and leisure on the other. A key question which is of fundamental importance is, how far should education be concerned with work and how far should it be concerned with leisure? The answer to this question will colour the whole approach to education. Answering this question is not easy, but philosophers over the years have touched upon the subject and it is interesting to consider some of their views. Amongst those who have looked at the role of leisure in education, we may include Aristotle and Plato of the Ancient Greek school, as well as more recent philosophers such as John Dewey and Rousseau. In Chapter One the relevance of the work of these philosophers to the question of the relative importance of education for work and education for leisure is discussed.

In recent years some interesting views about the nature of education and what the aims and objectives of education should be have been expressed by sociologists such as Bernstein, Young, Bordieu and Davies. Young, for example, (1971), has considered in detail what counts as valid knowledge and Barnes (1969, 1971) and Bernstein (1972) amongst others, have looked at relationships involving language and social class. The Marxists school of sociologists, such as Young, have also examined the relationship between education, knowledge and power and some of the facets of this argument are also worthy of consideration.

The introduction of microprocessors has already had some impact upon employment and as they are progressively introduced are expected by some commentators to reduce manpower requirements even further; the boldest predictions in this aspects have been put forward by Jenkins and Sherman (1979), who have suggested that by 2003 over five million jobs will have been lost as a result of the introduction of technology based on the microprocessor. The economic and social effects of the introduction of microprocessors have been discussed by a variety of authors and organisations, including reports by the Advisory Council for Applied Research and Development (ACARD) (1978, 1980), the Central Policy Review Staff (1978), Braun and MacDonald (1978), Gershung (1978), Barron and Curnow (1979), Hines and Searle (1979), Hubbard (1980) and Forester (1980), but the effects on education have not been considered in great detail by any of these authors. Before it is possible to attempt to predict the effects which the introduction of new technology might have on education, it is necessary to explore some of the relationships between technological change and education.

Technology changes constantly, but every so often takes what could be called a quantum leap. The silicon chip has provided the mechanism for a quantum leap just as the harnessing of the power of water and steam did during the Industrial Revolution. During the Industrial Revolution, there was not just industrial change, but also social and educational changes. A study of the social and educational changes which occurred during the Industrial Revolution could help elucidate some of the relationships between industrial and social and educational changes. In Chapter Two some of these relationships are explored vis-a-vis changes which may occur in the wake of changes resulting from the microprocessor revolution. It is hoped that this will help us not only to understand some of the relationships between industrial change and educational change, but may help us also to predict future changes in the educational system which may need to be made in the light of technological innovation. Pertinent questions which arise at this stage are:

(i) Is there a link between industrial change and educational change?

(ii) Does educational change follow industrial change or vice versa?

(iii) Are there any parallels between changes which occurred during the Industrial Revolution and the current situation vis-à-vis the microprocessor?

One of the main results of the introduction of the new silicon chip based technology may be to reduce the need for human labour. In our society there is a balance between work and leisure and this relationship has wide ramifications. The microprocessor may well increase the amount of leisure time available in our society and in looking at the consequence of the introduction of the new technology a study of work and leisure may prove useful.

In Chapter Three, the meaning of the term 'leisure' is examined; this is important because a distinction needs to be made between true leisure time and time not spent working due, for example, to unemployment.

Work is not only a means of earning a living; it also plays an important part in determining certain characteristics such as self respect. Unemployment is sometimes regarded as almost sinful and unemployment can bring with it a loss of self respect; this may be related to the protestant work ethic. The educational system has an involvement here, since our children are prepared for work at school. If work is no longer available, then changes in the educational system may need to be made. In particular, the notion of education for leisure is worthy of careful consideration. However, this is not an easy area to work in, and Roberts (1970) has discussed some of the difficulties.

In Chapter Three some of the relationships between employment, leisure and education are discussed with a view to understanding changes which may become necessary in our education system. Increased leisure time resulting from shorter working week and earlier retirement may follow in the wake of change in industry and commerce which may merit

changes in our educational provision. But perhaps the main impetus for change could come from unemployment. Before looking in detail at changes in employment which may be produced by changing technology it is useful to ask:

(i) What is leisure?

(ii) What is the relationship between work, leisure and education?

(iii) How will the microprocessor change the relationship between these?

One of the main problems facing industrialised countries is that of unemployment. Unemployment is an emotive topic and the spectre of the persistent mass unemployment of the 1930s still haunts many people. In Britain, unemployment reached the three million mark in 1982. The worldwide recession, which started in the mid-1970s, shows no real sign of improvement and Western countries have been severely hit by massive rises in oil prices imposed by the OPEC Cartel and competition from developing industrial nations, where labour costs are comparatively low. It is against this background that microprocessors are being introduced, and further reducing the demand for labour.

What effects the microprocessor will ultimately have on employment prospects in the long term is, in some ways, still an open question. The microprocessor is cheap and versatile and can be used in a variety of industrial and commercial situations. Microprocessors can be incorporated into microcomputers which can be used in typical computer

situations, performing numerical manipulations, stock and process control, and a variety of administrative tasks. However, because they are relatively cheap, they have greatly extended the number of potential users. A microprocessor can also be used to control robots, and enable very sophisticated and sensitive robots to be made. Equally importantly, microprocessors can be used to control robots in hostile environments, such as are found in some industrial settings, which would be unsuitable for a mainframe computer. Warnecke and Schrafte (1974) estimated that in Europe, at that time, there were only eight hundred robots in use, but by 1978, this number had risen to over twenty thousand (Marsh 1981).

It is, however, important to note that it is not universally accepted that microprocessors will, in the long term, lead to unemployment, since a new industry may spring up around them in the same way as the internal combustion engine led to the development of the motor car industry.

In passing, it is worth noting that the introduction of microprocessors may, in some cases, help protect some jobs from being lost to developing countries. By introducing microprocessors, industry may become more efficient and, therefore, able to compete with areas of the world where unit labour costs are low. In cases such as this the microprocessor may cause some jobs to be lost, but not all of them.

A further point worthy of note is that the microprocessor may not only affect the number of jobs available, but the type of job available.

One possibility is that microprocessor controlled devices may de-skill certain jobs; this may not only apply to manual work, but may spread to certain management tasks, where microprocessors may be used to take over decision making processes traditionally regarded as a safe human preserve. On the other hand, devices such as microcomputers can be used to reduce some of the tedium and repetitiveness from some jobs by, for example, taking over routine clerical jobs.

Key questions which arise in this section are:

(i) Which areas of employment are likely to be affected by microprocessors?

(ii) What effects might the introduction of microprocessors have on unemployment?

(iii) If jobs are displaced by microprocessors, what measures can be taken to combat the resultant unemployment?

(iv) How will changes in working practices influence the educational process?

(v) Will the notion of education for work be replaced by education for leisure?

Microelectronics are not only finding their way into industry and commerce, but are coming into schools at an increasingly rapid rate, helped by schemes such as that announced by the Department of Industry in 1981, which was designed to help every secondary school to have at

least one microprocessor. Interest in the use of machines as aids to learning is not new and there was a great deal of interest in them following some of Skinner's work in the 1950s. The early teaching machines were electro-mechanical devices and limited in scope and interest in them waned. Learning with the aid of a computer would appear to be opening up a new era of interest in this area.

There would seem to be a rush to put microcomputers into schools, but that is not to say they will be properly used when they arrive. Before beginning to use a microcomputer as part of a course of computer assisted learning, it is important to understand that the teacher should be aware of the learning theory associated with the design of the program which is being used. In this respect, the work of Hooper (1977) is useful, in that he has identified three broad groups into which learning theorists, such as Skinner, Piaget and Bruner can be classified.

Once the hardware - the microcomputer and peripheral devices - have been installed, it is important that teachers should be trained properly in their use. In this country the Microelectronic Development Programme, which is sponsored by the Department of Education and Science, aims to train teachers to use the hardware. How much emphasis needs to be placed on the provision of hardware compared to software and training is examined in Chapter Five.

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CHAPTER ONE

SOME PHILOSOPHICAL AND SOCIOLOGICAL CONSIDERATIONS RELATED TO THE INTRODUCTION OF MICROPROCESSORS INTO SCHOOLS AND SOCIETY.

Introduction

An important factor in the development of our educational system has been the input from the philosophers of education. It is not the intention in this dissertation to attempt a comprehensive review of the past and present impact of the philosophers of education, but to assess contributions which are helpful in understanding and predicting some of the effects of the microprocessor revolution on our educational system.

The earliest recorded views on the philosophy of education are those of the Greek philosophers. Plato appears to have been the first to work systematically in this field and was followed by his pupil, Aristotle.

In "The Politics", Aristotle suggested that the four customary branches of education were reading, writing, gymnastic exercises and music (Cahn 1970). In his view, the first principle of all action is leisure and that, while both are important, leisure is better than work. This is an interesting point, since one of the main consequences of the microprocessor revolution seems likely to be that leisure time will increase. Aristotle did not suggest that only work was virtuous, which is significant since, in Western countries, work has a high status compared to leisure time. In Britain, for example, unemployment can bring not only a low level of income but, in many cases, a degree of social degradation. Those who are working for a living often view the unemployed as being

parasitic, and as a group of individuals who are too lazy to work.

Traditionally certain groups have been prone to unemployment; mainly skilled, semi-skilled and manual workers in 'big contract' industries such as shipbuilding and engineering. In areas such as the North-East of England, the joy of a successful launch of a new ship has often been soured by the certainty of a return to the dole queue until another order is secured. There has also been a tendency for unemployment to be concentrated in certain areas, such as the North-East and North-West of England, parts of Scotland and Northern Ireland. In crude terms, this can be seen as a prosperous south and a poor north. However, in the space of two years, from 1979 to 1981, the level of unemployment has reached levels which have not been seen since the years of the great depression in the nineteen thirties. Official figures at the back-end of 1981 state that unemployment stands at just under three million, but the true figures, if those on job creation and special youth employment schemes are taken into account and those who would like to work but do not register as they would not obtain any unemployment benefit, are undoubtedly higher. The aim here is not to argue about the exact magnitude of unemployment, but to make the point that unemployment has reached a level at which it has ensured that all sections of the community are affected. Even the prosperous south is having to face up to the problems caused by lack of work, as are people in areas of employment

and occupations previously considered to be severe. It is interesting to ask if attitudes to unemployment change as more people find themselves without a job. This is an important question because one of the threats posed by the microprocessor is to make certain skills redundant and to exacerbate the problem of mass unemployment. This issue is considered in more detail in Chapter Four. If there is to be persistent mass unemployment society may have to re-examine attitudes to work and to leisure.

It is at this point that the work of the Greeks becomes relevant. Aristotle suggested that not just work, but leisure, is virtuous. The writings of Aristotle make it clear that, in his view, leisure gives pleasure, happiness and an enjoyment of life which is not experienced by a man busy with work. In his view, there are some branches of learning which must be studied with a view to the enjoyment of leisure and that these should be inherently valued compared to the knowledge required for business. In more modern terminology, it might be said that Aristotle appreciated the value of the concept of 'education for leisure'.

It can be argued that in Britain, our present day educational system is primarily concerned with fitting people for employment. For many people, particularly those regarded as the working classes, long hours of hard labour and low incomes have reduced the choice of what they could do with their leisure time. For these people, only a range of activities was realistically within their social or financial ambit.

The relationship between education, work and leisure is an interesting and complex one. Once the need for education for leisure has been established, then more concrete proposals for educating for leisure could be made. On philosophical grounds, Aristotle has made out a case for this, but it is interesting to note that, on more pragmatic and practical grounds, Lord Scarman, as a result of his enquiries into the riots by youths in the early part of 1981, also made a case for education for leisure (Scarman 1981).

Plato based his philosophy of education on the premise that society should be based on aristocracy and the power of reason and logic. In western European countries, and in the U.S.A., society is based on democracy and the work of philosophers of education tends to follow a more democratic line than Plato's. Notable among the philosophers of education who have followed a more democratic line has been John Dewey. Perhaps following in the tradition of his country, he suggested that the class-based society outlined in Plato's republic resulted in the subordination of individuality.

Dewey thought that education should be based on a belief in democracy and on the power of scientific method. He believed that scientific method consisted of:

> "... observation, reflection and testing ... deliberately adopted to secure a settled, assured subject."

He suggested that the utilisation and application of scientific method to other areas was of great value. Science to Dewey was

experience becoming rational and rationality was the most reliable method of reaching the truth. Knowledge was to be acquired by intelligent action and the possession of knowledge would enable a person to act more intelligently.

These are interesting views which still find application as we move into a new and increasingly scientific age. School science has changed dramatically in the last twenty years, with great impetus coming from organisations such as the Nuffield Foundation and the Schools Council. Curriculum development programmes which appeared under the auspices of these organisations in the 1960s aimed to change the basis of school science from factual recall to one of a more heuristic nature. The uptake of some of the curriculum development packages was poor in some cases and as finance is no longer as freely available to support some of the more ambitious packages implementation in schools, much of the initial impetus has now been lost. Despite this, and the many criticisms of some Nuffield and Schools Council projects, they did serve a useful purpose in that they encouraged reform and stimulated change in many traditional science courses. The result has been that science in schools has been placed on what could crudely be called a more scientific footing in that there is now more emphasis on experimentation, and the formation and testing of hypotheses. This fits in well with some of Dewey's ideas about the importance of developing skills in scientific method.

Furthermore, knowledge in some subject areas, particularly in the sciences is increasing at a rapid rate and can sometimes become

obsolete in a short space of time. For the subject specialist this may not be too much of a handicap as he can update his knowledge, but for some people it could present problems. Some people gain a large part of their knowledge at school and once they leave will not, in many cases, have the inclination or facility to update it. For these people, it is perhaps more useful to stress features such as scientific method rather than just factual knowledge, since the methodology involved will not become obsolete and can, hopefully, be applied in future situations.

Traditionally, our educational system has had preparation for work as one of its cornerstones. Many school subjects have aimed at giving a knowledge which would be of direct relevance in the work situation, or of producing attitudes or behaviour patterns which an employer would find useful. Formal examinations have been useful guides to employers as to how much of this knowledge a pupil has learned. It can be argued that many school subjects are work orientated and that one of the main purposes of the examinations sytem is to aid employers in their selection of workers. Employers, as a rule, like knowledge gained in school to be of immediate application, or at the very least, to fit into their training requirements. Deviations from this tend to produce unfavourable comment from individual employers and from their organisation, the Confederation of British Industry (CBI). One of the best examples of this has been the general rejection of modern mathematics, which teaches skills which may not be of immediate application; many employers would prefer a return to mathematics courses which emphasis traditional arithmetical skills and number

manipulation. Dewey's views on education have sometimes been misrepresented and he has been cited as supporting a utilitarian view of knowledge, i.e. that things should be taught with a view to their future application. This would, for example, support arguments in favour of traditional mathematical skills as opposed to modern mathematics. However, it can be argued that Dewey held the view that knowledge should possess an aesthetic quality or value for the individual.

Rousseau

An important step in the philosophy of education was the contribution of Rousseau. Rousseau believed that each child should be treated as a person in its own right. This was an important development in that it marked a move in the direction of what is known today as child-centred education. In Emile, Rousseau highlighted the importance of motivating the pupil so that he wanted to learn. Some of his aims were perhaps too ambitious and idealistic to be put directly into practice. For example, it was extravagant to claim that nature provides the goals of education and that, as a consequence of this, a chid should not be allowed to acquire any habits. Perhaps it would have been better to distinguish between desirable and undesirable habits. Furthermore, it is also difficult to give credence to his attempts to justify certain activities on the basis that they were 'natural'.

In Emile, Rousseau[a] commented that:

> "... plants are fashioned by cultivation, seen by education. We are born feeble and need strength; possessing nothing we need assistance; beginning without intelligence we need judgement. All that we lack at birth and need when we are grown up is given to us by education."

He goes on to suggest that education comes from men or from things and sees the internal development of the faculties as coming from the education of man, whereas the education of things comes from the events which affect our daily lives.

Rousseau made a great step forward when he started to consider the social implications of education. Perhaps the basic question to be considered is "do we educate man for himself or for society?" As Rousseau[b] puts it:

> "Consistency is plainly impossible when we seek to educate a man for others instead of himself. If we have to combat either nature or society we must choose between making a man or making a citizen. We cannot make both. There is an inevitable conflict of aims from which come two opposing forms of education: the one communal and public, the other individual and domestic."

These comments are equally applicable today and it is possible to see the present-day educational system in this country as either preparing citizens and workers, or of developing them as people. Training in certain skills which employers believe to be valuable is often the order of the day together with inculcation into certain patterns of behaviour which are thought to be desirable. Schools can be thought of in many cases as following a utilitarian approach in which an important aim is preparing children for future employment, i.e. education for work. This is an important theme which will be developed later. The ethic of education for work has been used as a motivation for pupils and even as a raison d'etre for education and, in some ways, can be argued to be a satisfactory and justifiable aim.

However, problems arise when there is no work or, in any case, a lack of work for the people being educated. The introduction of the microprocessor threatens to have a massive impact on work patterns and could mean the end of work for millions of people. Should this happen then it is difficult to justify education for work, and education for the person, as envisaged by Rousseau, could assume a new importance. Possible effects of the introduction of the microprocessor on employment are discussed more fully in Chapter Four.

Traditional curricula have had employment very much in mind. In the secondary modern school there was often a tendency to prepare the top end of their intake for skilled manual work, often via an apprenticeship, and to prepare their less able children for semi-skilled or unskilled work. The grammar schools, taking approximately the top 25% of the ability range followed a scheme of education based roughly on the Greek model, and intended to develop the mind and prepare the pupil for employment in areas requiring certain intellectual and cognitive skills.

The system as a whole survived for many years because, in broad terms, it worked. The job for which the pupils had been prepared existed and most pupils could be slotted into them. Had the system not been replaced (in most parts of the country) by the comprehensive school, the absence of jobs would, in itself, have had a serious effect on these schools. In the wake of comprehensivisation, many syllabi have been drastically revised, but it is not really known how much, if at all, basic attitudes to teaching and learning have changed, and the concept

of education for work must still be important for many teachers. Indeed, the idea of education and training for work is so firmly rooted in society that it would be difficult to change. In December 1981, the officially declared level of unemployment was just under three million, and youth unemployment was becoming recognised as a major problem. This has been identified not only by Lord Scarman (1981), but by people throughout the land; even the Queen, in her 1981 Christmas address to the nation, recognised the undesirability of high levels of unemployment. The government response in December 1981 has been to introduce a White Paper, suggesting that a semi-compulsory industrial training scheme be introduced in an attempt to combat youth unemployment. While politicians have confined their arguments about the merits of the scheme to the morality of making the scheme semi-compulsory by with-holding money from those who decline to participate, they have failed to appreciate the possibility that the jobs for which they intend to train these young people may never actually appear. The introduction of new technology may have introduced a permanent change in employment patterns which have yet to be understood. Perhaps it would be better to train these young people in such a way that they will be able to cope with enforced unemployment and leisure in the future. It is interesting to note that in the North East recently one headmaster pointed out that, at his school, the number of youngsters leaving without a permanent job had doubled; in 1979, fourteen percent had no job, or were in a scheme organised by the Manpower Services Committee, but in 1981, it had risen to thirty-one percent. This headmaster also suggested that schemes such as the Youth Opportunities

Programme were poor and that they only postponed the day that the youngsters hit reality and found themselves on the unemployment scrapheap (Bryce 1981).

The prospect of mass unemployment which may follow in the wake of the microprocessor revolution casts doubts about the validity of a philosophy of educating with employment in mind. What, in some cases, has been a tendency to educate for specific jobs, or types of jobs, as discuss previously vis-a-vis the grammar and secondary modern schools. A training in the ways of life was suggested by Rousseau as being of great importance and this idea has been greatly extended in recent years by several workers, particularly sociologists such as Young, who have been involved in educational theory. Rousseau suggested that:

> "In the natural order, where all men are equal, manhood is the common vocation. One who is well educated for that will not do badly in his duties that pertain to it. The fact that any pupil is intended for the army, the Church, or the bar does not greatly concern me. Before the vocation determined by his parents, comes the call of nature to the life of a human child. Life is the business I would have him learn. When he leaves my hands, I admit that he will not be a magistrate or a soldier or a priest. First and foremost he will be a man. All that a man must be, he will learn when the need arises, as well as anyone else. Whatever changes of fortune he will always be able to find a place for himself."

Rousseau's ideas are important, not just because they have influenced later workers, but because, even today, they are relevant in areas such as the linking of work and employment.

John Dewey

Another philosopher whose work is helpful when considering today's situation is John Dewey. Working in North America, he constructed a comprehensive philosophy of education based largely on a strong belief in democracy and the power of scientific method. A democratic society, according to Dewey,was one which makes provision for participation in its good of all members on equal terms and which secures flexible readjustment of the institution through interaction of the different forms of associated life. Scientific method, to Dewey, was, "observation, reflection and testing ... deliberately adopted to secure a settled, assured subject matter."

Dewey believed strongly in what might be called creative thinking, as opposed to the philosophy of some contemporaries, who stressed the importance of information storage. He saw thinking as being the method of intelligent learning that employs and rewards the mind. Furthermore, he was concerned with the idea that skill which is not learned concurrently with thinking, does not convey any real sense of the purpose for which it is to be used. To learn skills without practising their application would, according to Dewey, leave a person at the mercy of his routine habits and the authoritative control of others who know what they want, and are not too concerned about the means to their ends. Dewey was concerned that pupils should be taught to think in order that they should not become servile and would be able to have a real influence on their own lives. This idea forms part of the theme developed by some of the sociologists such as Young (1971), who have argued that "the system" depends upon certain groups in society accepting their lot without question and that real

thinking would not be in the interests of those with access to power. Some of the interesting ideas developed by Young and his socialist colleagues are discussed later in this chapter.

Another area of interest developed by Dewey was that of educational values. Dewey believed that it was not possible to establish an academic hierarchy amongst the subjects since he argued that any study has a unique and irreplacable part to play in the enrichment of life. In Dewey's words:

> "Since education is not a means to living but is identical with the operation of a living life which is fruitful and inherently significant, the only ultimate value which can be set up is just the process of living itself. And this is not an end to which studies and activities are subordinate means, it is the whole of which they are ingredients."

Dewey has expressed in unequivocal terms the concept that education should be subordinate to the person and should equip the person for living and not vice-versa. Once again, it is possible to see the dichotomy which can exist between the needs of society and the needs of the individual.

Some of the influence of industry and commerce have already been discussed but it is of further interest to consider what happens when the needs of industry change. Industry is such a wide and diffuse area of activity with different jobs requiring different skills that defining the needs of industry in terms of educational factors is difficult. Probably the only meaningful way to do it is to consider the requirements for different types of jobs such as the skills needed to learn a trade or to do clerical work in an office. In many jobs,

technological innovation has tended to come gradually with a steady increase in the level of sophistication of the equipment. In many cases there has been a concomitant increase in the level of educational attainment required for entry to that job. The introduction of the microprocessor is important because it threatens to produce changes very much more quickly than has been experienced to date and also because it finds a wide application so many people are affected.

It can be argued that traditional patterns of education and training at the workplace leave people badly equipped when it becomes necessary to change jobs and/or learn new skills. At school some pupils will have followed courses with a specific type of job in mind and then had training at work of a purely vocational and often very specific type. As people are pushed aside by the rising tide of the new technology they cannot find new employment easily because they have been educated for specific types of jobs which may no longer exist.

The introduction of microprocessors threatens to bring the largest changes since perhaps the harnessing of steam. The major changes in industry which occurred during the Industrual Revolution were followed by major changes in the provision of education. A study of the educational changes which occurred during the Industrial Revolution could help to illuminate some aspects of the relationship between them which, in turn, could facilitate possible responses of the education system to the challenge posed by the microprocessor. This theme is explored in Chapter Two.

The aims of education are the subject of constant controversy. Maritain, for example, accepts the utilitarian aspects of education but is careful to point out that, in order to get a complete picture, it is necessary to take into consideration the human person and his deep, natural aspirations. According to Maritain, these are linked to freedom, and freedom has to be attained by struggle. He believes that the main aim of education is freedom and that this is attained through knowledge, wisdom, goodwill and love. The important point here is the complete departure from the utilitarian ethic and a move towards personal development; this echoes, to some extent, the views of Rousseau and Dewey.

A development which follows from workers such as these has been the expansion of the sociological theme. One area which has been explored is the relationship between freedom and education. It can be argued that education should play an important part in the development of freedom. If it is accepted that social life helps free people from bondage to material things, it would, under ideal circumstances, allow common benefit to accrue to all members of society. From this, it could be argued that education should play a part in the social education of the individual which would help people fit into society. Developing a sense of obligation and responsibility is seen as an important aim but not a primary one. The main aim would revolve around the development of the human person, not in his relationship with the social environment. This is important since it underlines the social role of educational activity, its utility value and its contribution to helping individuals fit into society. This social theme is examined more closely in the following section.

Views of sociologists of education

In Western societies, the passing on of information has become, to a large extent, a ritualised process, with the selection and transmission of what is considered to be valued knowledge being entrusted to specialised educators. At the hub of the educational process in these countries are the schools which are, for the most part, staffed by trained, specialist teachers. Schools not only play an important part in the selection of knowledge to be transmitted, but organise and structure the knowledge to facilitate learning and also assess how well individuals respond to the various educational processes to which they are exposed.

An important point to note is that the education system interacts with the larger society of which it is a part. Schools themselves are subjected to a variety of pressures and influences which modify what is taught and how it is taught. Schools are influenced by central and local government, institutes of higher education, particularly the universities, employers, parents and other pressure groups.

In recent years, the views of the sociologists of education have been useful in that they have highlighted what they see as possible defects in the present educational system and have also offered various alternative educational strategies. The sociologists have portrayed a different viewpoint to that of the philosophers of education. Young (1971) has suggested that in the fifteen or twenty years leading up to 1970 the main areas of interest to the sociologists of education were equality of opportunity, wastage of talent (especially that due

to selection at the age of eleven) and the curriculum. More recently, there have been some challenging thoughts on what constitutes valid knowledge and what the aims of education should be.

Facts about "educational wastage" were highlighted by the Early Leaving and Crowther Reports. The "class" nature of education and lack of opportunity for certain groups were demonstrated by Floud et al. (1957). From the middle of the 1960s the main issues were selection and comprehensivisation. The abolition of the eleven plus examination was not only an educational issue, but a social and political one. The abolition of the grammar school was a deeply divisive move, with much resentment being felt by the parents of children who would normally have been expected to go to the grammar school.

The grammar school was largely an extinct species by the 1970s and the main thrust for change has since focussed on the curriculum. This was, in part, a response to comprehensivisation but also reflected pressures from society in general. There was, for example, pressure from industry and central government for more scientists. Following the Dainton Report (1968) this was reflected to an increasing degree in schools. It should, however, be noted that some doubt has been expressed at the alleged swing away from science which was part of the basis of arguments in favour of more positive discrimination in favour of sciences (McPherson 1969; Blaug and Gannicot 1969 and Gorbutt 1970).

A further stimulus for curriculum change came when the school leaving age was raised in 1973. A consequence was the proliferation

of pupils entering public examinatins. The CSE boards offered examinations believed suitable for the top sixty percent of the ability range and the overall aim was to get half the pupils doing some sort of public examination. The mode three examination allows, in some cases, pupils in the bottom forty percent of the ability range to be graded by the CSE boards. Important questions related to the examination system, which will be discussed later are:

(i) to what extent are public examinations used as a type of depersonalised social control in schools?

(ii) what part does education in general play in social control?

The big push toward comprehensivisation which began in the early 1960s has, twenty years later, still not been completed. In some ways the system is under increasing pressure and economy measures have affected staffing and the provision of equipment. In addition, falling school rolls are presenting major problems in some areas and schools are being closed or amalgamated. The Assisted Places Scheme was introduced in 1981 to enable bright children to be assisted to attend private schools; this is a very important measure since it threatens to denude some comprehensive schools of their brighter pupils. Part of the rationale behind the large comprehensive unit was that a large intake would generate sixth forms of a reasonable size and would enable a broad spectrum of subjects to be taught. In some poorer areas, especially in the older, inner city areas, even a large intake has

generated small sixth forms. This, in turn, leads to pressure to take away that sixth form to other schools or sixth form or tertiary colleges; a consequence of this is to deter able and highly qualified teachers from working in that establishment, which in turn, leads to a further fall in standards. The Assisted Place Scheme could exacerbate the problem; the very bright children who form the academic nucleus of the sixth form, would be taken away. In fact, the future of the sixth form in comprehensive schools could be in doubt.

It has been suggested by some members of the Marxist school of sociologists that existing curricula tend to mystify the students and fragment knowledge. It has also been claimed that curricula tend to deny students the chance of understanding society as a whole, thereby acting as agents of social control. Until relatively recently, the control of the curriculum has remained outside the mainstream of direct political influence. At school level, the only compulsory subject has been Religious Education, with the rest, in most cases, decided by the head teacher in consultation with managing bodies and staff. As mentioned previously, the head teacher is subjected to outside pressures from a variety of sources. A major influence has been that exerted by the universities, mainly through their control of the GCE examination boards and their authority to confer degrees on their students. It can be argued that this tends to preserve the status quo of society by defining what counts as valid knowledge, i.e. acting as agents of social control. This theme will be considered in more detail later. It should be noted that, to some extent, the influence of universities may have been reduced since one GCE examining board (the AEB), is not under the

direct control of the universities, while the CSE boards allow for considerable teacher representation; the Council for National Academic Awards, (CNAA) also has the authority to award degrees but the universities are well represented on this today.

Since the beginning of the century there has been a considerable expansion of the educational system in this country. Despite this expansion, many social inequalities have persisted, perhaps in a similar way to the inequalities in health provision by social class and geographical location which were highlighted in the Black Report on the National Health Service (Black 1980). Following studies by Douglas (1969) and Plowden (1967) which focussed attention on the characteristics of those who might be considered 'failures' of the educational system, e.g. the early leavers and the dropouts, concern was shown for the fact that 'life chances' were largely related to education, and that education was related to class structure.

A problem which is encountered when trying to define successes and failures in the educational system is identifying the parameters of success and failure. Conventionally success and failure are defined in terms of success in public exmainations, which as already explained, are dominated by the universities. It can be argued that the selection and organisation of knowledge and methods of assessment are based upon middle class attitudes, values and language. The people who are in charge of these factors are people who have succeeded in the system as it stands and it is perhaps hardly surprising that it is to some extent self perpetuating and resistant to change.

An extension of this is the concept that knowledge is related to power and that entrance to many positions of power is restricted to those people who have certain knowledge. Access to this knowledge may also require certain language skills, which tend to reflect middle class language rather than working class language. Most academic disciplines tend to have a specialised vocabulary (or jargon) which is useful to those inside it as a simple piece of jargon can often express a complex concept but to an outsider it can make attempts to understand the subject futile. Medical knowledge, for example, is restricted not only to those who have anatomical and physiological competence, but to the chosen few who have been introduced to its own specialised vocabulary. Access to knowledge also affects social structures; if we look at the example of medical knowledge it will be seen that the doctor-patient relationship is influenced to a large extent by the fact that one of them has access to knowledge which gives him power over the other. Furthermore, a group of doctors can talk amongst themselves about a patient, who will have, in many cases, little idea of what they are talking about. If the patient had access to medical information at a level similar to that of the doctor then it would lead to a changed relationship between them.

Access to knowledge has traditionally been via the medium of the printed word and during the Industrial Revolution there was a general movement amongst the hitherto illiterate working classes to learn to read and write. Access to knowledge was an important factor in gaining power for the working classes. The microelectronics revolution could produce its own distortion in the knowledge-power relationship. As

electronic information services become available due to improvements in the efficiency and cost of microprocessors, access to knowledge, or to some types of knowledge, might become restricted to those with certain computing skills. A pioneering work in this respect has been the Birmingham and Loughborough Electronic Network Development (BLEND) in which a group of British scientists, led by Professor Brian Shackel rely upon computers to store text and disseminate information. The researchers, who are based in twenty-five academic institutions, are producing Britain's first learned journal which exists only in computer data banks. Data is introduced via a keyboard or by optical scanning of typescript and can be recalled by peripheral users via a telephone line to the central computer. This programme which is sponsored by the Research and Development Department, could lead to wider application in computerised journals and enhance the process of bringing computers and telecommunications together (New Scientist 1981). Developments such as this tend to suggest that, in the future, computer skills will, in fact, be needed to gain access for some knowledge and that these skills will become increasingly important as time goes by.

It is, therefore, reasonable to suggest that, in the future, schools will be expected to produce pupils who, in addition to the present basic skills, will need to become computer literate. In some ways, the present generation of children are being schooled in a way which is preparing them for the needs of society in the 1970s, rather than in the 1980s and beyond. Many schools have made changes, but it remains to be seen if these will be effective. In the past the educational response to new areas of curriculum development, such as

social studies or health education, has been to give them low status and where they are actually timetabled, they often appear as an ubiquitous "one-a-weeker". It is to be hoped that the response of schools to the challenge posed by the microprocessor will not be to simply introduce a weekly lesson of computer studies and then, in the best Pontius Pilate tradition, wash their hands of any further involvement. The biggest impact of the microprocessor on the curriculum might be felt indirectly via changes in society. Some of the implications of the introduction of technology based on the microprocessor for the curriculum are discussed in Chapter Six.

The Crowther Report

The Crowther Report (1959) identified two broad groups present in the school population - an academic group and a second group. Lord Crowther suggested that the second group should be taught a sensible practicality and a wise use of leisure time. It is no longer fashionable to talk of "second groups" and, in some schools, separate provision for pupils of differing abilities is not made, but many people involved in teaching could identify groups of children who could be put into such a category. At the time of publication of Lord Crowther's Report it could be realistically assumed that the average working man would require a level of arithmetical ability consistent with the performance of simple calculations at work, the computation of household bills, income tax returns and, in some cases, returns from the betting shops, etc. Nowadays, the electronic calculator makes it easy to perform calculations such as these accurately and quickly. The skill needed is no longer the arithmetical manipulation of number, but the ability to use a machine. The definition of a sensible practicality has thus changed.

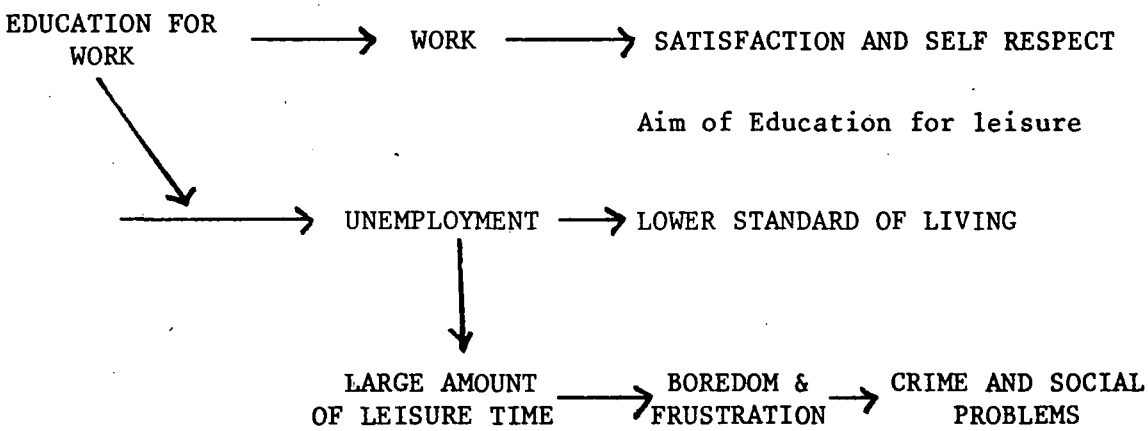
From the point of view of microelectronics direct influences such as that cited above are important, but perhaps the indirect effects will, in the long term, prove to be more significant. The Crowther Report identified the need to help people to make a wise use of their leisure time. Today, this is more important than ever. The microelectronics revolution, together with other factors, both economic and political which are discussed in Chapter Four, has helped create mass unemployment which may increase still further and may also lead to a shorter working week and earlier retirement. Juvenile crime is at an all time high, smoking and drinking are at an epidemic level and street rioting has appeared in parts of Britain. Part of the problem may be resentment at the social and economic deprivations caused by unemployment and part is, no doubt, related to the poor use of leisure time by some sections of the community. Lord Scarman (1981), in his report on the street riots of 1980 and 1981, stressed the need for education for leisure. Perhaps if his fellow Lordship's advice had been heeded in the Crowther Report, the problem today would not have been quite so serious.

If it is accepted that social manifestations of unrest, particularly amongst the younger sections of society, are symptoms of a deeper malaise, then problems such as educating people to use their leisure time can reasonably be suggested to be important. If unemployment, especially amongst young people, continues to rise, problems such as crime, drinking, smoking, drug abuse and even rioting may increase. The long term psychological and social effects of unemployment have been inadequately researched in the past and this

is another factor which makes society poorly equipped to deal with the problems arising from unemployment. Education has been concerned mainly with preparing people for work and when they fail to find it, the whole raison d'etre of the system is lost.

One useful piece of work in this area was that of Sinfield (1968) who discusses factors such as changes in social status and health which can be related to unemployment.

Some of the possible relationships between education, work and unemployment are shown in the diagram below:



When education is aimed as a preparation for work it is usually accepted that work, which brings self respect and money, leads to satisfaction, to a greater or lesser degree, depending on the individual. Unemployment brings a large amount of leisure time (if it is accepted that leisure time is time not spent at work or in duties essential for the maintenance of life), and a lower standard of living. It is suggested that together, these factors lead to boredom and frustration which, in turn, lead to social problems. An essential aim of education

for leisure would be to enable individuals to achieve satisfaction and self respect by making creative use of their leisure time.

Applications to Unemployment

Unemployment occurs for a variety of reason and may be, for example, due to an individual worker not being suited to the job(s) available or due to a particular company's trading difficulties. Mass unemployment is usually related to factors of a national or even global nature. The mass unemployment of the 1930s was a global phenomenon experienced throughout the industrialised world. At the moment, Britain is experiencing its worst unemployment crisis since the 1930s, with the school leaver being particularly badly affected. Many young people are being trained or educated for jobs which will no longer exist when they leave school; at this very moment, some children will be following curricula which have been geared to meet the needs of employers who will no longer have jobs to offer them when they complete their courses. The situation is, in some ways, more worrying than even that which existed in the days of the Depression, because the microprocessor may be destroying some classes of jobs permanently. It would be wrong to suggest that schools should ignore the needs of employers when they are planning educational programmes for young people, but it is surely irresponsible to allow children to be educated with certain areas of employment in mind if there is little chance of their employment in that area. In these circumstances, it might be sensible to suggest that education should not be linked too rigorously with the present needs of employers as these may be subject to short-term change, but should concentrate on developing qualities which would make them adaptable to

learning new skills where necessary. It is impossible at the moment to predict how much unemployment will be produced by the introduction of the microprocessor but there is at least a reasonable chance that it will increase unemployment and that some people will not work again. For these people, education for leisure could be vital in order to enable them to have self respect and to lead a satisfied life without work. The social consequences of failing to do this could be further disturbances of the type seen in some major cities in 1980/81, or even worse.

Two key parties in the problem of changing patterns of employment due to the microprocessor are the government, both as a policy making body and a major employer, and industry itself. The response of both has been disappointing. The government has made some relatively small steps, but some of the work experience provided must come in for criticism on the grounds that some of the jobs for which training is being given will cease to exist, or else will not be recruiting labour. An interesting development has been government plans to open thirty technology centres, costing about nine million pounds, to provide young people with training in electronic assembly, computing and basic information technology skills (Times Educational Supplement 1982). These centres are to be based on a pioneer scheme which has been running at Notting Hill in London and will cater for sixteen to nineteen year olds.

Each centre will be financed by central government, together with industry and, in some cases, local authorities. The Minister for

Industry and Information Technology said that eventually about one hundred of these centres would open and that they would come under the umbrella of the new Youth Training Scheme, which was announced by the Employment Secretary in December 1981.

The role of schools in social control

It is very difficult to estimate just how much of the total effort of what is classed as educational activity is really concerned with social control. It is an area which will be discussed further, later in this dissertation. For the moment, it will be simply argued that schools place a large measure of social control over their pupils by both direct and indirect means. This typically begins with registration of the pupils who are often required to sit silently behind orderly rows of desks before being marched off to a period of ritualised religious activity. This leads to lessons where pupils are subjected to further controls by the teacher in charge.

Marx claimed that, in a capitalist society, education is a tool of ruling class interest. From this it can be argued that our examination system plays an important role in imposing social control. What counts as valid or legitimate knowledge is usually defined by the elite classes and entry to that knowledge is via middle class language (see, for example, Barnes 1969). A further important point is that the school environment tends to be competitive, with rewards in terms of praise, a good report, or passes in public examinations. Good school reports and success in public examinations lead to enhanced employment prospects. For some children the examination system acts as a type of depersonalised social control.

The Marxists would argue that those in a position of power are able to define what is valid knowledge, and how different groups will be permitted access to that knowledge. It is, therefore, of interest to examine what these processes are and how they are related to the educational institutions.

Young (1971), drawing heavily on the work of Bernstein, has posed three questions about the way in which knowledge is organised in the curriculum:

Firstly, the power to define what is 'valued knowledge' leads to problems in accounting for the stratification of knowledge and also of specifying the criteria by which it is defined. The concept of stratification of knowledge involves distinguishing between the 'prestige' element of certain subjects and their 'property' elements. The prestige element is that part which is concerned with the different social status ascribed to different knowledge by academic, as opposed to vocational and pure, as opposed to applied. The property element, on the other hand, involves notions of ownership such as the freedom of access to, or the restriction of access to certain information.

Secondly, the restriction of access to certain areas of knowledge to certain groups, raises the issue of the scope of the curriculum which is available to different age groups and also provokes questions about the social factors influencing the degree and type of specialisation at any particular age.

The third question is what is the relationship between some areas of knowledge and those with access to those areas?

Bernstein (1969) has defined two ideal-type curricula which he has designated integrated type and collection type. Academic curricula in this country involve certain assumptions about how worthwhile some areas of knowledge are. Furthermore, it can be argued that attempts to change curricula will be resented if they are seen to undermine values and privileges and power of the dominant groups.

The curricula in this country have undergone many changes since the mid-1960s. It can be argued that curricula still tend to be dominated by traditional academic disciplines which displaya rigid stratification of knowledge and that school tends to legitimise them. Furthermore, it can be argued that the teachers tend to accord high status to those areas of the curriculum which are formally assessed and taught to the most able children in homogeneous ability groups. Those able children are those who tend to be successful in the system. If Bernstein's notion that knowledge is stratified is accepted, the following questions can be put:

1. What criteria are used to establish the status of certain subjects, and how did they develop?
2. How can the extent of stratification be related to different societies?

These questions are relevant to considerations of changes which may occur in society in the wake of the microprocessor revolution and the introduction of new technology based on the silicon chip. One of

the cornerstones of our society is the belief that to work is virtuous and that for most people it is necessary to work in order to enjoy social status and have a good standard of living. The one exception to this is that the very rich regard not having to work as contributary to their social status. If the amount of work which is available in society changes and high levels of unemployment become the norm, rather than the exception, then the relationship between school, society and work may also need to change. A danger of the microchip is that it threatens to make many jobs redundant very quickly. Some questions which arise are:

1. Can the value of work compared to non-work be evaluated?
2. Will the social value of knowledge change?
3. Will changes in patterns of employment affect the structure of society?

From the educational viewpoint, it is apparent that if some of the foundations of society, such as relationships between work and social status, change then, in due course, the impact will be felt by the educational system. It is interesting to pose the question: 'should schools simply respond to changes in society or should they try to influence the nature of some of the changes before they actually occur?' This question is related to the role of school in our society and involves decisions about whether or not they should play a positive part in changing society, or adopt a more passive role. The passive role would be seen by some as being tantamount to preserving the status quo of our class-based society.

Related to these points is the question of how educational institutions should respond to changes in the social values of knowledge if these values change in society - or should educational institutions try to influence the social value of knowledge and, ultimately, society? At the moment, the curricula of many schools consist of a nucleus of academic subjects which are by consensus accepted as "essential". Moves towards a "common core" curriculum would, in many cases, simply formalise existing arrangements. Subjects such as mathematics, English language, pure science, traditional art subjects (such as history and geography) and foreign languages have tended to have high academic and social value. Some other subjects, including social studies, P.E., and 'humanities', have enjoyed low status. This is sometimes reflected in the examination system, with some of the latter group being non-examination subjects.

The move towards a "common core" in recent years has been quite interesting and can be traced back to October 1976, to the Prime Minister of the Labour government, Mr. Callaghan's Ruskin College speech, which marked the start of what was known at the time as the "Great Debate". Well publicised meetings with interested bodies were followed in November of the following year by a circular to local authorities asking for their views. Following the change of government, a report was published in November 1979, stating that the government would seek a consensus for a national curriculum framework. A more dramatic document was published in February 1980, "Framework for the Curriculum", which proposed minimum time for certain subjects; namely, English, mathematics, science and languages. The final document published has been "The School Curriculum".

"The School Curriculum" contains the government's recommended approach to the problem of a common curriculum, with schools being left to sort out details. One important aspect of the document is that it represents an attempt by central government to influence what is taught at local level. The document contains a list of educational aims such as developing lively, enquiring minds and physical skills, but also makes reference to some moral and social issues. It it interesting to note that, in the list of aims, was one to help pupils acquire knowledge and skills relevant to adult life and employment in a fast changing world. This fits in with some of the ideas about the links between school and employment which have been discussed earlier.

There are also several sociological objectives, such as trying to develop religious and racial tolerance, and understanding of the world in which they live, and appreciating human achievements and aspirations. There is also a reference to the issue of the need for the more flexible and self reliant workforce demanded by the new technology. It is interesting to note that both the link between education and work and the impact of the new technology were both recognised, but that no concrete suggestions about the possible educational response to the challenge of the new technology were made. It was suggested that the present system of options at fourteen deprived some pupils of some employment possibilities in later life and that pupils up to the age of sixteen should follow a fairly broad curriculum which should include: English, mathematics, science, religious education, and physical education, together with some study of the humanities. In the section entitled "preparation for work" three suggestions for ways of doing this are made:

1. relating the curriculum to what happens outside the school, particularly through more applied and practical work in science and mathematics;
2. more and better systematic careers advice and
3. better links between school and industry.

The emphasis, then, is squarely set upon preparation for work. A disturbing omission is what provision should be made for those people who may never work if the worst fears of some commentators on the microchip revolution are realised. Nowhere in the document is there any mention of education for leisure, nor are some of the sociological issues related to a lack of employment. This is worrying in a document which is intended to form a blueprint for the curricula of schools, preparing pupils leaving school as the major impact of microtechnology will be severely felt. Even if the worst fears of the pessimists who have predicted mass unemployment are not fulfilled, it would appear prudent to make contingency plans in case mass unemployment becomes a reality.

Summary

Two major areas of input to educational theory are those of philosophy and sociology. It is suggested that both areas are of importance when considering the possible impact of the microprocessor revolution on schools. Education for work may cease to be a credible policy if mass unemployment is experienced and large numbers of people have no prospect of finding employment. Philosophical and sociological considerations show possible responses to the changed demands which

society may place upon its citizens as a result of technological change related to the introduction of microprocessors.

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CHAPTER TWO

SOME CHANGES IN INDUSTRY AND EDUCATION WHICH OCCURRED DURING THE INDUSTRIAL REVOLUTION AND THEIR POSSIBLE RELEVANCE TO CHANGES OCCURRING AS A RESULT OF THE SPREAD OF TECHNOLOGY RELATED TO THE MICROPROCESSOR.

Introduction

At the present time, the introduction of the microprocessor into industry, commerce and society in general threatens to produce changes on a massive scale. Industry, commerce and society are closely interrelated and mutually dependent upon each other. Industry produces much of the wealth of society and finances many of the other activities of society such as education, health care and other social services. Commerce is concerned with selling the products of industry and providing general financial services which industry needs. Society in general is important, both as a consumer of the products of industry and as suppliers of labour. The educational system has complex interrelationships with industry, commerce and society. In order to be useful to industry, people need to be educated to a certain level. As industry has become more technical and sophisticated, the educational requirements of industry have changed. Similarly, the needs of those employed in commerce have also changed. An important point which is often overlooked is that, as the products of industry become more sophisticated, a higher level of educational attainment is required to use them.

The educational system's response to industry is complex, but schools are expected to cater for the needs of industry. This is well illustrated in the government's 1981 document "The School Curriculum", which stresses the need to provide children with the knowledge and skills required in adult life and in employment. At the best of times it is difficult to predict exactly what the requirements of industry will be, since industry is such a wide and diffuse area of activity and, in any

section of industry, there will be constant change. When there is a major technological breakthrough, with the potential for wide application, then the problems are greatly increased.

In order to predict, or at least try to predict, what the educational response to the microchip revolution could be, it may be instructive to examine some of the educational changes which occurred during the last Industrial Revolution. This may also help us to understand some aspects of the complex interrelationships which exist between industrial change and educational change.

Causes of the Industrial Revolution

The changes in technology which are related to the microchip revolution span a comparatively short period of time. The first practical, valve operated computers were developed during the Second World War, but were massive, somewhat unreliable in service, and generated immense amounts of heat. The mainframe computers of the 1960s and early parts of the 1970s were based largely on technology related to the transistor. These were relatively cheap, small and efficient as compared to their valve operated predecessors. However, silicon chip technology has heralded the advent of the mini and microcomputers. These devices may soon challenge the mainframe computer in power but have the advantages of portability, size and relatively low costs. These characteristics have led to the increasing deployment and application of these devices in industry, commerce, schools and even homes. The changes related to the microchip revolution can be identified as having occurred in the main between say, 1945 and the present day.

The Industrial Revolution was a rather diffuse event, with major changes occurring over a number of years. Another somewhat diffuse area is that of the causes of the Industrial Revolution. Possible factors which may have been involved include a "knock-on" effect from the agrarian revolution, population growth, increased trade, capital accumulation and the introduction of new technology itself. The situation has been summed up by Redford (1960), who suggested that the causes of the Industrial Revolution have been sought by three generations of scholars, but that we are still no closer to understanding why the rapid increase in economic development between 1700 and 1830 in England occurred when it did. There is not even a consensus on when the Industrial Revolution began, or when it ended. In many historical texts the dates for these events are cited as 1760-1830, but there are other views. Deane and Cole (1962) have suggested that the Industrial Revolution continued after 1845, since there was a rapid increase in economic activity after this time, and Clapham (1962) has pointed out that no English industry had completed its technological revolution by 1850. Hartwell(1960a) has suggested that the great structural change occurred between 1780 and 1850.

The concept of an industrial revolution was derived to account for the economic transformation of England. Some authors have suggested that the Industrial Revolution had its origins in changes arising directly from the introduction of new technology. Smailes (1964), for example, suggested that:

> "... our engineers may be regarded in some measure as the makers of modern civilisation ... Are not the men who have made the motive power of the country and immensely increased its productive strength, the men who above all others have tended to make the country what it is."

The growth of science and a favourable economic climate can be seen as prime factors in the Industrial Revolution.

The publication of the "Wealth of Nations", by Adam Smith gave a stimulus to the philosophy of unfettered market forces. It has been argued that unfettered market forces set free by enlightened government and inspired by wise economists had caused the Industrial Revolution (Hartwell 1966b). Adam Smith would also appear to be the source of two other causes of the Industrial Revolution: increased capital accumulation and an increased demand for the products of industry.

In attempting to explain why the Industrial Revolution occurred historians have then attempted to identify causal factors. It is helpful in trying to produce a model of what happened, to consider what the economy was like prior to industrialisation. Factors which may have affected the growth in output were the growth in population, changes in technology and the accumulation of capital. An important question is, "Was the demand general from within the economy or outside of it?"

The relationships between these factors and the changes in the demand for education are not clear. It is apparent that the demand for education and the provision of it increased throughout the nineteenth century and that it was roughly paralleled by an increase in economic power up till about 1870, when the rate of economic growth began to slow down; this may, in part, have been due to inadequate educational provision.

Anderson and Bowman (1963) studied the relationship between education and development in terms of National Income. After looking at 83 countries (in 1955), they found that forty percent literacy of the population was needed for an income of three hundred dollars per capita, and that a ninety percent level of literacy was needed for a per capita income in excess of four hundred dollars. Anderson (1965) has suggested that a forty percent level of literacy is the general threshold for economic development.

Some idea of the economic growth which occurred in England and Wales at this time can be obtained from studying the National Income for the period. Some of the details are shown in Table 1 but, in summary, it can be seen that between 1845 and 1875 the National Income increased from two hundred and sixty-four million pounds to four hundred and fifty-seven million pounds. This represents an increase of fifty-eight percent in thirty years.

Equally striking, were the changes which occurred in the distribution of employment at this time. The main shift from the land to industry occurred early in the Industrial Revolution, but even after 1851, there was a drift from this. This could suggest that, even at this time, the Industrial Revolution was far from over. Some information about the drift from the land between 1851 and 1871 is shown in the table. In addition to this, it has been estimated by Giffen (1889) that the capital of the United Kingdom increased by forty percent between 1865 and 1875, suggesting continued rapid economic growth. A further important point is that there was a change from Britain being virtually self sufficient in food to becoming a food importer; this had to be paid for and in order to do this, industry and commerce needed to become even more highly developed.

Table 1 Changes in National Income between 1845 and 1875

Year	National Income (£M)	Percent increase over last date
1845	264	-
1855	308	17
1865	396	28
1875	457	44

Table constructed from data in Ashworth (1960), p.5.

Table 2 Changes in occupation between 1851 and 1871

Occupation	Year 1851	1971
Agriculture	20.9	14.2
Textile Manufacture	11.1	9.3
Building	5.5	6.3
Mining	4.0	4.5
Manufacturing (except Textiles)	11.3	13.8
Transport	4.1	4.9

Table compiled from data in Ashworth (1960), p.11.

Relationships between increasing sophistication in industry and education

It is not the intention here to chronicle major changes in technology which occurred during the Industrial Revolution, but it is probably fair to say that the development of steam power and new methods of iron manufacture (e.g. steam hammer 1842, Bessemer's Convertor 1856) were milestones of technological progress. By the 1850s, methods of machine manufacture were becoming increasingly sophisticated, and the machines were capable of rapid and accurate work. Armstrong, one of the foremost of a group of scientists and engineers and entrepeneurs developed a machine which worked to the previously unheard of accuracy of one thousandth of an inch. The development of self-hardening steel for machine tools helped to remove constraints on the speed of machinery.

Development such as those outlined above enabled industry to improve its efficiency, and also the quality of the goods which were produced. The same can be said of the microprocessor. Machines controlled by microprocessors can work to a very close tolerance, even in very difficult situations such as welding motor car bodies together. More complex tasks such as the control of whole industrial processes are well within the ambit of microprocessor activity. An important point to note is that although mainframe computers have been steadily introduced since the 1950s, the microprocessor, being cheaper and more adaptable, has greatly increased the speed at which automation is introduced; the time scale in the microprocessor revolution threatens to be very short.

The time taken for technological innovations to be introduced is very important. When changes occur gradually, there is time for training methods to change and for the workforce to adapt. More problems are experienced when changes occur rapidly. During the Industrial Revolution, some of the changes occurred gradually and, according to Ashworth (1960a), it was possible to succeed at various levels of industry with only a modest education. It is possible that one of the contributory factors to the slowing down of technological change, which heralded the end of the last Industrial Revolution, was a lack of education. The concept of technological progress being limited by inadequate education is an interesting one. At one level, as technology becomes more complex, a more educated workforce can become necessary, and at another, as the products of industry become more sophisticated, then a better educated population of consumers is needed, so that some of the products of industry can be used.

An important consideration to be kept in mind is that even when technology does become more sophisticated, the increased educational requirements of those involved in industrial activity will not be evenly spread throughout the workforce. The microprocessor, for example, demands very high levels of skill amongst those involved in the design of both hardware (the machines) and the software (the programs which the machines use). In some cases, less skill may be required at lower levels of industry, such as the factory floor, since the machines being used may be less reliant on human skill and judgement.

Another interesting point that is worthy of note is that unemployment during the Industrial Revolution (i.e. 1760-1830) tended

to be very low. The new technology was accompanied by economic growth and the opening up of new markets for the products of industry. This can be compared to the current situation in which new technology is being introduced against a background of world depression and declining markets for western countries, as well as severe competition from developing economies, particularly in South Eastern Asia. In the period which followed the changes unemployment was very low: in 1858 about 7.4% of trade unionists were out of work, but this had fallen to 0.95% in 1872. In fact, for thirteen out of the twenty years from 1856 to 1875, unemployment was less than 4% (Ashworth 1960b). This can be compared to present levels in Britain where, in 1981, over three million people are unemployed - representing over twelve percent of the workforce.

The move from the land to the towns, which was a feature of industrialisation during the Industrial Revolution, brought with it considerable social change. As industrialisation spread, a concomitant increase in education occurred. It is interesting to examine some of the factors which contributed to the spread of education at this time. It would appear that the working classes had a strong desire to learn to read and write, and were prepared to learn these skills in a variety of ad hoc situations such as Sunday Schools, Mechanics Institutes and night schools. The movement towards educating the working classes was aided and encouraged by some members of the upper and middle classes. The reasons why the privileged classes were disposed to helping the movement towards working class literacy are not clear. Some may have helped from a true sense of philanthropism, while others may have been

more concerned with regulating what was learned, or as a means of producing a more orderly and civilised society in which their own position would be perpetuated and safeguarded. The notion of schools as tools for preserving the status quo in cultural and social reproduction has been discussed in some detail by Bordieu (1974).

There were, of course, many members of the ruling classes who opposed the education of the masses, perhaps because they felt that it threatened their position. Sociologists, such as Young (1971) have explained their view that knowledge is linked to power, and that knowledge is a powerful tool of social control; this may have been at the heart of the reluctance of some members of the upper and middle classes being reluctant to encourage working class literacy. Hammond and Hammond (1937) have expressed the view that in the manufacturing towns any efforts which distracted the workers from long hours of work were despised by those in positions of power and that education had no place in the system, since it diverted the efforts of the workers away from productive labour. However, some manufacturers will have needed an educated workforce and Court (1967) has suggested that, in the new manufacturing districts, education was a vital concern for two main reasons; first, to meet a growing need for technical training and, secondly, because of the continued concentration of population in towns.

The relationship between the press and the working class literacy movement in the early part of the nineteenth century is interesting. At this time, the popular press began to flourish, with sales of publications such as the "Twopenny Trash" being buoyant with a circulation of between twenty and thirty thousand. It is thought that the availability of

journals such as these motivated the working classes in their drive to learning how to read and write.

As an example of one of the more extreme viewpoints of those opposed to universal education, it is interesting to cite the words of Davies Giddy, M.P. Mr. Giddy was opposed to the provision of any education for the working classes and, in 1807, suggested that education would encourage the labouring poor:

> "... to despise their lot in life, instead of making them good servants in agriculture and other laborious employment to which their rank in society had destined them; instead of teaching them subordination it would render them factious and refractory as was evident in the manufacturing counties. It would enable them to read seditious pamphlets, vicious books and pamphlets against Christianity."

He was clearly a very tolerant and perspicacious man!

Development of Schools

The early schools which were founded in the nineteenth century tended to be linked to various religious orders and appear to have been concerned, to a large extent, with the teaching of religious dogma and inculcating the labouring poor to accept their station in life. The emphasis seems to have been very much on what we would now call social control (Sutherland 1971a). The same author cites the attitude of Hannah More, a lady aided by the Wilberforces and Thorntons, who ran the Mendip Schools as:

> "... my plan of instruction is extremely simple and limited. They learn on weekdays such course works as may fit them for servants. I allow no writing for the poor."

The children were taught building, spinning and obedience.

There was little here that the purist today would call education and it is interesting that the lady herself referred to a plan of instruction as opposed to a plan of education. This early form of social control was overt and was clearly a socially acceptable idea amongst the ruling classes. Sociologists who have studied the relationship between knowledge, education and power, and who have looked in detail at the more covert and subtle forms of social control could argue that even today social control is a major aim of our educational system (see, for example, Young 1971; Davies 1970).

An important development in our educational system was the monitorial system. This was an interesting situation in which a teacher would be aided by one or more monitors to enable him to look after a large number of children. It was clearly an economical system, but it can also be argued that it enabled a perhaps scarce resource - the teacher - to be more widely spread. Dr. Bell, one of the foremost figures in the monitorial system, observed that:

> "It is not proposed that the children of the poor should be educated in an expensive manner, or all of them taught to read and to cipher. Utopian schemes, for the universal diffusion of general knowledge would soon realise the fable of the belly, and other members of the body and confound that distinction of ranks and classes of society on which the general welfare hunger ... there is a risque of elevating by an indiscriminate education the minds of those doomed to the drudgery of daily labour, above their condition, thereby rendering them discontented and unhappy in their lot."
>
> (Cited in Sutherland 1971, p.10).

Again, the attitude to educating the working classes clearly shows that at least in some sections of the ruling classes there was a fear that educating the working classes could lead to a downfall of the system. It seems reasonable to assume that Dr. Bell did not intend to give his pupils the type of education which would liberate their minds or give them the opportunity of rising out of the working class poverty trap. Perhaps the aim was to give just enough education to satisfy the working class clamour for it, without enabling those who were being educated to rise above their station in life as drudges.

A further development, which was important in the provision of a universal education for the working classes, was the formation of the 'British and Foreign School Society' in 1814, from a committee of the 'Friends of Lancaster'. This followed closely the formation of the rival 'National Society for Promoting the Education of the Poor in the principles of the Established Church in England and Wales' in 1811. Clearly, this latter society was intended to further the religious aims of the Anglican Church, and the Catholic Church responded by establishing their own schools. It is perhaps worth noting that the Industrial Revolution proper had been going on for about fifty years before widespread movement for educating the masses became established. Similarly, the first government attempt to survey educational provision appears to have been made in 1816 by a Select Committee of Commons, chaired by Henry Brougham. Again, it is interesting to note the time lag between widespread industrial change and action on the provision of education.

The fact that an attempt was made to survey educational provision suggests that some concern was being felt about education. As a result

of this survey, Brougham suggested that about seven percent of the total population of England and Wales were in school and, in 1818, he suggested that the target should be to have eleven percent of the population in school. Brougham, it will be noted, talked in terms of the total population rather than the child population. This seems to have been the accepted way of presenting educational data in the nineteenth century and, later, the target was raised to seventeen percent or one-in-six of the population. By modern standards the aim of educating a set percentage of the population seems somewhat crude since the figures paid little or no reference to the age-structure of the population, the number of non-working class children, sick or handicapped or chronic absentees. According to the Brougham Return, only about a third of the children attending school in 1818 went to endowed schools, the rest attending schools which were supported by school fees and/or local subscriptions. A proportion of these schools were referred to as 'Dame Schools". Some may have been looked after by 'dames', i.e. old ladies interested in children, but many would appear to have been little more than child-minding institutions. Sutherland (1971) has suggested that many of the Dame Schools were squalid institutions where education was of secondary importance.

The Kerry Report in 1833 suggested that only twenty-four percent of the child (i.e. five to fifteen years old) population were in school. The reliability of the Kerry Report is somewhat doubtful and shortly after publication was criticised by the Manchester Statistical Society. Phyllis Deane (1965) has suggested that the Return of 1833 showed that

only one in three of the school age population received any instruction and that, as a result of this lack of education, the organisation of labour in the 1830s and 1840s was delayed. West (1975) has taken a different view, and has argued that misunderstandings in the interpretation of the Kerry Report data may have arisen because the school age was not, in fact, five to fifteen, but five to ten years old. In addition, West considers that the Kerry Report may have underestimated the provision of education at this time. According to West, about ninety percent of the child population received some education.

Professor Weisbrod (1962) has put forward the idea that the child-minding function of schools is of greater economic significance than is often appreciated. From his work in the U.S.A., he has concluded that the function of schools represents what he calls a substantial external economy. After a study involving more than three and a half million mothers of six to eleven year olds, he came to the conclusion that, if it were not for the child-minding function of schools, one million of the mothers would not be able to work. If each mother earned two thousand dollars a year, the value of the child-minding service would be two thousand million dollars a year - this represents a substantial proportion of the national income. Similar considerations probably apply in this country and it would be interesting to study the utility value of our education system as a child-minding service.

The 1851 Census Report took one day in the year (March 31st) and made an estimate of the number of children in school. One aspect of the report was that the report studied, for different types of school,

how many of those on the roll attended on that day; it was found that in the private schools, ninety-one percent of those on the roll were in attendance, while at public schools, the figure was seventy-nine percent. How typical the figure was is a matter for conjecture, since schools may have made a special effort to encourage attendance on the day of the census. A typical pattern of education for a working class child would be to attend a Dame School for one year, followed by four years in a Common School. In terms of the total population, about one in eight of the total population was attending an elementary day school at this time.

In the 1850s, many children left school at the age of ten or eleven, and it was, therefore, important that the child soon learn the rudiments by that age. Even after the 1851 Census, there was little real idea about the state of educational provision in England and Wales. The Newcastle Commission was set up in 1858, and it had in its Terms of Reference, a mandate to:

> "... inquire into the Present State of Popular Education in England and to consider and report what measures, if any, are required for the extension of sound and cheap elementary instruction to all classes of people."

It is interesting to note that, at the time of the Newcastle Commission, it was felt in some quarters that an education up to the age of ten or eleven was sufficient for many of the working classes. The views of the Reverend James Fraser, an Assistant Commissioner, who later became Bishop of Manchester, have been recorded as follows:

> "Even if it were possible, I doubt whether it would be desirable with a view to the real interests of the peasant boy to keep him at school till he was fourteen or fifteen years of age. But it is not possible. We must make up our minds to see the last of him, as far as the day school is concerned, at ten or eleven. We must frame our system of education on this hypothesis; and I venture to maintain that it is quite possible to teach a child soundly and thoroughly, in a way that he shall not forget it all that is necessary for him to possess in the shape of intellectual attainments by the time he is ten years old. If he has been properly looked after in the lower classes he shall be able to spell correctly the words that he will ordinarily have to use; he shall read a common narrative - the paragraph in a newspaper that he cares to read - with sufficient ease to be a pleasure to himself and convey information to listeners; he knows enough of ciphering to make out, or test the correctness of the common shop bill; if he hears talk of foreign countries he has some notion as to the part of the habital globe in which they lie, and underlying all and not without its influence, I trust upon his life and conversation he has acquaintance enough with the Holy Scriptures to follow the allusions and arguments of a plain Saxon Sermon and a sufficient recollection of the truths taught to him in his catechism, to know what are the duties required of him towards his maker and his fellow men. I have no brighter view of the future or the possibilities of an English Elementary education floating before my eyes than this."
>
> (Fraser 1861).

This is quite a sophisticated, if somewhat condensed, educational philosophy of what must have been a well educated and intelligent man who achieved high rank in his chosen profession. There are some interesting elements in his views, not least his opinion that by the age of ten or eleven it should be possible to teach elementary reading and writing to a sufficient level to read a "common newspaper" or carry out simple tasks. Today, despite the attention of a well educated and highly trained professional workforce of teachers, operating in purpose-built accommodation, with a variety of teaching aids with what, in the 1850s, would have been considered small classes, there are children who leave

school at the age of sixteen without these basic skills! A further point of interest is the reference to teaching the child his duties in regard to his maker and fellow men; the Reverend was clearly aware of the social aspect of education.

A picture emerges of a very basic education being provided, with an emphasis on the essential skills. It is important to note that all the members of the Newcastle Commission saw this elementary level of education as the maximum level of attainment to be permitted. The Commissioners found it objectionable that some children were taught basic science or more advanced language work, since they saw this as diverting the teacher's efforts from the primary task of inculcating the basic skills. At a time when industrial growth and scientific innovation had made Britain the "workshop of the world" it is difficult to understand why the teaching of scientific skills was deprecated; it would seem sensible in retrospect to have encouraged the development of higher skills which could be utilised in the developing industries of the time.

In order to ensure that school concentrated on the basic skills, the "payment by results" scheme was devised. It was originally proposed that schools would receive from the rates an amount of money to be determined by the performance of each child in examinations conducted by a county inspector. This would free the H.M.I.s to concern themselves with other aspects of the school. The religious problem ensured that the idea of rate aid being channelled into schools via county Boards failed, but the basic principle of payment by results gained acceptance.

In the Revised Code grants to schools, with the exception of building grants were replaced by a capitation grant of twelve shillings per child per year. Of this, four shillings depended on regular attendance and the rest on examinations in reading, writing, and arithmetic conducted by an H.M.I. The examinations were graded and a child was expected to move up by one standard a year.

The Revised Code did not prohibit the teaching of other subjects, but it did reduce the incentive to teach them. Furthermore, the system of using the H.M.I.s for formal testing ensured that they had little time available for other activities. However, not all children attended inspected schools and, by 1870, only about half the children attending elementary day schools went to an inspected one (Sutherland 1971)[C].

It is interesting to look back and speculate as to the effects poor educational provision had on industrial development in the nineteenth century. Schemes such as that of 'Payment by Results' can be viewed as attempts to help industrial development by encouraging basic standards of literacy and numeracy, but they stifled the teaching of other subjects. The lack of basic science teaching may have had a particularly harmful affect with regard to science teaching. Many of the children of upper and middle class parents may have fared as badly as their working class contemporaries, since at this time, many will have received a 'classical' type of education in their private schools. When the provision of education was so limited, especially in science subjects, it is perhaps even more remarkable that Britain achieved such eminence in technological innovation.

Throughout the 1860s, the state became more and more involved with the education system via the Revised Code and by providing financial assistance for schools. By the end of the decade, the National Society's schools were facing financial difficulties and also opposition from non-conformist groups who began to support the idea of a non-denominational state system. The Liberal government of 1868-74 committed itself to a universal system of state education for the working classes; this culminated in the Education Act of 1870.

The picture which emerges from this discussion so far is that from about 1760 there were major improvements in technology, which increased the quantity,quality and range of manufactured goods produced by British industry. This was achieved against a background of generally poor educational standards, particularly in the working classes. By 1870, a system of universal day schools for the working classes had been instituted, but by then, the rate of industrial growth had slowed down. To what extent the lack of educational provision of the working classes contributed to this is an open question.

Changes in Educational Standards in the Nineteenth Century

The changes in provision of education which have been outlined are somewhat easier to chronicle than changes in standards of educational achievement. The assessment of standards of literacy in the early part of the nineteenth century is not easy, but some general deductions can be made from various sources of information. These include the educational qualifications of criminals, the number of people able to sign the marriage registers, as opposed to simply making a mark, and reports of various

Statistical Societies. Some of the changes in indices of educational attainment which occurred during the nineteenth century can be looked at vis-a-vis changes in technology and changes in society.

West (1975) has taken the view that standards of literacy in the early nineteenth century were surprisingly high and cites statistical data collected by contemporary sources to support this hypothesis. Tables 3,4 & 5 show respectively the standards of literacy amongst workhouse children in Norfolk and Suffolk in 1838, literacy amongst Durham and Northumberland miners in 1840, and literacy amongst Hull Weavers in 1863. The workhouse children, who occupied a very lowly position in society showed quite a high proportion (about eighty-seven percent) of readers. The study of miners in Durham and Northumberland was interesting in that it not only studied the ability to read, but also the ability to write. It would appear from these figures that seventy-nine percent could read and that almost fifty-three percent could read and write. Similarly, the study of weavers in Hull showed a very high (ninety-two percent) of readers. These figures are important, because they help modify ideas of an almost illiterate workforce in the early part of the nineteenth century. That is not to say that they were well educated, because, in many cases, other abilities such as scientific skills and knowledge were absent.

Table 3 Literacy amongs workhouse children in Norfolk and Suffolk in 1838 (Youths 9-16)

Standard of Literacy	Number	Percent.
Read Well	206	42.5
Read imperfectly	217	44.7
Unable to read	62	12.8

(Source : West 1975, p.39).

Table 4 Literacy amongst Durham and Northumberland Miners (1840)

Number of Pitmen	Able to read	Able to read and write	Able to read only	Unable to read or write
843	645 78.9%	445 52.8%	220 26.1%	178 21.1%

(Source : West 1975, p.39).

Table 5 Literacy amongst Hull Weavers in 1963

Number of Adults	Number able to read	Number unable to read	Percent. Readers
14,526	13,472	1,054	92%

(Source : West 1975, p.39)

Summary

The precise nature of the causative factors of the Industrial Revolution is not perfectly understood, but important factors were the growth of population, the growth of capital, knock-on effects of the Agrarian Revolution, and technological developments. The concept of an industrial revolution suggests a massive change in lifestyle and this is, indeed, what happened with a massive move from employment on the land to employment in industry in the rapidly developing towns.

Changes in industry were accompanied by changes in educational provision, particularly for the working classes. Before industrialisation, there was little call and perhaps, in some cases, little need, for education for the working classes, but industrialisation seemed to create not just a need for education but a clamour for it.

It would appear that in the early stages of industrialisation it was possible to succeed with only a very modest education. However, it is not clear whether or not some degree of education became necessary for progress beyond a certain level, or whether a lack of education amongst those involved in industry may have been a factor contributing to the slowing down of technological innovation after about 1830. A further point to note is that the quality and content of education is also important and that science was not a major part of the curriculum in either private or public (i.e. working class) schools. The private schools tended to follow a 'classical' type of education as did universities and schemes such as the 'Payment by Results' did nothing to encourage the provision of a science education in the working class schools.

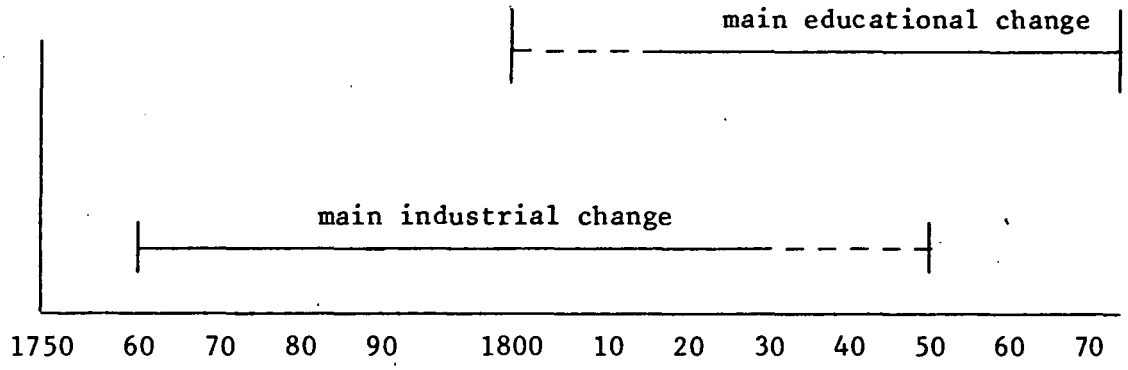
Science can play an important role in technological change and it would appear to be sensible to suggest that a healthy science education would be a useful catalyst in promoting technological innovation.

At the time of educational change in the nineteenth century there appears to have been a division of opinion amongst the middle and upper classes as to the value of educating the working classes. Some argued that educating the working classes would lead to them becoming dissatisfied with their lot in life, while others believed that if they started to read the bible, then learning to read could be beneficial.

Provision of an education for the working classes came gradually but by 1870 a universal state system of elementary education had been provided to replace or supplement some of the previous measures. As well as schools run by the two competing societies, there were a variety of more ad hoc arrangements, including night schools, Sunday schools and Mechanics Institutes. The Mechanics Institutes were particularly important as a source of science education.

A study of technological change and education in the nineteenth century suggests that technological change occurred on a massive scale and that this was followed by an improvement in educational provision. The Industrial Revolution is generally accepted to have started about 1760, but planned educational provision on a large scale for the working classes does not appear to have been made until some fifty years later, when the National Society (1811) and the rival British and Foreign School

Society (1814) became established. The Revised Code (1862) and the 1870 Education Act were major steps forward.



It is interesting to note that when the main industrial thrust was over, after about 1850 at the latest, it was a further twenty years before the main educational changes embodied in the 1870 Education Act were completed. Furthermore, major social changes, such as universal male suffrage took longer to achieve and universal female sufferage was not realised until 1928.

From about 1850, the speed of Industrial development slowed down and one reason may have been a lack of education of the workforce. As we stand at the gateway of what has been hailed as the microprocessor or second Industrial Revolution, it is important to examine whether or not a lack of educational provision will be a factor in slowing down further industrial development in Britain.

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CHAPTER THREE

SOME ASPECTS OF THE RELATIONSHIP BETWEEN THE ROLES OF UNEMPLOYMENT, LEISURE AND EDUCATION IN SOCIETY, AND THE IMPLICATIONS FOR THEM OF TECHNOLOGICAL CHANGE.

Introduction

It has been suggested in previous chapters that one of the consequences of introducing technology based on the microprocessor will be to reduce the amount of time spent 'working'. The form this may take is uncertain but includes as elements, unemployment, a shorter working week and a shorter working life, i.e. earlier retirement. Recently, 'leisure' has become seriously regarded as a topic worthy of serious academic study; much of the work which has been carried out in this area has been done by sociologists.

Leisure is not an easy topic to study; this may in part be because there is no standard way to measure it and because it is difficult to define exactly what we mean by leisure or leisure time. According to Parker(1972a) there are three ways of defining leisure:

(i) Residual methods of determining leisure time involve measuring the time spent at work, travelling to and from work, eating and carrying out tasks which are essential to life, and subtracting the total from the number of hours in the day. There are clear methodological difficulties involved in this type of approach; for example, eating under some circumstances can be classed as a leisure activity.

(ii) Leisure time can be considered as the time spent engaged in activities regarded as leisure, e.g. sport, or other freely entered into activities.

(iii) It is possible to combine the first two approaches and try to combine a residual or time factor with some sort of value judgement about the nature of leisure time activities. Gist and Fava (1964), using this type of approach, have defined leisure time as:

> "... the time which an individual has free from work or other duties and which may be utilised for purposes of relaxation, diversion, social achievement or personal development."

This definition is somewhat cumbersome and what would appear to be important when leisure time is analysed, is that some account is taken of both the time available and the quality of the activity. Using an approach of this type, free time, as provided by enforced unemployment, would not be true leisure unless it was accompanied by meaningful leisure time activity.

The problem of leisure time generated by unemployment is particularly serious and is one which causes great concern to many people in many parts of the western industrialised world. Part of the problem may be that in our industrialised societies people have become used to working quite long hours. This practice would seem to have arisen at the time of the Industrial Revolution. Wilensky (1961) has suggested that the leisure time available to artisans and craftsmen declined from the Middle Ages till it reached an all time low in the

middle of the nineteenth century. Wilensky suggested that the skilled urban worker has only recently managed to regain the position of a roughly comparable worker in the thirteenth century. Farm workers would appear to have always worked long hours.

A further phenomenon associated with the Industrial Revolution was the fact that work moved from the home to the factory and "time off" for leisure became essential. Before the move to factories, the worker at home, while obliged to produce a certain amount of goods to live, was able to choose when he wished to have his leisure. Before the advent of what might be called consumer goods, the main pressure on a worker was to be able to afford food, clothing and accommodation. Clayre (1974) and Thompson (1967) have suggested that, in some cases, leisure time only ended when the need to work arose.

In an industrial society, leisure is often a social activity and the leisure activities of people are related to their class position in the society to which they belong. It can be argued that, because leisure time is the product of the increased output and productivity resulting from industrialisation, its social structure may be related to the industrial society which it was derived from. For example, many leisure activities, such as soccer, have many more spectators than participants and the activities tend to become closely regulated and perhaps even routine. Leisure institutions have become established and these play an important part in determining how the leisure demands of certain groups may be met or, in some cases, actually create a leisure demand.

In pre-industrial societies, pressures to conform to custom and practice tended to be of a direct nature and leisure may have been linked to a set of social occasions following a definite structure or plan. In industrial societies, the pressure to conform to plan or set structures may be less evident, but may still be present and related in some ways to class structures. For example, most of the people who attend football matches in this country tend to be working class, but the people who run the clubs, i.e. the Boards of Directors. are mainly upper and middle class, since a certain amount of capital is an essential prerequisite to buying the shares which determine who sits on the Board. The Management Committee of the Football Association and Football League also tend not to be of working class origin. In this example, we have what is basically a working class pastime being controlled by the middle and upper classes - an example of how the class structure of, say, society or industry is reflected in a leisure-time activity. It would be difficult to imagine an example of an upper class activity, such as grouse shooting, being controlled by members of the working classes.

Distribution of Leisure Time

Some of the difficulties in measuring how much time a person has available for leisure have already been discussed in this chapter and it has been suggested that references to leisure-time should probably involve some notion of the time available and also of the quality of activity carried out in the time available. In the residual definition, one of the factors which is most easily measured is the number of hours worked in a week. Even here, there are difficulties, since some

professions have traditionally taken 'work' home with them. In Britain, many people who are involved in a wide variety of occupations would appear to spend roughly the same amount of time at work, i.e.about forty hours a week, spread over a five-day working week. Some groups do no work, or very little work; for example, those wealthy enough not to have to work, those who have retired, the sick and the handicapped.

How much time not actually spent at work is occupied by leisure is an interesting problem. Young and Wilmott (1973), using a time budget, suggested that the leisure time of various groups of adults was thirty-two hours for men working full-time, twenty-six hours for women working full-time; women who did not work were found to have about forty-four hours of leisure time a week. It has been suggested by Parker (1972b) that, in Britain, leisure time is reasonably evenly distributed between the classes and the sexes.

The variety of leisure opportunities available to the working classes has increased as real living standards have risen. Leisure occupations such as world cruises remain for the most part the prerogative of the very rich, but the advent of the cheap package holiday, and cheaper air travel pioneered by ventures such as the now defunct Laker 'Skytrain', opened up new horizons for the lower classes.

There is another aspect of the relationship between industry and leisure which is worthy of attention; that is, because we live in a consumer society, the consumer needs leisure time in which to consume some of the products of industry. An interesting point to note is

that as the working week gets shorter, the time available for leisure and, therefore, the time available for consuming industrial products increases. This is important vis-a-vis changes in working habits brought about by the new microelectronics technology. The introduction of the new technology is not only creating unemployment but also pressure for a shorter working week, earlier retirement and job-sharing. These factors would create more leisure time and, in turn, could lead to an increased demand for consumer products.

An increase in leisure time could stimulate the demand for leisure goods and services which, in turn, could produce more employment in those industries which are involved in leisure. These would not only involve people engaged in manufacturing goods per se but also those people providing services. However, the demand for these goods and services will be limited by the spending power of the unemployed and, if they are paid an allowance which is at or near the subsistence level, then there would not be much surplus available for spending on leisure activities. It is interesting to note that, in this respect, the jobless in Britain do not appear to do particularly well. Lipsey (1982) has produced figures, which are shown in Table 6, suggesting that spending on benefits and health in this country lags behind that of many other Western Industrialised countries. It is also worth noting that money given in benefits to the unemployed is, in general, spent and not saved, thus putting money into the hands of the unemployed tends to stimulate the consumption of industrial products. Another important point which should be considered is the effect that the level of unemployment benefit has in the social sense. Resentment at being unemployed would be

Table 6 A comparison of Welfare Benefits in different Industrialised countries in terms of percentage of national income spent on social security benefits and health.

Country	Benefits	Health	Total
Sweden	29.7	8.3	38.0
Netherlands	26.6	8.6	35.2
Denmark	23.3	7.4	30.7
France	22.5	7.2	29.9
West Germany	22.4	5.7	28.1
U.K.	16.3	5.4	21.7
U.S.A.	12.9	9.0	21.9
Japan	8.6	4.4	13.0

(Source : Lipsey 1982)

expected to be greater if there is a large gap between the living standards of those who have a job and those who do not have a job. However, to look at things another way, if present attitudes to work and unemployment remain as they are at present, then those who are working could well resent the fact that the unemployed are having a similar income to themselves. As part of his panacea for unemployment resulting from the microchip, Clive Jenkins, leader of the powerful trade union, the Association of Scientific, Technical and Managerial Staff (Jenkins and Sherman 1979) has suggested that the unemployed should be paid slightly less than the national average wage, but failed to grasp the nettle and give his readers some idea of how much less he had in mind.

Further aspects of the relationship between leisure and work

The relationship between leisure and work is complex and, in most cases, the two are closely related in helping determine the pattern and quality of a person's life. On a simplistic level, it is possible to consider factors such as tiredness as being part of the relationship and, for example, if a person becomes excessively tired at work, it impairs his leisure time and vice-versa. At a more sophisticated level, Fromm (1956) has attempted to analyse the relationship between the quality of a person's experience at work and his leisure time. Fromm has suggested that a person who is working without a genuine involvement is impaired in his ability to make free use of his leisure time, since in many ways he is a passive and alienated consumer. This author sees such people as consuming newspapers, sports activities, television and so on, their task being manipulated and conditioned to

want things which are offered to them. The work of Fromm could clearly be extended by studying advertising and the general effect of the media on governing people's desires.

A related theme is that of social control and it is possible to look at some leisure activities as agents of social control. If we look at sport, as one of the most popular forms of leisure activity, one of the basic features of it is that a participant has to accept the rules of the game and obey them. In team games, a referee or umpire is charged with administering the rules and dissent from his opinion or interpretation is forbidden. Furthermore, sport is essentially a competitive activity which introduces children to some of the competitive aspects of life. Children are also taught that the rules are implemented in a fair and neutral way; this can be seen as preparation for accepting the rules of society and accepting that those in power will interpret them in a similar fashion.

In Britain it has become widely accepted that work is the main plank of life and that work has a type of inherent virtue. This can be considered to be a Puritan ethic, but it is worth noting that it is also a communist ethic and, in some communist states, such as some of those in the Eastern Bloc , the work ethic has been adopted into their political philosophy. The belief that work has an inherent virtue is important, because it also suggests that not to work is in some way reprehensible. Furthermore, the work ethic has had a considerable effect on our education system and, in particular, has steered education in the direction of preparing young people for work. That is not to say that education should not prepare young people for work but the real question

is, in fact, one of balance between educating for work and educating in the broader sense, according to the ideas of very liberal thinkers such as Rousseau.

Work is not an easy term to define in a universally acceptable way. There are features of work which can be readily identified, such as the occupation of time, and payment for one's labour, but other facets, such as job satisfaction, and companionship at work, may be more difficult to define. A person who is occupied with work which he enjoys and derives satisfaction from may have some difficulty in identifying everything he does at his place of employment as work per se, since there may be an element of leisure in it. In other words, job satisfaction can, for some people, blur the boundaries between work and leisure. In addition, we must consider the fact that one person's work can be another person's leisure time activity or hobby, and that, particularly in the case of people such as professional sportsmen, can also be their leisure time activity.

Work also affects leisure by setting certain financial or time limits upon it. Clearly, long hours of work and a low level of income put greater restrictions on leisure time activities than a short working week and a high income. Other factors, such as shift work can present difficulties in timetabling leisure activities.

An interesting way to look at leisure is to see it as something which can compensate for deficiencies associated with work. According to Parker (1980), sociologists and psychologists who have studied work have concluded that the opportunities for creativity and self expression

at work are less than they used to be. Though this author does not specify why this is so, it is reasonable to assume that increased automation and the increased deployment of machines have tended to de-skill certain jobs and that pressures to increase productivity and output have reduced the social satisfaction in some places. The reduced level of job satisfaction may also be related to the frequency of industrial disputes and time lost from work. Two possible approaches to this problem are either to improve the quality of the work or to use leisure to try to compensate for some of the deficiencies of work. Both approaches have inherent difficulties associated with them. Modern methods of production in industrial settings are becoming increasingly automated, and the role of the human operator is being reduced and the scope to make jobs more interesting in many cases being reduced. It is difficult to encourage a productive use of leisure time, partly because of the ingrained attitudes on the virtue of work and the tendency to educate for work, rather than for leisure.

Unemployment

Some reference to the relationship between leisure and unemployment has already been made in this chapter. Unemployment without question produces plenty of free time, but whether this is actually spent in the pursuit of leisure time activities per se is another question. Unemployment is usually regarded as being most unwelcome in that it denies government revenue in lost taxes and payment of state benefits, it represents an increased tax burden to those who are in employment and also a tax burden on employers through increased taxation. Furthermore, unemployment may be linked to increases in crime and to the mental and physical health of those affected.

In another way unemployment is related to the economic and political power of those who wish to sell their labour and those who wish to hire labour. The employer, who purchases the labour of the proletariat, is in a position of power by virtue of his inherent influence as the employer who controls capital and is the key figure in decision making processes. The organisation of labour into trade unions which are, in turn, associated with political parties, has taken away some of the power of the employer. In this country there is a balance between the power of employers and the power of their employees, with a variety of "front organisations" which could, in the broadest sense, be seen not only to include the employers organisation, the Confederation of British Industry (CBI) and the Trades Union Congress (TUC), but the main political parties, since the Conservative Party and the Labour Party have traditionally been class and attitude based. One of the factors which has a marked effect on the balance between employer and employee which has been discussed above is unemployment. At times of labour surplus, the position of the purchaser of labour is strengthened and this can lead to a deterioration in wages and conditions. Perhaps the attitude of less enlightened employers was personified by H.M. Government in 1982, when it decided that it was not necessary to offer civil servants under twenty years of age any salary increase, as there were so many unemployed young people who would be grateful to have their jobs!

In times of economic recession, it is common for the employer to shed labour if demand for his product falls or, in some cases, to force through changes in work practices, reducing the demand for labour, which would normally be blocked by the trade unions. It is, however,

worth noting that, in some cases, there may be a tendency to "hoard" certain people with special skills which could be useful when demand for the product increases. Reductions in overtime or short-time working are sometimes used as devices to hoard labour at a reduced cost to the employer, or, in some cases, at no cost at all.

Some unemployment is created as a direct result of a fall in demand and in extreme cases bankruptcy of the whole firm. In these cases, the bargaining position of the worker usually varies between weak and futile; even the "sit-in" has faded as an effective gesture. However, the situation is slightly different when management wishes to reduce its labour force by doing the same amount of work with fewer people, usually by introducing more sophisticated equipment. Sometimes the introduction of new machinery is the only way to save the firm and this tends to reduce the bargaining power of trade unions who are engaged in negotiating redundancy payments, pensions, early retirement schemes, etc. Where automation is introduced into a healthy firm with the main aim of improving an already profitable organisation, the power of those representing the interests of the worker is increased.

Some of the direct effects of the microprocessor on employment are discussed more fully in Chapter Four, but it is worth noting, again, at this point, that the introduction of the microprocessor is expected to reduce the demand for labour in many industrialised countries. Another important point to note is that the microprocessor is being introduced at a time of world economic recession and an onslaught from

developing industrial areas such as Korea and Taiwan, and so any unemployment created by the introduction of new technology is difficult to mop up elsewhere.

The effects of unemployment on people

In the introduction to this chapter, some aspects of the part played by work in a person's life were discussed. Work is not only a means of earning a living, but is also related to status in society and even more difficult to define areas such as self respect. Unemployment is not a new phenomenon and some parts of the country have traditionally had to suffer from high levels of unemployment, even at times of economic growth. In some areas of the country, twentieth century unemployment has become almost endemic; the North of England, Northern Ireland, Scotland and parts of Wales have traditionally suffered more than most. In the North-East of England, successive generations have grown up to accept unemployment as a way of life. Workers, such as those employed in the shipyards, have never enjoyed security of tenure, but have worked from job to job; for some, the joy of a launch was frequently tainted with the knowledge that unless another order was found they would be out of work. A further hazard for workers in the depressed areas has been the tendency for some national or multi-national companies to open factories in the regions at times of economic growth, only to close them at times of slump. This trend may have been encouraged by lucrative financial packages sponsored by local and national government (e.g. Community Development Project 1977).

At times of high unemployment the problems created receive more attention when it is low but the precise nature of the effects of unemployment are only poorly understood. An early study by Eisenberg and Lazarsfield (1938) identified three stages which an unemployed person passes through:

(i) An initial stage of shock, followed by active searching for a job; the individual is normally optimistic and not resigned to long-term unemployment.

(ii) If a job is not found, the person becomes pessimistic, anxious and distressed.

(iii) The person accepts his fate and has a "broken" attitude.

More recently, Sinfield (1968) has suggested that an analysis of the psychological and social effects of unemployment needs to recognise a wide variety of factors such as age, financial reserve, chances of re-employment, education, and the health of the individual should be carried out. A report which did examine some of these factors was, in fact, commissioned by David Ennals in 1978, when he was Social Services Secretary. However, the report by Dr. Leonard Fagin, a consultant psychiatrist, was published in a limited quantity of two hundred, which have proved difficult to obtain, despite protestations to the contrary by the D.H.S.S. Mr. Ennals (1981), quoting from the report, stated that:

> "The loss of a job can set in motion psychological changes which in some male breadwinners result in clinical depression with feelings of sadness, hopelessness and self-blame.
>
> The depression was accompanied by insomnia, loss or gain of weight, suicidal thoughts, impulsive or violent outbursts and an increased use of tobacco or alcohol.
>
> Wives of unemployed men might also become depressed especially if they too were unemployed. In addition to mental illness it has also been suggested that the job loss might also be accompanied by physical symptoms such as asthmatic attacks, skin lesions like psoriasis, backaches and headaches."
>
> (Fagin 1981).

Clearly, a report such as this arouses anxiety, especially when the present situation is considered. In 1982, there are over three million people officially recognised as unemployed (the official figures do not include those who would like a job but do not register as unemployed because they do not receive benefits, youths on government schemes and those who have opted for certain early retirement schemes), and the prospects of obtaining work are, for many people, bleak. Furthermore, there has not yet been anything to suggest that the rate of job loss is slowing down.

In addition to the suppressed report by Dr. Fagin, there have been some interesting press reports linking unemployment with suicide. For example, an article in the Daily Telegraph on the 28th August 1981 revealed how two youths, one aged eighteen, and one aged nineteen, committed suicide because they could not find work. The following day, an article by Charles Henn in the same newspaper catalogued six similar cases in the last year, where unemployment had been cited as a

reason for suicide. These included a twenty-two year old B.A. Honours graduate, a redundant engineering apprentice, a seventeen year old girl, and two young men aged twenty-three and twenty-four. The article quoted Samaritans in the North-East as saying that unemployment in the area was the main cause of depression and that there had been a sharp increase in the number of young people threatening to take their own lives.

Comments such as these by a respected voluntary organisation are particularly worrying at a time when the young jobless total continues to soar. In August 1981, following the annual school leaving, there were more than 5,000 youths on the dole in Newcastle and North Tyneside alone, with another 3,000 on the Youth Opportunities Programme. This combined dole-Y.O.P. total was almost thirty-two percent up on the previous year; the figures indicate that only a small number of school leavers had actually obtained jobs (Lorenz 1981).

Against this background of mass youth unemployment it is perhaps surprising that there has been little or no response from the schools. Pupils continue to be prepared for work and for jobs which do not exist. It is perhaps surprising that there are not more riots and suicides amongst our unemployed young people. Details of unemployment amongst school leavers from 1976 to 1981 are given in Table 8.

Table 7 Adult unemployed (seasonally adjusted) 1976-1981.

Year	Thousands out of Work	% Unemployed
1976	1,359.4	5.7
1977	1,483.6	6.2
1978	1,475.0	6.1
1979	1,390.5	5.7
1980	1,794.7	7.4
1981	2,733.8	11.3

(Source : Employment Gazette, January 1982, Vol. 90, No.1.)

Table 8 Unemployment amongst school leavers 1976-1981.

Year	Thousands out of Work
1976	85.9
1977	105.4
1978	99.4
1979	83.2
1980	127.1
1981	168.0

(Source : Employment Gazette, January 1982, Vol. 90, No.1.)

Some aspects of the relationship between leisure, education and unemployment

In the Western part of the world, education is usually associated with the development of intellectual and cognitive skills. A feature of our educational system has been that the major part of education is done in special institutes such as schools or colleges. Traditionally, our schools and institutes of higher education have taken the task of preparing children for gainful employment in adulthood seriously. In part, the content of the curriculum reflects the link between education and work and some skills are taught which are deemed desirable by industry and commerce; for example, traditional arithmetical skills. A further point which is worth noting is that schools also fulfil a social function and some sociologists have argued that schools are tools which are used to preserve the class-based nature of our society (see, for example, Bourdieu 1973). The examinations system has been seen by some sociologists of the Marxist schools as a means of depersonalised control used to preserve discipline within schools (Hargreaves 1979).

The use of automation has increased with the introduction of cheap microprocessor control units and, with it, there has been increased interest shown in the concept of education for leisure. As unemployment increases and there is more pressure for a shorter working week it is clear that some people have a vacuum in their lives which they have some difficulty in filling. It has been argued earlier in this chapter that our schools are presently concerned mainly with education for work, and with the inculcation of knowledge and attitudes which will prepare a person for work. When the work is not available certain difficulties are likely to be encountered.

One of the most dramatic manifestations of the effects of unemployment is that of street violence. In 1981, rioting by youths in Britain, in Brixton, and Toxteth, forced the nation to take note of the serious social pressures in some areas of the country, particularly those having high youth unemployment, economic and social deprivation and racial tension. In the wake of street rioting, Lord Scarman led an inquiry into the causes of the riots and made certain recommendations designed to prevent future disturbances of this type (Scarman 1981). The precise causes of the riots are difficult to establish, but one factor which did emerge was that, in the Brixton Area, unemployment amongst black youths under nineteen years of age was a staggering fifty-five percent, and that this contributed to the social instability in the area. Other factors identified as also being important in this respect were racial disadvantage and a high rate of family break-ups. Lord Scarman identified two important contributions to preventing this type of social unrest as preparing all our children, regardless of colour, for their life in Britain and education for leisure. It was suggested that leisure should not result in boredom or idleness, but in satisfying activity in sports or arts. It is interesting to note that Professor Edward Wragg, Director of the School of Education at the University of Exeter, when addressing a one-day conference, organised by a teachers' union, suggested that there could be worse to follow if training plans did no more than keep children off the unemployment register for two years (Wragg 1981).

Dramatic events such as street riots naturally attract much interest but it would be wrong to disregard some of the other possible effects which may be associated with unemployment such as the influence on health and tendency to suicide which have been discussed earlier in this chapter.

Education for Leisure

The British educational system can, in some ways, be considered to have practised some degree of education for leisure for many years in that activities such as sport and music have appeared on the curriculum. However, occurrences such as the riots in 1981, and the generally poor response to activities such as live theatre and classical music etc. by the majority of the working classes leads to doubts about its effectiveness. In this respect it is interesting to note that Lord Scarman cites the need for satisfying activity in sport or the arts without defining exactly what he means by arts. One possibility is that he had in mind some of the activities which have traditionally been considered to be of artistic merit. It is possible to suggest that some of these activities, such as drama and classical music are part of an elite rather than a working class culture. This may, in turn, be related to the fact that our educational system is still dominated by upper and middle class attitudes and values via, for example, the university dominated General Certificate of Education examination system. Basini (1975) has suggested that education for leisure may well reflect the norms and values of those holding economic and political power within a society and be elite orientated. This

hypothesis fits in with some other ideas developed earlier in this chapter, that the consumer may be manipulated or conditioned into wanting certain products or activities; those groups which control these processes are then in a position to gratify the needs of those who have been so conditioned.

In a discussion about the relationship between leisure and education it is important to take note of those features of the educational process which facilitate conditioning. From this point of view some members of the Marxist school of sociologists in particular would criticise some of the activities which are carried out in schools as tools of social control which are used to instil attitudes such as a slavish obedience of those in authority as tools of social control which are aimed at preserving the class-based nature of our society. Activities which encourage thought, and provide an interest in decision making policies can be seen as useful vis-a-vis leisure in that they may help students to make up their own minds about how to use their leisure time.

One possible way of helping people to use their leisure time is to expose them to educational experiences which will help them to develop the skills necessary to use it. These educational experiences need not necessarily be confined to vocational subjects, because even traditional academic skills can help by encouraging abilities such as decision making skills. It would not be prudent to suggest that schools should switch totally from education for work to education for leisure, but it would seem sensible to move towards a better balance between the two. Education for leisure is not easy and Roberts (1970) has pointed out some of the difficulties:

(i) The problem of developing values which pupils can use throughout their future lives.

(ii) Technological and social changes make it difficult for schools to predict what skills, attidues and values will be need in the future.

(iii) Many recreational activities cannot be fully appreciated until a certain degree of maturity has been attained.

(iv) The emphasis in schools is often different to that in life. For example, in games, the emphasis at school is mainly upon participation, but in adult life, more people watch sport than compete in it.

(v) Less successful pupils are sometimes alienated from certain activities because they associate them with school.

Similar concerns about the difficulties faced by schools in attempting to educate for leisure have been expressed by Simpson (1973). At a time of rapid technological change and social change which the widespread introduction of the microprocessor threatens to bring, it is even more difficult for schools to predict what skills, attitudes and values their pupils will require in their future lives.

The educational system in this country is in a constant state of flux and new ideas and innovations are incorporated into our educational institutions. Schools, which are the foundation of the educational system, are subjected to pressure for change from a variety of sources. Some pressure for change may come from society in general, or may be of an endogenous origin, stemming from those working in the education system. Changes may occur for direct educational reasons or, in some cases, may have their origins in socio-political factors.

Schools are charged with the responsibility for preparing pupils for adulthood and an important aspect of this preparation has been developing the knowledge and skills which will enable the individual to work and earn a living. The activities which occur in schools are, therefore, closely related to the needs of industry and commerce, in which many of them will find employment and in the wider sense of society in general.

At the present time, industry in Britain is facing radical change in view of the challenge posed by an important piece of new technology - the microprocessor. The microprocessor is one of the most powerful items of technology ever to appear. It is small, cheap, reliable and adaptable to a wide range of industrial and commercial applications. The microchip, or microprocessor, is expected to have dramatic effects on society; for example, by producing mass unemployment and by increasing the time available for leisure.

Education in Britain and elsewhere in the Western world has been linked to work and, in many cases, has been an essential

prerequisite to it. Work in our society has an important sociological role. Work provides money, which is used not only to provide life's necessities, but also to buy the luxury items which are related to a person's status in society. People without work have traditionally had a low income, a low standard of living, and low status in society.

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CHAPTER FOUR

THE IMPLICATIONS OF THE MICROPROCESSOR REVOLUTION FOR EMPLOYMENT.

Introduction

As part of a government drive to introduce new technology, 1982 has been designated "Information Technology Year". The term "information technology" is a relatively new one, and is an umbrella term for the goods and services related to computers and communications. Some idea of the importance attached to the project can be gained by looking at the fact that information technology even has its own Minister, Kenneth Baker, its own committee - the "1982 Committee", and a set of commemorative stamps.

Information technology depends primarily upon technology related to the silicon chip - often referred to as the microprocessor. In view of the importance of the microprocessor it is worth considering briefly what a microprocessor is, what it does, and how it has been developed.

An interesting account of the development of microelectronics is given by Marsh (1981a). The calculating engine developed by Charles Babbage (1834) was followed by the ENIAC machine which was built in Britain during the Second World War to help decode the messages produced by the German ENIGMA machine. This first electronic computer was a giant which weighed thirty tonnes and consumed immense amounts of power; its main components were electronic valves which were, by today's standards, unreliable and produced vast quantities of heat. The ENIAC machine was also expensive, costing about a million and a half pounds. A machine of comparable power today would be small enough to be hand-held and would cost under a hundred pounds!

In 1947, it was found that the valve could be replaced by a semiconductor known as a transistor; the most important semiconductor is silicon. The transistor was a big advance on the valve, being smaller, cheaper, more efficient and it did not produce large quantities of heat as it operated. By connecting together a series of transistors, resistors and capacitators on a single chip, scientists developed the "integrated circuit" and soon four or five components were appearing on a single chip. Today's microprocessor is a development of the integrated circuit, but as many as two hundred thousand components can now be mounted on a single chip. Equally important is the fact that these chips are cheap - only costing a few pounds - and versatile. It is not surprising that the microprocessor is being quickly incorporated into a variety of devices which are quickly being incorporated in industry and commerce; some of the applications are dealt with in more detail later in this chapter.

Some applications of microprocessors

The microprocessor has not only enabled 'clever machines' to be made, but it has enabled them to be made cheaply; this, in turn, has increased their commercial application. The cheapness of very sophisticated technology has opened up a large consumer market for products based on the microchip, and items such as digital watches, microwave ovens and video television games are now common. Microprocessor control units can also be fitted to other household items such as washing machines, refrigerators and clothes driers. Early microwave ovens, for example, had manual control knobs linked to timers which gave a crude control over the equipment. The manual controls can be replaced by a microprocessor, which enables a program to be followed such as defrosting and subsequent cooking. The motor car industry is now using microprocessors in ignition systems which require no maintenance and to control warning devices such as brake wear and oil levels.

In industry, the low cost of the microchip can be used to revolutionise production procedures. Many of the major motor manufacturers are now deploying microprocessor-based control units on an increasing scale. For many years, motor manufacturers have been using large mainframe computers to control certain aspects of production. In a typical plant, the computer would control the arrival of components so that each would arrive at the right place at the right time. The parts were then assembled - mainly using manual labour. However, the most recent plants are using a new generation of computers, those derived from the microprocessor and the large mainframe computer have now been

largely replaced by smaller microcomputers. These microcomputers can not only work in hostile environments, but are cheap and versatile. A new and sophisticated type of robot, controlled by microprocessors, can now carry out complex operations such as welding and paint spraying. These changes have increased the quality of the product and reduced costs but have displaced labour. An interesting point which is worth noting in passing is that the large mainframe computer controlled systems used by the motor manufacturers were so expensive that they were only feasible to use in large-scale operations and even when the system was installed, it was impractical to have certain jobs controlled by it. The low cost of the microprocessor and its versatility have made it worthwhile to put microprocessor control units into situations such as boiler control or flowmeters.

Microprocessors can produce savings in the time and cost required to develop new products and this facilitates the development of those items. Computer-aided design is now a common feature of many industries and cuts out a lot of time which would otherwise be spent in producing drawings and subsequent models. In the aircraft industry, designers put ideas into a computer and simulations on a screen and an assessment of their performance can be made. The next step is the actual manufacture of the object and here, again, the object can, in some cases, be fabricated via microprocessor-controlled equipment without any manual intervention. Sensors on the production machinery, again controlled by microprocessors, can inform the central processing unit of any difficulties and design corrections can be made.

In large industrial units it is now possible to produce an almost completely automated factory where the machines work alone with only a few controllers who monitor a control panel and perhaps sweep the floor. However, many factories of the future will probably not be completely automated, since the cost of totally removing all human labour can be disproportionately high. The real problem in producing total automation is the software, i.e. the programmed instructions for the machines, rather than the hardware.

The progress towards large scale automation has been rapid. About twenty-five years ago, machines controlled by paper tape began to appear; these included not only devices such as lathes, but also early robots. The use of paper tape as a medium for the storage of computer information was not very satisfactory and tended to make machines controlled by it slow, expensive and sometimes unreliable.. This probably accounted for their low uptake - only two and a half thousand in the world by 1966. Today, robots and other, similar, devices have a solid state electronic memory instead of a paper tape feed which increases speed, reliability and overall performance, and it has been estimated that, in 1978, the number of robots in the world had increased to over twenty thousand (Marsh 1981b).

A big stimulus for the introduction of the new technology related to the microprocessor was the American space programme under the auspices of the North American Space Agency (NASA) in the 1960s and 1970s. This space programme demanded accurate work without any defects and, when equipment was designed to work in space, reliability and size were of the

utmost importance. Following the success of the space programme and the spin-off from the technology developed, it has been estimated that the use of computers in industry has been increasing by a staggering forty percent a year (Ruzic 1978).

The application of computers in industry are clearly increasing, helped to some extent by agencies such as the Technical Utilisation Group of N.A.S.A., which was formed to spread space technology to other industries. The '1982 Committee' formed in Britain as part of Information Technology Year has, as one of its main roles, the encouragement of the use of new technology, i.e. microprocessor and associated products in industry and commerce.

The implications of increasing automation for labour and employment

Increased automation has, to a large extent, been accompanied by a process known as de-manning, i.e. shedding of labour. In the previous section, some important stages in the process of automation were highlighted. In the early stages of automation, machine tools were directly controlled by numerical control, via paper tape, but this was followed by the application of the computer to the design process. Computer assisted design was aided by developments such as the 'light pen' which made it possible to draw designs directly onto a cathode ray tube and from there into the memory banks of a computer; the light pen was, incidentally, another spin-off from the American space programme. It is now possible to go directly from design to fabrication via machine controlled by microprocessors. It has been pointed out that the production machines are linked to the design processing unit which enables adjustments in design to be made as a result of observations made during manufacture; this represents an important step towards what is sometimes referred to as a "thinking machine"

The application of automation linked to computers has been gradual in the 1960s and 1970s, but the increased use of microelectronics threatens to greatly increase their spread. The introduction of robot machinery was, in the past, limited, and they could only operate at a relatively low level of sophistication. The robots were limited, to a large extent, by their lack of ability to respond to environmental changes. This meant that robots tended to be designed for a specific job and were not adaptable to other applications; this tended to make them expensive and

confined them to big volume establishments. The microprocessor promises to make robots more flexible and to enable equipment to be produced which will be adaptable to a wide variety of different uses and which will be sensitive to environmental changes. The latest robots are, in some cases, very sensitive instruments, capable of very delicate tasks. In America the General Motors Corporation, in conjunction with Unimation, has developed a robot which does jobs such as screwing in electric light bulbs to care instrument panels. This robot, known as PUMA, works to an accuracy of 0.1mm.

Early American designed robots began to penetrate the British market in the 1960s. These early robots were of somewhat limited application since they needed special development. By the mid-1970s, the first fully teachable British robot (RAMP) had been developed and the Norwegian designed paint-spraying robot (TRAUFA) was being widely deployed in situations such as motor car factories. Warnecke and Schrafte (1974) studied the deployment of robots in Europe and found that, in the whole of Europe, only about eight hundred units were in use; their main applications are shown in Table 9.

Improvements in the cost and performance of microelectronics have greatly increased the potential deployment of robots. In particular, robots can now be made much more versatile and more cheaply, so that it is becoming possible to buy a robot "off the shelf" and then program it to fit specific requirements instead of having a robot specially built for a specific job. This is opening up the market for robots, to small and medium sized industries. The introduction of microprocessor-controlled equipment brings advantages of cost and reliability and, in some cases,

Table 9 Applications of Robots in Europe in 1974

Application	Percent use
Coating/Spraying	21
Welding	20
Pressing	15.5
Injection moulding	11

quality. The most important applications of microprocessor-controlled devices are the controlled movement of materials and products; the control of process variables and operating conditions; cutting. mixing and welding ofproducts, and quality control and other related functions such as design, stock control and despatch of completed products.

Microprocessors are particularly important in controlling logical tasks such as industrial processes which operate in a fixed, linear way. Computers have been used to control these logical processes for a number of years, but microprocessors enable greater sophistication to be built into control systems.

Microprocessors, then, are comparatively cheap to make, are reliable in operation and versatile, but there are some factors which tend to limit their rate of diffusion. One of the most important of these factors is "hidden costs" such as programming and development to meet specific user requirements. Another limiting factor has been the lag between the development of microprocessors themselves and the peripheral devices needed to supply them with information and act on their commands. Furthermore, suitably trained personnel are needed to operate the new machinery. This last point has important connotations for those who are involved in education, since they are providing the educational experiences of the next generation of workers.

The relationship between the adoption of the new technology, related to the microprocessor and the demand for labour is by no means straightforward. The simplistic view is that the introduction of new technology simply displaces labour and leads to redundancy, but this is

not always the case. Even when labour does become redundant, some of the surplus labour may be retained for cosmetic reasons, or to placate union pressure until natural wastage and retirement reduce the workforce in due course. Natural wastage is sometimes hastened by offering the so-called "golden handshake" to those willing to become redundant and/or accept early retirement. The government would appear to tacitly support these schemes and there are special tax exemptions for those who receive moderate golden handshakes.

If technological innovation occurs within an expanding market it can be argued that it may allow employment levels to be maintained and that displaced labour will be re-employed elsewhere. On balance, it appears likely that more jobs will be displaced by the introduction of new technology than will be gained and new measures to combat unemployment may need to be introduced. Amongst the measures suggested have been a shorter working week, job sharing, and earlier retirement. On this latter point it is interesting to note that, in France, the socialist government has announced plans for earlier retirement. In this country the most comprehensive proposals put forward to counter the threat of mass unemployment have been put forward by Jenkins and Sherman (1979); these are discussed in more detail later in this chapter.

An important point to note is that the replacement of labour by the microprocessor will not be confined to the blue collar worker on the shop floor, but will also affect white collar staff and management. A microprocessor can, for example, undertake tasks such as cash flow which are, at present, the prerogative of middle-management.

The introduction of new technology does not only affect the numbers of jobs available but the types of jobs, the distribution of jobs between different industries and the types of jobs available within those industries. One way of looking at this is to look at how employment in different industries has changed. At the beginning of the eighteenth century, about ninety-two percent of the labour force worked in agriculture, but improvements in farming machinery and the movement to the towns had reduced this to twenty-one percent in 1851, and only fourteen percent in 1871; today, only about three percent are involved in agricultural activity. Marsh (1981c) has put this another way, and suggested that, during the Industrial Revolution people moved out of the primary industries, such as farming and fishing, into the secondary industries, which include mining, manufacturing and construction. At the same time, a tertiary sector of service industries grew up. Figures cited by Marsh suggest that, by 1950, forty-six percent of workers were employed in the service industries and that, by 1978, this had risen to fifty-seven and a half percent. Data from the Department of Employment in their report, "The Manpower Implications of Microelectronic Technology" (1979), indicate that in Britain and the United States employment in the service industries has risen steadily this century and has been accompanied by a decrease in those employed in the manufacturing industry. Stonier (1979) has suggested that by the end of the twentieth century only about ten percent of the population will be employed in the manufacturing industry with most of those who are involved with this activity being employed in the capacity of information operations. Stonier suggests that modern productive systems no longer

depend upon land, labour and capital, but on information; it is the growth of knowledge which is displacing most of the labour. It has been suggested that processes such as factory farming and intensive building techniques have freed large amounts of land and that, in the future, novel techniques such as bacterially produced protein, will further decrease our dependence on conventional farming.

Stonier further argues that the history of technology suggests that major changes in technology are sometimes accompanied by massive changes in societies; for example, the development of the deep plough of Northern Europe in the Middle Ages and much Dutch wealth was created by the drainage of the polders. The new employment in the wake of the microprocessor might be in the knowledge industries; the problem in Britain at the moment is that labour is concentrated in the manufacturing industries and that these jobs are being displaced by the new generation of industrial machinery periferating from the development of microprocessors.

Stonier suggests also that the most sensible way of switching employment from the manufacturing industries is to channel resources into education, since this is labour intensive and would, therefore, provide many jobs. It would also keep people, especially youngpeople, off the labour market and would, in some cases, increase the suitability of those being educated for employment in the new information industries. This is an interesting suggestion, but one which is open to question. In this country, there have been successive increases in the school-leaving age, but this has not always produced commensurate benefits for the pupils or their teachers. The leaving age was raised to sixteen in 1973 and, since then, many teachers have experienced problems of boredom and indiscipline

with their fourteen to sixteen year old pupils. This problem may have been exacerbated by inadequate funding and resources. At a time of economic crisis, as is faced by this country, a compulsory influx of bored, unemployed youngsters, without adequate funding would not be welcomed by those employed in education.

By January 1981, unemployment in Great Britain had soared to just under two and a half million and, at the corresponding time in 1982, had exceeded three million. The unemployment crisis appears to be worldwide but has risen exceptionally quickly in Britain. Some of the factors which have led to this crisis have been discussed earlier but include factors such as increases in oil prices, competition from developing industrial countries, and the new technology. In this country the problem is exacerbated by the fact that a peak in the birth rate in 1964 is now working its way through the system and there is now a resultant peak in school leaving. Some of the relevant demographic facts are shown in Table 10.

The demographic evidence also suggests that the falling birth rate of the 1970s, which is already affecting the school population, will, in due course, reduce the number of people entering the labour market.

Exactly how many people are unemployed is a question of some controversy. The official unemployment figures record the number of people who are registered as out of work. There are also people who are unemployed in that they would like to work but who do not sign on the unemployment register, since they do not obtain any benefit for being

Table 10 Live births in England and Wales 1960-1980

Year	Number of Live Births
1960	785,005
1961	811,281
1962	833,136
1963	854,055
1964	875,725
1965	862,725
1966	849,823
1967	832,164
1968	819,272
1969	797,538
1970	784,430
1971	733,155
1972	725,440
1973	675,953
1974	639,885
1975	603,445
1976	584,270
1977	569,259
1978	596,413
1979	633,018
1980	656,234

(Source : Birth Statistics 1980, Series FM1 No.7,HMSO)

unemployed; many married women fall into this category. In December 1980, the TUC estimated that at that time there were over a million unregistered unemployed people; so the true unemployment figure at that time would be three and a half, rather than two and a half, million. It is difficult to accurately predict exactly how many people like the non-registered married women are actually unemployed. An interesting analysis by Showler and Sinfield (1980) was based on the General Household Surveys. In years of low unemployment such as 1973 and 1974, non-registrants would have added another forty-three percent but, in 1979, an additional twenty-five percent declared that they were unemployed. Showler and Sinfield also suggest that some sympathetic doctors may keep people "on the sick" where poor health, disability and previous long-term unemployment condemn them to further unemployment and lower rates of supplementary benefit than sick pay. Sherman (1978) estimated that, in 1978, the official unemployment figures underestimated unemployment by at least six hundred thousand. The official figures do not include people who are temporarily taken off the unemployment register by schemes such as the Youth Opportunities Scheme; in 1978-1979, these schemes accounted for almost another two hundred thousand people (Manpower Services Commission figures).

Effects of microprocessors on employment

The introduction of microprocessor into industry and commerce seems likely to produce both changes in working practices and in the actual numbers of people employed. There are two main bodies of opinion on the impact that microprocessors will have on the number of people employed. On the one hand, there are optimists who believe that the microelectronics revolution will create new products and new jobs in the same way that an industry has grown up around the motor car; but, on the other hand, there are others, who believe that microprocessors will lead to mass unemployment. There are also important economic considerations which must be taken into account such as government revenue which is lost when a person is unemployed; this includes not only the payment of unemployment benefits but lost revenue in taxes.

Another important aspect of the economic significance involves factors such as the value of the pound on world markets, balance of payments problems, and inflationary or deflationary policies pursued by the government of the day. When a government follows deflationary policies, such as limiting public sector borrowing, placing restrictions on credit and increasing taxation, this tends to increase unemployment. Reflation would, therefore, appear to be an attractive alternative and, in fact, reflation does tend to reduce unemployment; but there are sometimes unpleasant economic repercussions such as high levels of inflation and, sometimes, balance of payments problems.

At times of reflation extra money is put into circulation; sometimes this money is borrowed and is sometimes simply "printed". In

recent years, the extra money in circulation has not been used to stimulate British industry, but to buy imported manufactured goods from other industrial nations in Europe and increasingly from Japan. This, in turn, tends to lead to balance of payments problems. A further problem which bedevilled the Heath government of 1971-1974 was that the extra money in circulation was not used to stimulate industrial investment but was used to finance property speculation. The idea of Budget Deficit Financing has not been accepted in some economic circles and the so called "monetarist" ideas of those such as Professor Freeman have been adopted in both Britain and the United States. The main plank of the monetarist argument appears to be that tight controls of public borrowing and spending will reduce inflation, which is seen as the main economic problem to be tackled. Once inflation is controlled and the deadwood is pruned from industry, then economic revival should follow, and unemployment should show a concomitant fall. It is interesting to note in passing that Professor C. Freeman, in a paper delivered at Birkbeck College in May 1978, suggest that job displacement, even without the introduction of new technology related to microprocessors would, in Britain, reach five million by 1990.

British goods compete in a world market and, in order to sell these goods, they must be competitive in terms of both price and quality. The use of new technology to control advanced machinery, such as robots, is essential in keeping prices in line with those of our industrial competitors and also from the point of view of quality, since machine produced items tend to be of a higher and more uniform quality than those produced by human operatives. The dilemma is this: if new technology

is introduced, British goods remain competitive, but less human labour is required to make them, and if the new technology is not introduced, then British goods become uncompetitive and cannot be sold and labour is, in consequence, displaced. The microprocessor can, in some ways, be seen as a means of protecting some jobs which would otherwise be lost.

An interesting report, produced by a team from Manchester University (Green et al., 1980), suggested that the effects of the microchip on jobs in the Salford Borough of Manchester would not be as severe as first feared. Over a thousand firms were interviewed and employers were asked to estimate how many jobs they feared were at risk because of the microprocessor. In most areas of employment, between three and ten percent of jobs were believed to be at risk but, in the textile industry, losses could be as high as forty percent, with another twenty-three percent at risk in the clothing industry. In real terms this would mean between 680,000 and 2,200,000 more people becoming unemployed. If the current level of unemployment is taken as three million, it can be seen that, if the worst fears of the Manchester team are realised and the microchip caused ten percent of jobs to be lost, this would bring national unemployment to over five million.

Jenkins and Sherman, in their book, "The Collapse of Work", looked at possible job losses on an industry by industry basis and suggested that developments in microelectronics and associated factors could lead to job losses of three million, eight hundred thousand (or seventeen percent) by 1993 (on the basis of employment figures in 1978, when the labour force was listed as 22, 365,700). Details of their predictions

are given in Table 11; but what is interesting is that they are in the same order as those derived by extrapolating the results of the Manchester team. Clearly extrapolating data from a small area such as Tameside to the whole country should be done carefully with full appreciation of the limitations involved in exercises in extrapolation of this nature.

Sadler (1980) has reviewed some aspects of the microelectronics revolution and has pointed out that in countries such as Britain a process of de-industrialisation has been taking place for a number of years. This process of de-industrialisation has been a shift in the pattern of employment from manufacturing to service industries. Some of the ultimate effects of de-industrialisation have been discussed in detail by Kahn et al. (1977). Before 1975, losses in manufacturing industries were made up for by increases in service industries such as education and health. Since 1975, this has failed to happen and unemployment has tended to rise.

Between 1951 and 1977, manufacturing industries lost four hundred and fifteen thousand jobs, with almost seven hundred thousand lost in agriculture, and over five hundred thousand in mining and quarrying; at the same time, health and education gained over one million, six hundred thousand jobs, with almost two million being gained in private services such as insurance and banking (Hines and Searle 1979).. These figures suggest that over two million jobs have been lost between 1951 and 1977. Another report (Caits 1978) has suggested that two million jobs have disappeared from British industry in the ten years 1969-1979.

Table 11 Prediction of job losses by the year 2003

Year	Predicted Labour Force	Number of jobs lost	Percentage of jobs lost
1978	22,365,700*	--	--
1983	21,340,000	1,000,000	4.6
1993	18,560,000	3,800,000	17
2003	17,140,000	5,200,000	23

* Actual labour force in March 1978.

(Source : Jenkins and Sherman, The Collapse of Work, (1979), p.123).

Table 12 Some predicted job losses in clerical work.

Task : Country	Prediction	Source
Office Equipment W. Germany	40% office work carried out by computerised equipment by 1990	Siemens Internal Report, cited by Dangelmayer(1978)
Banking and Insurance France	Staff to be reduced by 30% by 1988	Nora and Minc (1978)
Local Authority Clerical tasks Bradford	Word Processors produced 50% staff saving	Hines and Searle(1979)
"Information Workers" (order entry, data processing accounting and stock control Britain	2.6 million job losses by 1985; 3.9 million by 1991	Hines and Searle, p.14 from ASTMS Report(1978)
Banking and Insurance Britain	500,000 jobs will be lost	Hartley (1978)
U.K. Offices Britain	250,000 jobs by 1983	APEX Report

(Constructed from data in Hines and Searle 1979, pp.14-8).

Employment problems are exacerbated by the fact that the birth rate in the prosperous early part of the 1960s was high (see Table 10) and many of those born in the bulge years are just entering the labour market.

It would seem that from 1951 till relatively recently the jobs which were lost in the manufacturing industries were matched by new ones in the service industry but this trend has now been halted and is, in some cases, being reversed. One of the main effects of microprocessors may be to increase the rate of job losses in the service industries. This view has been examined by Gershung (1978) who has suggested that instead of purchasing services the consumer is now tending to buy goods to perform services. This, of course, creates employment in manufacturing industries but this will be offset by the use of microprocessor controlled equipment to make these products.

Sadler suggests that the present levels of unemployment are due more to a loss of economic confidence than the introduction of new technology. This author also suggests that a greater threat to jobs in Britain is posed by developing industrial nations than the introduction of new technology. In countries such as Taiwan and Korea, people are prepared to work longer hours and with lower wages than in western countries and they are prepared to accept new technology without argument as labour is not organised into effective trade unions.

Microprocessors will not only affect job numbers but the type of work which will need to be done. One aspect of the introduction of devices such as microprocessor controlled robots is that some jobs tend to be de-skilled. Similarly, word processors greatly reduce the need for

Table 13 Major job losses and gains in employment 1951 - 1977

Industry	Job losses	Job gains
Agriculture	688,000	
Mining/Quarrying	517,000	
Manufacturing	415,000	
Construction/ Utilities	653,000	
Health and Education		1,648,000
Banking/Insurance Scientific Services		1,878,000
TOTALS:	2,273,000	3,526,000

(Source : Constructed from data in Hines and Searle 1979, p.11.)

trained typists. It has been suggested that microelectronics might improve the quality of work by removing elements of human drudgery and some of the dirtier and more dangerous tasks, but it should be noted that this may not be true in all cases. By de-skilling jobs microelectronics may actually make some jobs more boring and repetitive than they are at the moment.

Access to computing facilities

The first computers were not only large and unreliable but they were also very expensive and could only be afforded by governments. As prices began to fall, especially after the introduction of semiconductors, they fell within the price range of large companies and large public organisations such as the police force and universities. Microprocessors have now reduced the price of microcomputers to a few hundred pounds. A microcomputer is small in size but many of the microcomputers available are very powerful computers, capable of very sophisticated work. In addition to microprocessors, which can be purchased at home, it is possible to link up via a telephone line with a central computer and gain access to large data banks. One example of such a service is that offered by British Telecom with its "PRESTEL" service. In March 1982, the Minister for Information Technology announced plans for a massive investment in the installation of cables into private homes; this would enable those with the cable facility to take a variety of cable-television services, but also allow them to communicate with remote computer data banks. The main trunk cables would be of the fibre-optic variety, with cheaper co-axial cable being used to link private homes to the trunk routes.

The microcomputer and facilities such as PRESTEL open up access for powerful computer facilities and information banks to a wider section of the general public than ever before. Access to information at the moment is largely via books, but in the future, more and more information may become accessible only via computers. Access to information is

crucially imported to both individuals and society as a whole because it is linked to power; some of the relationsips between knowledge and power have been discussed in Chapter One. In our future society, computer literacy may become as important as conventional literacy is at the present time.

Perhaps an analogy can be drawn between the advent of cheap, printed publications at the time of the Industrial Revolution and the availability of cheaper computer facilities at the present time. At the time of the Industrial Revolution there was a clamour amongst the working class population for an education, which would enable them to read the new publications and communicate by the written word. It is not unreasonable to suggest that, in the future, it will be necessary for people to be computer-literate and able to communicate with a computer and also with other people via a computer, for example, by electronic mail. Schools will, in turn, need to prepare their pupils to meet the new requirements which will be expected of them.

If the schools fail to change, and fail to meet the challenge of preparing their pupils to use the new information technology, then the pupils will be at a great disadvantage in society. One obvious danger is that a gulf will develop between those who can use a computer and those who cannot, in the same way that there was once a gulf between those who could read and write and those who were illiterate. This could, in turn, lead to differences in power between these groups and changes in power could change the nature of society.

In some primitive societies work is unnecessary and people live on the fruits of nature. In our industrialised society people's standards of living and expectations are higher. If people's aspirations are not met, social problems at the level of the individual and for society as a whole, tend to follow. In Britain, the wealthy classes, principally the aristocracy and the landed gentry, have a tradition of not working. This they presumably find an eminently satisfactory lifestyle; they do not need to provide for their material needs and their upbringing has been such that they do not need to work to establish self respect. Thus we have the spectre of the "Bertie Wooster" type, who effortlessly spends his time in unproductive and idle pursuit but, nevertheless, retains his dignity. Society tends to regard the Wooster type with humour and affection, whereas the working class person who has no job has a low standard of living and if he indulges in unproductive and idle activity is looked upon as a layabout of the type epitomised by "Andy Capp".

In the previous chapter, some time was spent discussing the relationship between work and self respect and it was suggested that, for many people, particularly those in the working classes, the two go hand in hand. There is also evidence (see Chapter Three) that unemployment is linked to the health. It is perhaps somewhat ironic that one of the developments of microprocessor technology has been the medical program MYCIN. MYCIN has been used under experimental conditions for the diagnosis of physical illness, and it has been reported that patients found the machine more friendly, polite, relaxing and comprehensible that the average doctor (Card et al. 1974).

At the moment, work is for many people a social activity but, in the future, an increasing number of people may find it possible to work from home with the aid of a computer terminal. This could eventually lead to problems arising from social isolation.

For those employed in education it is worth considering the possibility that schools might disappear. Possibilities of learning from machines will be considered in more detail in Chapter Six but, for the moment, it is worth noting that learning from machines will be expected to increase. The early teaching machines,which followed some of Skinner's work, appeared in the 1950s and 1960s could only handle linear-type programs with certain fixed responses; these machines were of only very limited scope, but the new generation of machines with artificial intelligence could re-awaken interest in machine learning.

One of the main points which has been made in this chapter is that microprocessors will affect the number of jobs available and the nature of the jobs available. Work forms an important part of many people's lives; it provides income, it provides friendship and is, in some cases, linked to the self respect of the person. A major impact of microprocessors will be via employment. Microprocessors are already having a very direct effect on people and they are found in a variety of domestic appliances, watches and calculators and cars.

It is interesting to note that computers and similar devices are now becoming available to private individuals and that these may soon have an impact upon certain aspects of society. Cheap calculators have been available for a number of years, but relatively inexpensive

micro-computers costing a few hundred pounds can now be obtained. These devices have extended access to computer facilities to a wider band of the general public than ever before.

The main effect of the microprocessor seems likely to be via unemployment and it is to this which we now turn our attention.

Methods of reducing unemployment

Unemployment in this country has been increasing for several years and has been a source of embarrassment to successive governments of various political persuasions. One of the main measures which has been used to reduce levels of unemployment has been government job creation schemes. One of the most sensitive areas is that of youth unemployment and most of the money which has been made available for job creation schemes has been channelled in the direction of reducing youth unemployment.

In 1975, the first job creation scheme was introduced by the Labour government under the auspices of the Manpower Services Commission (MSC). It was assumed that unemployment would be a short-term phenomenon but, clearly, this has not been the case. Loney (1978) has put forward the idea that the MSC have approached the problem of youth unemployment primarily from the point of view that the young person coming onto the labour market finds that his greatest handicap is lack of experience and skills. It has been suggested by this author that the MSC approach has ignored the fundamental questions which are, how many of the young people bein g trained will be offered jobs at the end of their training period and how can long-term employment be provided. Furthermore, people are being trained for jobs which do not exist and being given skills which will never be required.

However, when the initial job creation schemes were introduced they were successful and have managed to reduce youth unemployment.

Cunningham (1978) has suggested that, in the spring of 1979, unemployment would be over seven percent without intervention schemes.

By 1978, the original scheme, far from being ended, had been extended and the costs of running it had risen to five hundred and thirty million pounds. At the beginning of the intervention scheme in 1975, the Temporary Employment Subsidy, a measure designed to encourage employers to retain workers who would otherwise be redundant, was designed to run for two years in the worst areas of unemployment but, by 1978, had been extended to cover the whole country and was keeping over four hundred thousand people in employment. (Employers who would have had to temporarily make ten or more workers redundant received a subsidy of twenty pounds a week for one year for every job which they retained; by 1978, 408,000 people benefited from the scheme.) Another measure to help reduce unemployment was the Job Release Scheme, which was intended to encourage early retirement.

When the Conservatives came to power in 1979 a new philosophy to job intervention became apparent and support for the job intervention measures of the Labour administration was reduced. Initially the Budget of June 1979 reduced the expenditure of the MSC by a hundred and ten million pounds. The Special Temporary Employment Programme had been intended by the previous government to provide over thirty thousand new jobs, but a cut of just over forty-two million pounds in the budget for the programme reduced the job target to between twelve and fourteen thousand. Further cuts in the MSC Training Opportunities Scheme (twenty-two million, three hundred thousand pounds), the budget of the Industry

Directorate (nine million, eight hundred thousand pounds) and reduced support for mobility of unemployed people from areas of high unemployment (two million, nine hundred thousand pounds), added to unemployment. A leaked government report from James Prior, the then Employment Secretary, proposed further cuts of three hundred to four hundred and fifty million pounds in the MSC spending programme from 1980 to 1983, with concomitant reductions in MSC staff. Reduction in the places offered by the Youth Opportunities Scheme (YOPS) would produce savings of fifteen to seventeen percent, and the Special Temporary Employment Programme would end. In addition, the Training Opportunities Programme would reduce its intake from seventy to forty thousand (Hencke 1979). It is interesting to note that, since this report was leaked, the employment situation has declined and even the Conservative government, committed to a policy of non-intervention, has been forced to introduce new schemes to try and reduce unemployment, especially amongst youths.

The latest scheme is the New Training Initiative Scheme (NTI) which has been announced by Mr. Tebbit, the Employment Secretary. In the White Paper which was published giving details of the scheme, we are informed that:

> "... a new and better Youth Training Scheme should be introduced to cover all minimum age school leavers by September 1983 ... Unemployed school leavers will be offered a full years training course."

The scheme, which will cost about a thousand million pounds a year will replace the Youth Opportunities Scheme and, under the terms of the scheme, the government will pay fifteen pounds a week to employers.

The new scheme has not met with universal acclaim and Kaufman (1982) has pointed out some of the worries felt about the scheme and its provisions. For example, this new scheme does not stipulate any training conditions which needs to be included and does not make it clear whether or not there should be a formal educational component. Kaufman suggests that civil servants are actually busy dismantling the mechanisms for training, by abolishing two-thirds of the Industrial Training Boards, and reducing expenditure in further and higher education. However, on the credit site, it should be noted that the government has announced that it intends to open thirty information technology centres to train unemployed young people, with about seventy more to follow later. These centres, according to the Minister for Information Technology, Mr. Kenneth Baker,will be integrated into the NTI scheme announced by Mr. Tebbit in the December of 1981. It is interesting to note in passing that these new centres are the result of a joint initiative by the Department of Industry and the Manpower Services Commission and that the Department of Education and Science, which might well have been expected to be at the forefront in helping to develop the new technology, is conspicuous by its absence.

Hines and Searle (1979) have reviewed the problem of youth unemployment on a worldwide basis and concluded that the problems faced by Britain are by no means unique. These authors point out that in France more than thirty-five percent of the unemployed are under twenty five years old and that the corresponding figures in the Netherlands and Belgium are approximately forty and thirty-five percent respectively. The United Nations International Labour Office Bureau of Statistics and Special Studies looked at data for fifteen European countries,

Australia, Canada, Japan, New Zealand and the United States and found that, in spite of job creation programmes creating twelve thousand six hundred jobs a day in 1977, one thousand nine hundred jobs were lost, and that the outlook for people under twenty-five had deteriorated everywhere (ILO 1978). The ILO suggested that internationally very little progress had been made with unemployment. The schemes worldwide would appear to concentrate on short-term measures and that, according to Hines and Searle (1979):

> "There would appear in the countries surveyed to be no real idea of how to provide sufficient paid employment for the whole workforce or equitably reduce the amount of work done per person."

Work Sharing : Early retirement and related measures

One of the most remarkable attempts which has been made to produce a workable package of measures to combat unemployment has been made by Clive Jenkins, General Secretary of the Association of Scientifice, Technical and Managerial Staffs (ASTMS) and Barrie Sherman, Director of the Research Department of the same union (1979). The scene for their comprehensive publication was set in 1978, when Barrie Sherman delivered a paper to a London Conference in which an outline of the measures which could be adopted for unemployment problems created by the new technology was given. In the first place, we could adopt a head-in-the-sand attitude and ignore the new technology; this would lead to mass unemployment, low growth, low productivity and low wages. Secondly, by introducing new technology we could have high unemployment, high growth, high wages, high productivity and high profits. The third

alternative,and the preference of the author,is to change the pattern of society's expectations in both physical and material terms. It should be noted on this latter point that the author is non-specific and does not make his intentions clear.

In their 1979 publication, "The Collapse of Work", Jenkins and Sherman expanded the earlier paper and produced specific proposals for dealing with mass unemployment. These authors point ut that work as a way of life first assumed importance at the time of the Industrial Revolution, and that the work ethic was originally a protestant value, but one which has since then been incorporated into the philosophy of communist states. They suggest that, if any change is to come, it must come from the schools; this point is discussed in more detail in Chapter Five. It is suggested in the book that certain behavioural phenomena such as vandalism, crime and racialism become more acute when unemployment is high. Jenkins and Sherman suggest that the educational system should respond positively and that the notion of schooling for life should assume increased importance and that we should begin to educate for leisure instead of simply preparing the child to accept industrial discipline and learn vocational skills. The proposals made to combat mass unemployment may be summarised as follows:

(i) A reduction in the working week

At the 1978 TUC Conference, the effects of microprocessors on employment and of a shorter working week on employment were discussed. In particular, the unions considered the effects of a thirty-five hour working week on employment. It is difficult to estimate how many jobs

could be saved by introducing a shorter working week. The Department of Employment Gazette (1978) estimated that between one hundred and five hundred thousand jobs could be saved, but Hughes (1978) has suggested that a thirty-five hour working week could save as many as seven hundred and fifty thousand jobs. Jenkin and Sherman (1979) have postulated that, for every two percent reduction in the working week, one percent more jobs would be saved or created. These authors suggest that, if nothing is done, unemployment could reach sixteen percent and the working week should be reduced to twenty-seven and a half hours. Jenkins and Sherman (1979) suggest also changes in the pattern of working, so that less days are worked each week, with a three-day week of eight hours a day by the year 2000. However, the CBI suggest that a reduction in the working week would cause more unemployment by making British goods even less competitive (Gooding 1978; Taylor 1978).

(ii) Increased Public Spending

This is part of the Keynesian approach of budget deficit financing and Jenkins and Sherman estimate that to fund for five million jobs would create a Public Sector Borrowing Requirement of twenty billion pounds (at 1979 prices). Other trade union leaders have taken a similar view; for example, David Basnett (1978) of the General and Municipal Workers Union would like to see some of Britain's oil revenue used to create new jobs, particularly in education, training and health.

(iii) A shorter working life

A shorter working life would clearly reduce the level of unemployment. In times when sex equality has become a passion with certain sections of the community, particularly with certain so called feminist pressure groups, it seems anachronistic that women should have a longer life expectancy than men, yet should retire earlier. This point was made in a very forthright manner in January 1978, when a petition signed by over a million people was presented to the House of Commons asking for a common retirement age of sixty for men and women, if they desired to retire at that age. The cost of the scheme at the time would have been high in terms of lost revenue and payment of pensions (two and a half thousand million at 1978 prices) and would have necessitated raising income tax by between five and six pence in the pound (Tickell 1978).

(iv) Sabbatical Years and greater educational opportunities

Jenkins and Sherman suggested that people should have regular blocks of leisure throughout their working lives, with a sabbatical year every ten years. Allied to this, the authors would like to see greater access to educational facilities for adults with the time and the finance being made available to enable them to benefit. It is suggested that people should be free to make two major changes in their careers and that they should be provided with the necessary resources. Jenkins and Sherman would also like to see more emphasis placed on education as a leisure activity coupled with more interdisciplinary teaching and specialist training in science and technology.

The main drawback with this scheme is finance, but it must be remembered that some of the costs would automatically be recouped as less people would receive unemployment benefit and they would also contribute money in taxation revenue. Work sharing, such as that found in the U.S.A. and Sweden (Boyle 1978), does not appear to have been a popular measure for unions or employers. The employees suffer from lower pay and employers have higher administrative and other costs; for example, two sets of tax returns, two sets of national insurance contributions and two sets of holiday pay. If unemployment is not to become even higher and remain at high levels, it would appear that future governments will need to consider very seriously the possibilities of introducing schemes which include at least some elements of the schemes outlined above.

Summary

Microprocessors and equipment controlled by them have become much cheaper in the last few years and have been increasingly deployed in industry and commerce. This trend looks like continuing and it is expected that microprocessors will be even more widespread in the future.

One of the most important aspects of the introduction of microprocessors is the effects which these devices will have on employment. Microprocessors will replace human labour in many work situations and this may have an adverse effect on the numbers of people employed. The precise impact of microprocessors is difficult to predict, but estimates such as those made by Jenkins and Sherman suggest that, unless vigorous measures to counter unemployment are adopted, persistent mass unemployment may become a feature of our society. However, some jobs will be created by microelectronics; it is difficult to predict how many jobs will ultimately be created. It must be remembered also that part of our unemployment problem is due to competition from developing nations and not from microprocessors.

A precedent for massive industrial changes which alter patterns, not just of employment, but of life, was established by the events which occurred during the Industrial Revolution; some of the details of important events are discussed in Chapter Two. While it is impossible to single out any particular event as a causative factor of the Industrial Revolution, the application of steam power had widespread ramifications. The application of steam power did, in fact, destroy many jobs, particularly

in the country, but new jobs were created in the towns. Some interesting details of the impact of steam-power on employment in agriculture are given in the recently republished classic work, "The Village Labourer" (Hammond and Hammond 1911). For example, it was reported that in one Parish near Canterbury there were twenty-three barns each employing fifteen men, but that all of these were thrown out of work by a threshing machine. The situation is different today because microprocessors are not contributing to industrialisation as did the spread of steam power, but to what is sometimes known as de-industrialisation, i.e. a shift from employment in industry to employment in service industries.

De-industrialisation has, in fact, been going on for a number of years, and data presented in this chapter suggests that there has been a steady drift to employment in the service industries which has, to a large extent, mopped up labour which has been displaced from manufacturing industry. However, in recent years, the service industries have not had the capacity to employ those displaced from manufacturing industry and due, in part, to economic recession, have begun to shed labour. Microprocessors may be exacerbating the situation, not only by displacing jobs in industry, but by displacing jobs in the service industries.

It has been assumed by many that most of the jobs displaced by microprocessors will be manual ones and it is true to some extent that the initial impact of their introduction has been borne by the working classes. As an example of those who seem to view certain "professional" jobs as safe from the encroachment of microprocessors it is interesting to consider the views of Hubbard (1980), who writes:

> "First at the top of the tree and sitting pretty in any scenario, come the highly qualified - the distinguished and learned professions such as accountancy, insurance, the Stock Exchange, commodity dealing and banking. In all these fields microelectronics may undertake the drudgery but the professional will keep his hands on the interesting and remunerative part."

It is interesting to note that this author excludes from his list of "distinguished and learned professions" those engaged in the presumably humble fields of medicine, religion and education. However, Hubbard's views appear to be rather naive and somewhat simplistic and why this author should consider that some of the glorified clerical workers in his "distinguished professions" are safe is difficult to see. The new generation of what are sometimes called "intelligent machines" would appear to threaten occupations of this type - especially those grades at the level of middle-management and below more than most. Even the medical practitioner, who is conventionally held in high esteem may find himself threatened by developments in microprocessors and computer science (Card et al. 1974).

Education will need to adapt to changes in the needs of industry and society as a whole. Education for leisure has become a popular theme but it must also be remembered that people will need new skills in a society influenced by microprocessors. Possible educational responses to the microprocessor revolution are discussed in Chapter Five. It would be nice to see a positive and early response from those involved in education to the challenges posed by the introduction of the new technology.

* * *

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CHAPTER FIVE

EDUCATIONAL APPLICATION OF MICROPROCESSORS

Introduction

In Chapters Three and Four it has been suggested that microelectronics will have a major effect on the way we live in the future. The ready availability of cheap and reliable microprocessors has encouraged their incorporation into a wide range of domestic products, which are in general, everyday use, both at places of work and in the home. The spread of microprocessors and devices controlled by them is also expected to have an effect on the number of jobs available and some aspects of this were discussed in Chapter Four. These changes will be expected to have an influence on society and the educational system will be expected to respond to these changes in society and perhaps to prepare their pupils for a lifestyle which is different to the one we experience today; it has been suggested in Chapter Three that education for leisure is likely to assume increasing importance.

Changes in schools such as those described above are not the only ones we are likely to see in the wake of the microprocessor revolution. Microprocessors can have a very direct effect on schools because they can be incorporated into a variety of devices which can be used in a variety of learning and instructional situations. Perhaps the most dramatic and widespread changes so far have been produced in response to cheap and, in some cases very sophisticated, electronic pocket calculators which are now available. There have been those who have doubts about the wisdom of encouraging children to use electronic calculators, but the Cockcroft Report (1982) suggested that the use of

calculators has not produced any adverse effects on computational ability and that every child should have access to one for their lessons at school. This official blessing for calculators is impressive when it is considered that the devices have been available at reasonable cost for only about ten years. It is interesting to speculate as to whether or not an inquiry ten years from now will be recommending that every pupil should have access to a microcomputer for all his lessons.

In this chapter it is intended to trace some of the events which have occurred in the last twenty to thirty years which are relevant to issues related to the intrusion of microelectronics into the teaching situation. Thus some attention is given to the earliest mechanical and electro-mechanical teaching machines, the use of mainframe computers and, finally, to the microcomputers which are available today. It is not the intention to concentrate simply on developments in the "hardware" but to examine some of the educational principles underpinning the use and deployment of electronic teaching aids.

Application of computers to the learning situation

At the present time there appears to be a rush to push forward with the introduction of microprocessors into schools. In 1981 the Department of Industry announced a four million pounds scheme to put a microcomputer into every school which did not have one, but the grant has been extended to allow schools already possessing computer facilities to extend their systems. There is also pressure to put microcomputers into the primary schools (Makins 1981). While the Department of Industry presses on with plans to get microcomputers into schools, the Microelectronics Education Programme for England, Wales and Northern Ireland, funded by the Department of Education and Science, which started work in 1981 with its stated aim of:

> "... to help schools prepare children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive,"

continues to try to formulate a basic strategy. Doubts about the liaison between the Department of Industry and the Department of Education and Science have already been expressed (Thorne 1982). It is worth examining the events which preceded the Microelectrics Education Project and also to look at educational theory which is relevant to the use of computers in the educational process

1. Early learning research in Britain with computers

In Britain, some early research into the applications of computers to the learning situation was carried out under the auspices of the National Council for Educational Technology (NCET) which was wound up in 1977.

The NCET drew up a programme which aimed at developing and securing the assimilation of computer assisted and computer managed learning at a reasonable cost. The project began in a humble way, but grew, so that in his final report, the Director of the project, Richard Hooper (1977), was able to report that almost fourteen thousand students were involved and suggested that computers would play an increasingly important role in the learning experience. Hooper suggested that part of the reason why this may happen is that the computer is as versatile as the teaching machine was restricted and is not tied to any pedagogical theory.

At this point it is worth noting the distinction between two related, but different, roles of the computer in an educational setting; that of providing information and that of education. Computer assisted information (CAI) implies a rather simplistic application of a computer to provide information only, whereas computer assisted learning (CAL) suggests a more complex approach in which learning theory has played an important role in formulating the learning experiences to be presented.

Some of the early applications of computers to the learning situation which followed the Skinner-type teaching machines were often geared towards the dissemination of information rather than learning and the Carnegie Commission on Higher Education (Rockhart and Scott-Morton 1975) concluded that:

> "Computer assisted information has been overemphasised. In the areas of learning where it is applicable, other technologies dominate along the relevant dimensions. The primary target of opportunity for the computer in Higher Education is in "enrichment activities". For almost all kinds of material, problem solving games and simulation can provide the learner with better ways of integrating and testing the knowledge he has acquired

> than other available technologies. It follows that the impact of computer assisted learning will for the most part be adding to rather than replacing current learning mechanisms."

There is a clear emphasis here upon learning and this is clearly reflected in references to "problem solving", "simulation" and "testing the knowledge he has acquired". A contemporary study by Jamieson et al. (1974), who compared evaluation studies in schools, concluded that computer assisted information is no more than equally effective as traditional instruction. It is worth noting the reference here to computer assisted information, a technique which few would even consider using in schools today and "traditional instruction" which is the authors' term for traditional teaching and learning and a term which perhaps they would have been wiser not to use in this context.

2. Application of Learning Theory to Computer Aided Instruction and Computer Assisted Learning

An essential prerequisite to any form of computer-based instruction or learning is an evaluation of the aims and objectives of the exercise followed by a strategy to implement them. The computer can be used in a variety of ways in the learning situation and some of these have already been alluded to. Computers can be used to give information, but they can also be used for testing and problem solving. Testing to see whether information presented has been learned can be done very efficiently, but perhaps a more important application is in the solving of problems. Problem solving is an important procedure because it does not only give an idea of how much information has been learned but indicates if that information has been understood and if the learner is capable of applying it in new situations.

Hooper (1977) has looked at some of the applications of learning theory to computer assisted information and computer assisted learning and has identified three broad groupings or situations which he has termed paradigms, referring to them as instructional paradigms (i) the instructional paradigm, (ii) the revelatory paradigm and (iii) the conjectural paradigm.

(i) The instructional paradigm: Hooper sees the instructional paradigm as being related to the early drill and practice programmes of some American and British projects such as the Leeds Statistics Project and the CALCHEM Project (the latter was funded from 1974 to 1978 by the National Development Project and since then has been financed by the Council for Educational Technology. A full review of the Project has been made by Aynscough 1979).

Hooper suggested that projects which fit into the instructional paradigm are based on Skinner's ideas of operant conditioning in which the reinforcement of responses leads to the student performing increasingly complex tasks. The instructional paradigm is underpinned by the premise that the knowledge which a student requires can be specified in language and learned via the medium of verbal messages.

An important aim in the instructional paradigm is the acquisition of knowledge. The information which is to be presented to the student is carefully selected and structured in a hierarchical order and the student is required to respond at intervals. The computer gives a fast feedback to the

student's responses; this not only provides motivation but it reinforces desired responses. Learning projects of this type tend to follow a linear pattern based on programmed instructional texts. The computer puts the pages onto a screen and responds in a sophisticated way to the responses made by the student.

It is interesting to note that Hooper suggests that the ideas of Gagne and Glaser are compatible with the instructional paradigm.

(ii) The revelatory paradigm: The revelatory paradigm is related to data handling and simulation of situations rather than with the acquisition of knowledge. Projects which are included in this paradigm are the Glasgow Medicine Project and the Engineering Science Project.

The educational psychology of the revelatory paradigm is suggested by Hooper as being more closely related to the work of Bruner than that of Skinner. Key ideas or concepts in certain areas are gradually revealed to the learner and the learning experiences provided by the computer are intended to close the gap between the structure of the subject and the structure of the student's knowledge of it. The student is led to discover for himself ideas and concepts and the computer is the vehicle which provides the opportunities for discovery and experiences. The computer can subsequently be used to provide information and practice in handling that information. The flexibility of the computer can permit the simulation of new experiences.

When a computer acts in this manner, it is in some ways taking over part of the role of the teacher. Not only does the computer act as a source of information but it can be used to provide a rich and stimulating environment in which learning can occur. An interesting project, reported by Makin (1982), allows children to explore an ancient Egyptian site, using "... a proper archaeological mix of strategy, academic research and serendipity". The program is said to have produced "astonishing work". It is also worth noting that by linking a microcomputer to a remote data bank a large amount of information and programs can be made available. Prestel, for example, provides a large data bank and if a teletext decoder is incorporated into the computer it is possible to copy programs to the machine's memory from a source such as this.

(iii) The conjectural paradigm: The conjectural paradigm is useful in situations such as modelling and computer science and projects which would be classed in this category include the Computational Physics Teaching Laboratory at the University of Surrey and the London Business School Management Decision Making Project.

The conjectural paradigm is based on the idea that knowledge grows with experience and develops as a psychological and social process. Hooper suggests that Piaget's ideas are consistent with this view of the learning process in the sense that he supported the concept of adaptation through interaction with the environment and also with Popper's idea that progress is made by a series of conjectures and refutations.

> Projects included in the conjectural paradigm emphasise understanding and use the process of making conjectures and subsequently attempting to refute them as tools to accomplish this end. The computer is used to create models, plans and conceptual structures which are then explored by the learner.

Before deciding to use any form of computer assisted information or learning it is important to understand the underlying educational principles which are involved. Hooper's (1977) concept of the three paradigms is useful, because it gives some guidance as to the type of program or "software" which is most applicable to a particular situation. The teacher who wishes to utilise a computer as part of the learning experience of his pupils should consider the underlying educational principles which are involved before trying to either write a program or use other people's software. One of the dangers of using software prepared by another person is that the underlying principles of it may not be understood by the user and this could limit the benefit his pupils gain from the package. Taylor (1982) has encapsulated this nicely when he points out that the user of pre-prepared software should ask "What learning model does the software reinforce?" Particularly apposite was the question raised as to whether or not young minds were to be regarded as programmable chips, electronic tabula rasa that needed to be plugged in and programmed. This author's comments on software are discussed later in the Chapter, but it is worth pointing out that programmes in the mould of paradigm (i), the instructional paradigm, would be those most likely to be criticised as having the intention of

programming young and formative minds. The educational possibilities of learning are also worth considering in the light of a recent claim that pupils are not taught how to learn in schools (Schools Council 1981); perhaps the paradigms could be applied here in order to promote the understanding of the issues involved.

A more detailed consideration of the implication of educational theory for computer assisted learning and computer assisted information

In the previous section it was suggested that, before embarking upon any programme of computer assisted learning or computer assisted information, the teacher should be in the position of understanding the educational theory on which it is based. It was suggested that Hooper's three paradigms offered a basis for identifying the educational theory associated with different types of computer assisted learning and computer assisted information.

Of all the educational theorists the work of Skinner has probably had more influence on computer assisted learning (and, some would argue, computer assisted information) than anyone. Before a machine can be used to perform any function it is necessary to analyse the task and then specify certain parameters and instructions. In a learning situation, this is very difficult, but Skinner made a major contribution in the field of task analysis and also focussed attention on entry and terminal behaviour in the learning situation. Skinner noted that the behaviour of the learner was more important than the behaviour of the teacher, and suggests that, by selectively reinforcing certain responses, the individual could be guided towards certain specified ends. Skinner was, therefore, concerned with what is sometimes called operant conditioning and the main tool was differential reinforcement and successive approximations towards mastering a task.

In this approach to learning, the learning of a concept involves presenting a set of stimuli to which a student makes a response which is

subsequently reinforced. The learner encounters alternative responses or discriminations and a chain of responses can be built up. It is important to note that the Skinner-type approach lends itself best to a linear program, where one step follows another in a fixed logical sequence; the linear program does not permit divergent thinking.

Gilbert (1962) has extended some aspect of Skinner's work, particularly on behavioural analysis (operant conditioning) and has suggested that the responses in a chain should be brought to mastery retrogressively. This means that prompts are progressively withdrawn from the last response, followed by the penultimate one, and so on. Gilbert argues that the last response is the one which is most easily reinforced and is most directly linked to the "reward" of successfully completing the task.

A particularly useful aspect of Gilbert's work has been that he has analysed in detail some of the tasks involved in completing certain mathematical manipulations; he has coined the term mathetics to describe his system of task analysis. This concept of task analysis is very important in programmed learning because, before a machine (in this case, a computer) can be utilised, it must be given precise parameters on which to act. This can be compared to the situation where a teacher in the classroom who wishes to present his pupils with a learning experience; sometimes he may spend time analysing his task in a purposeful and deliberate way, or may intuitively analyse the task. As an example of mathetics, Gilbert has analysed in very precise terms the steps involved in doing a long division.

Gilbert sees his system as a systematic application of reinforcement principles to the analysis and re-synthesis of the complex pattern of behaviour which make up knowledge and skill. In this system, the principle of mathetics have formalised the procedures of task analysis. The problem for those writing the programs are, therefore, deciding what experience the student needs in order to understand a topic, and how the conditions in which this learning can be arranged in order to facilitate it.

A further feature of Gilbert's work is his views on motivation. He has suggested that if a student is to learn, then the results of mastery of the topic should be made known to him. In a program designed on the mathetics model the aim is to arrange conditions so that the desire to learn will be controlled and encouraged. In other words, the program will simulate the role of a good teacher and capture the alert interest of the learner and maintain it throughout the lesson or learning experience. Gilbert suggests that it is naive to believe that the satisfaction of completing a task will itself provide sufficient reinforcement for adequate motivation.

The main steps involved in writing a mathetics program are as follows:

(a) Task Analysis : an analysis is made of the required behaviour.

(b) Learning prescription : a provisional scheme of learning experiences is decided upon.

(c) Characterisation : this consists of the identification of responses and stimulus situations which would facilitate learning followed by deciding upon specific ways in which it can be done.

When these three steps have been completed, the actual program can be written. A mathetics program usually has three phases:

(a) Demonstration : this is the presentation of information.

(b) Prompted response : prompts and cues are given to stimulate the required response.

(c) Released response : here, the prompts and cues are withdrawn and the student performs on his own.

More recently, Gilbert (1967) has refined his ideas to include diagnostic procedures for systematically identifying training needs. This is a useful idea since a computer cannot be used as a power tool for teaching only, but can also be a powerful aid to diagnosis. Gilbert distinguishes between accomplishment (the value of what has been learned) and acquirement (what has been learned) and has introduced the concept of a performance deficiency. According to Gilbert, there are two forms of performance deficiency; that due to a lack of knowledge (which he has suggested can perhaps be improved by training) or due to inherent deficiencies which prevent the individual from carrying out the task (training will have little or no effect).

Gilbert's work follows a clear behaviourist line, but is useful because it gives a practical guide to some of the tasks faced by a person

who wishes to produce a learning program. The links with Skinner's ideas is clear, but some of his ideas (for example, of task analysis) would be useful to those who wished to base a program on, for example, the ideas of Bruner or Piaget, which would fall into Hooper's revelatory and conjectural paradigms respectively.

The work of Skinner and that of Gilbert had elements in them of what some would call training, and it is interesting that Gilbert himself, when considering his "performance deficiency", suggests that some could be corrected by training, whereas others could not. In his first paradigm, Hooper also included Gagne, but the work of Gagne was much more concerned with learning in the sense of understanding than that of Skinner. Gagne's work is particularly useful to teachers who are concerned with the development of concepts. In some subjects such as sciences concepts are often built up on a series of multiple discriminations. These multiple discriminations may, in the case of science subjects, be based on the results of experiments possibly involving a heuristic approach. In order to establish a concept it is necessary to generalise within a class of related stimuli and to discriminate between this class and other classes. From concepts, principles can be established (i.e. groups of related stimuli). In the classroom, it is one of the tasks of the teacher to devise a strategy which will enable his pupils to chain together concepts in order to establish principles. Gagne (1963) has suggested that the following stages are pre-requisites for learning a principle:

(a) The learner should be informed about the nature of the task he is expected to perform and told what he is expected to do.

(b) The learner can now be encouraged to recall the concepts which will eventually be used to make up the principle.

(c) Cues are used to help the learner chain the concepts together to establish the principle.

(d) The learner is asked to give examples of the principle.

(e) The learner is asked to make a verbal statement of the principle.

Learning often involves a change in a pattern of behaviour and, in order to bring about a change in the pattern of behaviour, the learner needs to be motivated. Gagne has suggested that the learner must first of all display a willingness to enter into the learning situation (Bruner would call this willingness to enter into the learning situation 'activation', which needs to be followed by maintenance if the task is to be completed). Secondly, the brain must be alert to the learning situation.

When a computer is to be used in a learning situation it must, therefore, stimulate the student (i.e. activation) to make the desired response to the stimuli which he is about to be exposed to. It is worth noting here Gilbert's (1962) views on the importance of motivation in which he suggests that progress through a program is unlikely to provide sufficient reinforcement to lead to completion; he recommends informing the learner of the consequences of mastering a task to provide further stimulation. It is interesting to note that in the area of computer

assisted learning the views of learning theorists of various shades of opinion can sometimes be used together to develop a more composite type of approach to certain aspects of a problem such as motivation.

Writing a computer program for use as part of learning experience can be seen from this discussion to be not simply a question of learning a computer language but of applying basic educational principles, at least as rigorously as in a normal teaching situation. The person who writes such a program must first come to terms with the nature of the learning process - not an easy task. The work of educational philosophers and psychologists is important because they offer an insight into the learning process. An appreciation of the work of theorists such as Skinner, Gagne, Bruner and Piaget can be considered to be an essential pre-requisite to meaningful work involving computer assisted learning. The work of Hooper (1979) is useful because it acts as a link between the educational theorists such as the psychologists and practical computer programmers.

Learning can, in some ways, be considered to be an active interaction between the teacher and the learner. Gagne's pre-requisites for principle learning as discussed earlier in this chapter illustrate this point; the learning process begins with the teacher informing the learner of what is required of him and ends with the teacher asking the learner to make a verbal statement of the principle. When a computer is used as a teacher, the pupil interacts with the machine in the same way. Kemmis (1976) has refined the idea of interaction between the computer as a teacher, and the learner, and has identified five types of interaction

which follow a hierarchy based on their complexity. These interactions range from simple recognition interactions (for example, multiple choice or Yes/No items) to constructive understanding. The types of interaction are:

Type A (recognition) : The learner examines the information and has to say if he has encountered the information before; in other words, he has to decide whether or not he recognises it.

Type B (recall) : The learner is asked to recall information, but not necessarily to demonstrate that he understands it, since the recall could be of the "learned by heart" type.

Type C (comprehension) : In this case the learner is required to manipulate information and to construct concepts or principles. However, the manipulations are, generally, within the limits of the information which has been presented. This is probably the most popular type of computer interaction employed in computer assisted learning.

Type D (intuitive understanding) : This involves developing more sophisticated cognitive skills such as problem solving.

Type E (constructive understanding) : Interactions of this type are related to original thinking and involve procedures such as the formulation and testing of hypotheses.

The paradigms and the types of interaction are loosely related to one another in that they are both slightly different approaches to the

problem of relating learning theory to its practical application in computer assisted learning. They are also useful to some extent to the more usual teaching situation in the classroom, since they help analyse the learning process by formalising some of the things which a teacher often does intuitively. Furthermore, learning by computer is not necessarily an easy option or a trouble-free process, but one in which difficulties arise in the same way that they would in the classroom.

For example, a basic problem encountered by both a teacher and a computer engaged in the learning process is that of language and language related problems have been studied by several workers such as Barnes (Barnes et al. 1969 and 1971) and Chomsky. Bernstein has made some interesting observations on the role of language in learning and also as a tool of social control. Bernstein (1977) has suggested that there are different speech codes for different classes. It is suggested by Bernstein that languages can be context tied or context independent and that context tied leads to what is referred to as a restricted code and context independent leads to an elaborated code. Certain areas of knowledge are only available to those with an elaborated code, and power is related to access to certain knowledge. It follows from this that power, knowledge and language are closely interrelated. Bernstein makes the point that the class sytem limits access to elaborated codes (and therefore to power). According to Bourdieu (1966), schools are not a liberating force, but one of the most effective means of perpetuating the existing social pattern, treating social inequalities and cultural heritage as natural phenomena. The point which it is intended to bring out here is that learning is related to language, and

that power is related to knowledge; power and language are, then, related to each other. Before a person can gain access to knowledge and power, they must possess certain skills related to language. Further aspects of the relationship between social control and education have been reviewed by Davies (1970).

In order to learn from a computer and to communicate effectively with it, it is necessary to speak the language of the computer; in many cases this will involve learning a whole new vocabulary such as that used in "BASIC","FORTRAN" and"COBOL". Those who do not speak computer language may be denied access to information in a similar way to that in which people having a restricted code (Bernstein 1977) are at the present. Those people who are not computer literate will also be denied access to power, if it is accepted that knowledge is related to power.

It is also worth noting that the use of computers is sometimes related to power in a very direct way when they are used to store information on individuals for a corporate body such as large government departments. A particularly worrying feature is that several computers can be linked together to produce a very complete profile on a person. A new police computer being installed in London in 1982 is believed to be intended for this task and will be used eventually to gather and correlate information from sources such as the Department of Health and Social Security and the Driver and Vehicle Licensing Centre. No doubt it will also link up with the computers presently being installed by H.M. Tax Inspectorate in due course.

The uptake of computer assisted learning in schools has, according to Trigger (1981) been slow, and he attributes this to unsuitable or insufficient equipment and poor software packages. To this must be added concern about the training of teachers in this area, such as that voiced by the European Democratic Group of sixty-three Conservative members of the European Parliament, who suggested that a shortage of qualified staff was "a major obstacle" (European Democratic Group 1981). It is worthwhile examining some of the problems associated with this in more detail:

(i) Provision of Equipment

In many secondary schools the first provision of computing facilities for schools was via a telephone line to a large, remote mainframe computer. In Newcastle upon Tyne, for example, secondary schools had access to the computing facilities of the local Polytechnic, via telephone lines. This was a rather unsatisfactory arrangement for a variety of reasons, the worst being the unreliable nature of the telephone connections and the slow response of the computer at peak times. These problems were exacerbated by the fact that there were insufficient terminals to allow each secondary school to have a terminal permanently and so they were rotated from school to school. The heavy use and mechanical damage this arrangement entailed caused hardware problems with the terminals. An arrangement such as this was clearly most unsatisfactory.

A range of cheap microcomputers is now available and most secondary schools, aided by the Department of Industry initiative, should have one

by April 1982. The Department of Industry scheme limits the choice of machines to the Research Machine 380Z (£1,680) and the BBC/Acorn Atom (£260). The 380Z comes as a sophisticated systems package, but the Acon Atom is a basic machine which can be expanded when financial constraints permit. The most popular school microcomputer seems to be the Commodore PET and, according to McGee (1981) there were about three thousand of these machines deployed in schools. Other popular machines are the Tandy TRS80, the Apple and the low priced Sinclair ZX81. The range of machines available is large, and while all suffer from some disadvantages, they are all of high quality.

It is interesting to note that, according to Trigger (1981), the introduction of high quality microcomputers such as the "PET" or "APPLE" have not resulted in computer assisted learning because, in many cases, they have been syphoned off in the direction of computer studies, have been hogged by enthusiasts, and that teachers have been ignorant of computer assisted learning. He also suggests that poor quality software is also a major problem; some of these aspects are examined in the next sub-section (ii).

(ii) Poor quality Software

The quality of "hardware" (that is, computers and their peripheral devices such as cassette and disc storage systems and printers available) is good and they are low priced, but there would appear to be problems with the software (programs) available for educational use.

(a) Choice of Language

One of the fundamental problems would appear to lie with the choice of computer language. A computer language is a vocabulary of key words and rules which enable computers to be given instructions. A language should enable a program to be written which will carry out the required task. There are many different computer languages because no language yet devised has been able to deal satisfactorily with all possible demands which might be made of it in different situations. Different languages have, therefore, been developed with specific applications in mind. Some of the language difficulties, with particular regard to the educational context, have been examined by Atherton (1982). In many science applications FORTRAN (Formula Translation) is very popular and in business settings COBOL (Common Business Orientated Language) has been widely accepted. In 1965, a new language, known as BASIC (Beginners' All-Purpose Symbolic Instruction Code), became available. BASIC was intended as the name suggests to be a straightforward language, aimed at novices.

In order to make BASIC a language suitable for beginners, the vocabulary was kept short with a relatively easy notation. To help correct errors in the program, operating and editing instructions were included. BASIC has proved to be a very popular computer language and is the most popular choice in schools. However, BASIC does have its critics, and Laski has described BASIC as an educational and an intellectual disaster. Atherton (1982) has suggested that the lack of structure in BASIC can lead to poorly structured and tangled programs in which essential concepts of problem analysis may not be properly acquired. This author sees one possible solution as the introduction of variations of BASIC, known as STRUCTURED BASICS. The most popular versions of the STRUCTURED BASICS are American Standard Basic (ANSI BASIC),

OPEN UNIVERSITY BASIC and COMAL. Edgar (1981) has also looked at problems associated with the use of BASIC, and concluded that BASIC encourages poor program structure. Edgar suggests that PASCAL would be a better alternative for educational use, since it does encourage good programming practice. However, PASCAL is a more difficult language to learn and is at present mainly used in universities, but Edgar suggests that it could be used at Advanced Level. A further problem with PASCAL is that few teachers are familiar with it.

An important step in developing computer literacy is the BBC computer literary project, which started in 1982. An important aspect of this project is that the language which has been chosen is a modified form of BASIC. Atherton (1982) suggests that even this modified form of BASIC is unsatisfactory because it leads to unsatisfactory presentation of programs, and is not a fully structured language. Peltu (1981) has suggested that it would have been better to orientate the project towards languages such as PASCAL or COMAL, which encourage better programming principles. Peltu has suggested that BASIC should be used as an introduction to programming, which could then be followed by experience in other languages, such as PASCAL, FORTRAN, ALGOL and COBOL.

The present situation of using BASIC as the principal computer language in schools would appear to be unsatisfactory in certain respects. The main criticism of BASIC is that it encourages poor programming practice. There are other languages available, such as PASCAL, but it would appear that these are initially more difficult to learn than BASIC, which could restrict access to computers to those of the highest ability.

(b) Software

The availability of relatively cheap microcomputers has ensured that most secondary schools in Britain should now have access to at least one of these devices, but their value will be reduced if there is insufficient, or only poor quality softward available. Thorne (1981) has suggested that the computer industry and the salesmen which it employs are more concerned with putting hardware - even unsuitable hardware - into schools than with developing the programs which would make them useful. Thorne suggests that all the commercially available software worth having in 1981 could have been purchased for thirty pounds. Sweeton (1982) has reviewed the curriculum software available for general subjects and has concluded that:

> "Many computer manufacturers claim to offer "educational" software but these claims should be looked at closely. Most of the material is rubbish ..."

This author suggests that even the most popular machines such as the PET or the APPLE have only dreadful software available for them.

To make matters worse, the software available elsewhere also appears to leave much to be desired. Sweeton suggests that the Schools Council "Computer in the Curriculum" material (APZ) is dated, unattractive, and a demonstration of what software should not look like. On the credit side, Heinemann are cited as supplying some good value programs with further useful programs being available from the Central Program Exchange based at Wolverhampton Polytechnic, the Micro Users in Education group (MUSE) and the Scottish Microprocessor Development Project.

A similarly dismal view has been taken by Taylor (1982), who cites the editor of an esteemed U.S. microcomputer software directory as saying that ninety-five percent of microcomputer programs should never have been written. Taylor suggests that many publishers of educational materials have prevented major educational text publishers from entering the market, and that those who have taken the gamble have cut costs in areas such as adapting programs designed for mainframe computers to microcomputers with unsatisfactory results. Part of the reason for the poor quality of educational software is said to be the fact that most of it has been written by professional programmers who know little about education, or by educators who lack expertise in programming. This author also cites the endurance of BASIC as a language as a limiting factor in good software production. In a useful article, Taylor has drawn up a list of criteria for judging the quality of software. This list does not only include topics related to the program itself, such as: does it work or not?, is it well documented? and, will it work on the school's machine?, but considers educational issues. A particularly important educational point which Taylor considers is "what learning model does the software reinforce?", in which he distinguishes between learning and training. Another very valid consideration raised by Taylor is, "what values does the software reinforce?". Computers can be such a powerful educational tool that questions such as ethics and moral values need to be carefully considered when a program is being written.

(c) Training

In addition to problems associated with the choice of hardware, software and programming language, many schools face the problem of staff who are insufficiently trained to teach children computing skills. The problem of the training of teachers already employed is difficult and is not helped by financial restrictions and attitudes of some headteachers, who are reluctant to release staff for in-service training in school time, as it disrupts the normal school routine. There are, sadly, some heads and local authorities who believe that in-service training is a fine thing as long as it is done in someone else's school and is paid for by another authority. The James Report (1972), which was published when more money was available for education, recommended greatly increased in-service training, but this was never implemented. With the introduction of microprocessors, the need for in-service training would appear to be greater than ever.

In order to train teachers in the skills needed to teach computing skills to their pupils, a massive training programme would appear to be needed (Hennessy (1981) has pointed out that it takes a minimum of one academic year's training to produce a trainee programmer who would still lack the skill to teach the subject and who would lack knowledge about systems analysis, data processing, and the social consequences of computers, all of which are included in current Ordinary Level and CSE syllabi.

The Microelectronics Development Programme, sponsored by the Department of Education and Science is to spend nine million pounds in

a four-year period from 1981, mainly on software development and training but, as pointed out by Thorne (1981), the Japanese spend more on microelectronics education in one year than we intend to spend in four. Even the Republic of Ireland, one of the poorest nations in Europe has made substantial funds available for an extensive series of in-service courses for training teachers in microelectronics education. Neville (1981) has reported that the Director of the Microelectronics Education Project hopes to have provided appropriate training for half of the United Kingdom teachers in a three-year programme. However, he does not give details of what exactly he means by the term appropriate and, as Thorne (1982) has pointed out, the Microelectronic Education Programme has done little to keep people informed about what progress is being made. Some of the deficiencies of the scheme have been reviewed by Thorne, who points out that, apart from the lack of information about progress, the provision of facilities varies from region to region. In Wales, for example, the regional centre at Cardiff is only open from nine till five and is four or five hours drive from remote parts of the principality, whereas in London, the centre is open till nine in the evening and is within easy travelling distance.

Despite the resources and efforts allocated by the Microelectronics Education Projects, doubts must remain about the quality and the quantity of training being offered to teachers. Training would appear to remain a poor relation, with more money being made available for hardware than to train teachers how to teach their pupils how to use it.

(d) Application of microcomputers to help those with special needs

An interesting application of microprocessors is to help those with special needs, such as severe disablement. Doe (1981) has reported that a pilot programme in Walsall has been successful in using microcomputers to help severely disabled children. A program has been devised which enables disabled people to write by activating a light-pressure switch - even, if necessary, by blowing down a tube. The normal computer keyboard, which resembles that of a typewriter, has been adapted for the young and disabled, and a "primary keyboard" created. This primary keyboard has twelve large pad switches which can be covered by an overlay of a word or picture.

It has been suggested in an article in the "Technology" column of the New Scientist (30.7.81), that computers can help disabled people onto a learning curve. At a school for physically handicapped people in London, an APPLE microcomputer is in use, and a pupil with a cerebral palsy who has a normal brain, but cannot manage to coordinate limb movements, has been able to use a foot-controlled switch and a program called ETCHA-STRETCHA to produce pictures. Another device used at the school, which is known as MAC (Microcomputer Answered Communicator) enables disabled people to write. A switch such as a foot switch can be used to guide a light spot to a matrix of letters on a screen. When a letter has been selected, it can be used to make up words or sentences. This system is to be extended by allowing whole words to be selected in the same way.

Marsh (1982) has reported that, as part of Information Technology Year, a two million pound scheme is to be initiated to provide computerised aids for the disabled under the auspices of the Department of Industry. There are several elements to this scheme, including plans to adapt standard machines such as an APPLE or a PET to the needs of the disabled by providing suitable interfaces - perhaps of the type used in Walsall or of the MAC variety used in London. A special multipurpose MAVIS machine for disabled people was developed in 1979 at the National Physical Laboratory, but needs more development before it will become commercially available. Microcomputers could also be used to enable the disabled to work at home, for example writing programs, and could also be used to provide information to the disabled from a central file. Officials at the Department of Industry are said to be keen to develop a teaching aid for retarded children known as "TURTLE". This device, the brainchild of researchers in artificial intelligence at Edinburgh University, consists of a piece of hemispherical plastic mounted on two wheels, which is controlled by a microcomputer. By fitting a felt-tipped pen to the TURTLE device, drawings can be made.

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CHAPTER SIX

IMPLICATIONS OF THE MICROPROCESSOR REVOLUTION FOR THE CURRICULUM.

Introduction

One of the features of our educational system is the presence of "the curriculum". Various definitions of the term "curriculum" are available and most practising teachers associate the term with those activities related to learning which occur in the school. Hirst and Peters (1970) have defined the curriculum as:

> "... a programme of activities explicitly organised by teachers in a school as a means by which pupils may attain through learning a set of objectives desired by pupils."

There are, however, difficulties with definitions of this type such as defining objectives and then attempting to measure them. Furthermore, there has, in recent years, been some interest shown in what is known as the "hidden curriculum". Illich(1973), for example, has suggested that we need to distinguish learning from schooling, which means separating the humanistic goal of the teacher from the impact of the invariant structure of the school. It has also been suggested by Illich that this remains beyond the control of the school and conveys the impression that what is not taught in school is of little value, and what is learned outside the school is not worth knowing. Illich suggests that the hidden curriculum is always the same regardless of the size of the school, or the curriculum or, for that matter, the country. The hidden curriculum is clearly very difficult to express in tangible terms.

Education does not occur in a political, economic or social vacuum and each of these factors exerts some effect on the educational system; the curriculum is also related to these factors. In Britain,

responsibility for the curriculum of an individual school rests nominally with a Board of Governors or Managers. These generally allow a good deal of freedom to the headteacher whose professional judgement is an important factor in this area. However, it is worth noting that the appointment of staff is controlled not by the head alone but by Boards of Governors, albeit advised by the head and local inspectors. At the highest level, the appointment of the head teacher is also controlled by the Board of Governors of the school, and it is reasonable to assume that the appointment made will reflect the political and philosophical atmosphere at the time. Headteachers may, however, survive for much longer than Boards of Governors and the head may not always be in total agreement with them.

Development of the Curriculum

The development of the curriculum is an interesting area of study and one in which there are constant changes. Some of the earliest stages in the development of the curriculum in state schools have been examined in some detail by Gordon and Lawton (1978). These authors suggest that the period 1800-1833 was marked by conflicting groups and issues arising from events such as the Industrial Revolution and the French Revolution. The Industrial Revolution effectively broke many of the feudal ties and some of the privileges of a socially superior aristocracy, but this did lead to some social problems. The gentry had not only had power over their workers, but also had responsibilities to them; the Industrial Revolution changed this relationship, and industrialisation tended to mean that employers and workers were only linked by money. The new order was, of course, the subject of intellectual thought at the time and their views influenced not only industrial, but also social and educational development at the time.

There were perhaps two major philosophical viewpoints at this time. On the one hand, there was what may be termed a "Laissez faire" attitude, represented, for example, by Adam Smith, who saw the main concern as efficiency. Another group whose aim has been described as "utilitarianism" were represented by intellectual heavyweights of the time such as Jeremy Bentham and John Stuart Mills; the utilitarians were, in the simplest terms, concerned with providing the greatest amount of happiness for the greatest number of people. At the beginning of the nineteenth century they supported the monitorial system, reform

of secondary education and the establishment of a non-denominational University in London. In order to preserve order and stability they advocated different schools and curricula for different social classes. For all classes it was believed that the curriculum should contain useful knowledge and John Mills wanted to develop powers of reason.

When state schools were first established, there was a rigorous control over the curriculum. The Revised Code of 1862 limited the ability of the managers of a school to claim grants for their pupils to allowances for those pupils who reached pre-determined standards in reading, writing and arithmetic. This control was gradually loosened and other subjects crept into the curriculum on a larger scale. Furthermore, the inspection system changed and eventually it was the schools which were inspected and not the individual pupils.

The influence of the Board of Education declined when it ceased to be responsible for controlling the educational standards in elementary schools, but they, nevertheless, continued to produce model syllabuses.

The Elementary Code of 1904 stressed the emphasis on the behavioural aspects of education and not just the acquisition of knowledge. This emphasis on behaviour may have been linked to the needs of industry and commerce, where habits of obedience, hard work and the unquestioning acceptance of orders from superiors were useful. Today we would include these characteristics in the concept of social control. The skills taught followed the classical pattern of the private schools, where the emphasis was on typical academic subjects such as English language, mathematics, geography, history, science, drawing, physical training and, for girls, housewifery. For elementary

schools there was a fairly rigorous control of the time to be allowed for each subject; not less than four and a half hours a week was to be spent on English, geography and history, with seven and a half hours to be spent doing science and mathematics.

Following the 1944 Education Act, the elementary schools were abolished and the system of selective grammar schools and secondary modern schools was established. There had been selective schools before 1944, with entry governed by entrance examinations, with a system of scholarships for some pupils. The grammar school, as the name suggested, was concerned with the top end of the ability range, and followed a public-school type of curriculum, with the grammar element not confined to English, but extending to Latin and Greek. The secondary modern schools offered a lower academic standard for what were presumed to be less academically gifted children. The eleven plus examination was considered by some to have had a stultifying effect on the curriculum of the primary school; some of this pressure on the primary school curriculum may have been removed. The curriculum of our secondary schools is nominally free, but it is, in fact, subjected to a variety of pressures. These include the examination boards, employers, parents, teachers and local and national government.

The 1960s and 1970s were decades of unprecedented curriculum change in our schools, with organisations such as the Nuffield Organisation and the Schools Council taking leading roles. Political pressure has become important and some schools have not only been used in a traditional teaching role, but have, to some extent, been used as tools

in a programme of social engineering. The relationship between what goes on in schools and what goes on in society is nebulous and complex. Changes in society would appear to have a greater impact on schools than vice-versa. One of the main functions of the school is to prepare children for adult life. This has necessitated fitting children for work which involves not only the provision of knowledge but the inculcation of attitudes and values compatible with work and adult life in general. The curriculum has, till now, been work orientated, with the attitudes and skills needed for work being highly valued. The Board of Education syllabuses demonstrated this point nicely and there were both behavioural and knowledge objectives.

Changes in our educational system have traditionally been slow; the reasons for this are complex and will not be analysed here. Factors usually accepted as having some influence on the slow change include the general conservation of society, preservation of what is sometimes considered to be legitimate knowledge by elite classes, and control of public examinations, particularly the General Certificate of Education, by the universities.

During the Industrial Revolution, massive changes in technology produced concomitant changes in society which moved from agricultural to industrial based units, centred in towns. Changes in educational provision for the masses at that time were linked to changes in industry and society. At the present time, developments in the field of microelectronics are being hailed as a second Industrial Revolution and knowledge is expanding faster than ever before. It would be

surprising if these changes failed to have a major impact on society. One of the main effects of the new technology would appear to be upon the demand for labour. In Chapter Four this was discussed in detail, and the balance of opinion seems to be that unemployment at a high level is here to stay. Exactly how high unemployment will go, or how long it will stay,is an open question, but the results of a study by the Institute of Employment Research at the University of Warwick suggests that there will be three million jobless till 1990 (Taylor 1982). Some of the alternatives to mass unemployment,such as a shorter working week, earlier retirement and job sharing have been discussed in Chapter Four. Whether we accept high unemployment or implement some of the measures above to reduce it, changes in the educational system appear likely. A major problem is, how should our educational system respond to these changes?

The curriculum is an important part of our education system, which needs to be carefully considered in the light of changes which may occur as a result of changes stemming from the development of microprocessor technology. Some important questions are:

1. What are the present conceptions of the curriculum?
2. How does the present curriculum meet the needs of society?
3. In what ways can the curriculum change to meet the needs of a changing society?

1. Present conceptions of the curriculum

One of the interesting features of our education system is the fact that there is no standard national curriculum. It is true that there have been proposals to establish a "common core" but, so far, these suggestions have not been implemented.

A phenomenon of the curriculum boom of the 1960s and 1970s was a preoccupation with aims and objectives. Part of this can be traced to the work of Bloom and his colleagues, who produced their major work on The Taxonomy of Educational Objectives in the Cognitive Domain in 1956, with another in the Affective Domain in 1964. Some workers in the field have specifically included mention of aims and objectives in their definition of the term curriculum. Hirst and Peters (1970) suggested that the term curriculum should:

> "... be the label for a programme or course of activities which is explicitly organised as the means whereby pupils may attain the desired objectives whatever they may be."

According to these authors, it is a nonsense to plan a curriculum until the objectives are made clear. The idea of setting objectives and then attempting to test them to see if, in fact, they had been attained, has become a popular exercise among curriculum planners. Few curricula are to be found which are not prefaced by a set of aims and objectives.

The use of Bloom's Taxonomy or a derivative to classify these aims can, in some cases, give a pseudo-scientific air to these aims and objectives. Unfortunately, some of the aims and objectives, particularly those which are not in the cognitive domain, may not be easy to define and can be difficult to assess. Notable in this sense, are those which involve developing certain attitudes; in health

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education, for example, the teacher wishes to develop attitudes and values which will not be required for many years, and the true test of his work comes in later life. Pring (1971) has produced an interesting philosophical critique of Bloom's Taxonomy which deals with some of these points.

In attempts to understand the curriculum and relate it to other aspects of the educational process various models of, and for, the curriculum have been developed and aims and objectives are featured in them. For example Kerr (1968) produced a model with four main subdivisions: knowledge, school learning experiences,evaluation and aims and objectives. Other models of the curriculum which have emphasised the prerequisite need for aims and objectives have been those of Tyler (1949) and Whealer (1967). In looking at curriculum design for the future, curriculum planners are faced with certain difficulties. One of the most important aspects of school is to provide pupils with the skills which they will require in adult life, but this is difficult in a time of rapid technological flux because it is not easy to predict what skills will be needed. Furthermore, certain attitudes, such as those to work, may need to be changed, incorporating themes such as education for leisure and trying perhaps to get away to some degree from the work ethic and feelings that not to work is somehow sinful and degrading.

W.O. Lester Smith (1973) has suggested that teaching cannot always be up to date, because there is an inevitable time lag between the discovery of new knowledge and skills and the teaching of them.

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W.O. Lester Smith (1973) has suggested that teaching cannot always be up to date, because there is an inevitable time lag between the discovery of new knowledge and skills and the teaching of them.

There are few who would disagree with this sentiment. The latter half of the twentieth century has seen rapid technological change, comparable perhaps with those which occurred during the Industrial Revolution, and this can make keeping up to date a difficult task.

In recent years the teaching profession has had to contend with many problems. Not only have teachers had to cope with the massive expansion of knowledge which has occurred, particularly in science subjects, but with fundamental changes in the organisation of the system, especially comprehensivisation. Since the Second World War, transport and communications have improved beyond recognition, atomic power is commonplace, and space travel is an accepted fact of life. The area in which the greatest technological breakthroughs have come is that of microelectronics and in some respects it is the changes in microelectronics which have made other changes possible. These changes have had a substantial influence on the society of developed countries, but it is the most recent advance - the microprocessor - which threatens the greatest changes.

In part, the microprocessor seems likely to have a major effect on society in this country as a result of changes in employment patterns which have been discussed in detail in Chapter Four. Children who are at school at the present time would seem to need to be equipped for a different life to that enjoyed at the present time. What form a future society will take is at the moment an open question, but it would seem likely that a response from the educational system will be required. At the heart of the response of the educational system lies the curriculum.

Many articles on the relationship between microelectronics and education have concentrated on computer assisted learning and the development of computer science as a subject in the curriculum. Typical of this genre was the article by Harrison (1981), which dealt with a Schools Council Project related to microelectronic technology. The author looked at three projects, "The Machine Assisted Teaching Project", the Schools Council, "Computers in the Curriculum" Project and the "Modular Courses in Technology". Valuable as some of these projects are, the emphasis is firmly on the narrow idea of the in situ of microelectronics and the writing of software. It can be argued that this is a somewhat shallow view of the impact of microelectronics on education which assumes that skills associated with microelectronics such as programming will be superimposed on a non-changing society. No doubt, the skills taught in this area will be useful to the relatively small numbers of pupils involved in some projects, such as those above, but the indirect consequences of the microelectronics revolution on society may ultimately exert a more profound and longer lasting effect.

It seems reasonable to assume that in industrialised countries fewer people will be required to work to produce the wealth of the nation, and that people who do work have shorter hours and earlier retirement than at the present time. During the Industrial Revolution, working hours were reduced, but new industries took up the labour which was released by technological innovation. At the present time there is little evidence that displaced labour is being absorbed in this way. Many of the children now at school are leaving school to come onto a

labour market where their labour is not required. The western world is currently in recession, but is also suffering from jobs displacement due to microelectronics.

The present curriculum is intended to prepare children for work and this is a satisfactory aim as long as there is work available for the children to do when they leave school. If a situation arises in which many children do not have any prospects of finding employment when they leave school, then part of the raison d'etre of the educational process is lost. It would, therefore, appear to be sensible to introduce measures into schools to help prepare pupils not only for an adult life in which work is an automatic progression from school, but one in which many of them may not find work. What the response of schools to the microprocessor revolution should be; but it cannot be satisfactory to assume that putting a few microcomputers into schools will be a satisfactory answer to the challenge to be faced.

It has been suggested in this dissertation that education in Britain has been, in part, a preparation for work and, as such, has been linked to the needs of industry and commerce. A radical change would be needed if this emphasis was to be changed. It can be argued that mass unemployment may not be seen, or that to accept the inevitability of unemployment for some pupils would be bad for morale, but this could be a lesser evil than training a young person for a job which does not, and will not in the future, exist.

The changes in the curriculum which may be required would appear to be rooted in philosophy, psychology and sociology, and not in simply

providing microcomputers and courses in computer operation. This brings us to a fundamental question of how should the aims and objectives of the curriculum be designed to equip children for life in a society which may be very different from the one in which we live today. To this extent, it is worth considering some of the possibilities for alternative curricula. Two interesting alternatives have come from what could be termed the "left" of the political spectrum and the "right"; these are examined in the following section.

Proposals for alternative curricula

The response of the "left"

It is, in some ways, quite easy to point out some of the deficiencies of the current curriculum, but it is more difficult to produce viable alternatives which would be better than those they set out to replace. Perhaps the most challenging suggestions for curriculum reform have come from some of the sociologists of education. Young (1981) has suggested that the subjects or disciplines of the present curriculum were socially constructed on sets of shared meanings, rather than being valid in absolute terms. In 1971, Young produced an important paper, "Curricula on Socially Organised Knowledge", which was a landmark in the application of sociological concepts to the curriculum. Young argues that the thought systems embodied in formal curricula are superior to those of people who have not been educated, or who remain to be educated. From this, he argues that social considerations are important legitimising factors in determining what counts as valid educational knowledge. In other words, people who are well educated (and who will belong mainly to the middle and upper classes) define their knowledge and thought systems as the valid ones, and the knowledge which they have is defined as the legitimate or valid knowledge of the whole population.

Some of the ideas which Young and his school incorporate into their theories are related to communist doctrine and issues such as the class-based nature of our society are important considerations. One of

the main arguments of the "new left" is that the elite (educated) classes have defined legitimate knowledge and legitimate culture as their knowledge and culture, and limit entry to that knowledge and culture, thereby perpetuating the existing class sytem. This may be the reason why sociologists have placed such importance on the question of the validity of knowledge.

The question of validity of knowledge which has been raised by sociologists is worth considering in some detail. The present curriculum was evolved over a long period of time and is constantly changing and, from time to time, the validity of certain subjects, or of items within a subject, are questioned. When a subject ceases to be regarded as sufficiently valid, it may be removed from the curriculum, and, from time to time, subjects do more or less disappear. An example of this is Latin, a subject which was found in the curriculum of most grammar schools up till the 1960s and its value as a mind-training exercise was widely accepted. However, it became an early casualty of comprehensivisation and is now very much a minor subject in most state secondary schools. Many of the subjects on the curriculum are there as a result of custom and practice and to remove them would be almost unthinkable. Once a subject is established, it can be self-perpetuating, not only because the passage of time confers legitimacy, but because a lobby of involved parties, such as teachers of the subject, is created. In recent years, some philosophers have looked at the content of the curriculum and have been concerned with classifying knowledge and then relating concepts such as "forms of knowledge" to that of an educated man.

A development of the concept that the present curriculum is based on middle-class culture and values has been to promote the idea that working-class culture could form the basis of an alternative curriculum. The pressure to look for a viable alternative may have been increased by comprehensivisation, as it has been found that it is difficult to find a curriculum which is universally suitable for different social groups, and groups of children with differing abilities. Linking a curriculum to working-class culture would not be easy and Vicinus (1974) has even suggested that there is no longer any working-class culture, due to the impact of the mass media. Some suggestions as to which item of working-class culture could be included in such a curriculum have been made by McInnes (1973) and Jackson (1976). These authors include such miscellaneous items as dog racing, bingo, pop music, gardening, pigeon racing and writing on walls. Keddie (1973,1971) has supported the idea that different classes have their own cultures which could act as the basis of viable alternative curricula.

One interesting point is that the emphasis of the left to the context of the curriculum has changed in recent years. The initial thrust towards breaking what was seen as the power base of a powerful and well educated elite class was an attempt to get working class penetration of the system by gaining access to the grammar schools. Harold Wilson remarked at the time when comprehensives were first being established that these new schools were "grammar schools for all". An alternative view would be that they were secondary moderns for all. The emphasis of the left has now shifted from restructuring the educational system so that the working classes had greater access to knowledge, to

challenging what is regarded as valid knowledge which, as previously suggested, involves concepts such as basing the curriculum on working-class culture. It is also important to note in passing the relationship which the sociologists see between education, knowledge and power. They argue that access to positions of power is restricted to those in possession of certain knowledge and that the education system plays a fundamental role in making knowledge available; Education is, therefore, closely linked to power.

Bantok's Alternative Curriculum

At the time when the secondary education of children in England and Wales was organised on the basis of grammar and secondary schools in Britain it was widely accepted that pupils of differing abilities and outlook could be best educated by providing different types of school. Such views are today regarded by some as being almost heretical. The movement towards comprehensivisation backed by socialist governments and local education authorities has almost made the grammar school an extinct species. The move towards comprehensive schools has been accompanied by a trend towards a common curriculum. Some provoking challenges to this philosophy have come from an Emeritus Professor at the University of Leicester, G.H. Bantok.

In a recent book, Professor Bantok (1980) has written one interesting account of his alternative ideas to the common educational approach adopted by many comprehensive schools. With regard to the educational implications of the microelectronics revolution, his ideas are of interest, as he has analysed some of the implications of changing technology from the educationalists point of view. He suggests that his alternative curriculum would be suitable for children whose lives are affected by the new technology.

The notion of a common curriculum is not one which finds favour with Professor Bantok and he argues that such an approach is educational nonsense. He sees the moves towards comprehensive schools as being mainly politico-social, designed as tools of social engineering. On the issue of positive discrimination for the low achiever, Bantok disagrees totally with the concept and supports the view of Glazer (1976),

who has suggested that, in the U.S.A., such policies had resulted in:

> "... a lower degree of competence in jobs at all levels."

Bantok believes that the concept of commonness espoused by some theorists has led to a trivialisation and mediocratisation of the school experience; he identifies the roots of this movement in Rousseau's insistence on nature and Dewey's on socialisation.

The main thrust of Bantok's argument is that alternative curricula are needed for low achievers and other sections of the school population. Bantok suggests that there are rational grounds for believing that some children are incapable of following an intellectually demanding curriculum and that there is a conflict between socio-cultural potential and the demands of the school which are typically cognitive. There are others who support this viewpoint; for example,Hallam (1969) has suggested that the majority of secondary school pupils up to a mental age of sixteen seem to be operating at what Piaget would regard as the concrete level. There is also the problem of poor motivation which Bantock sees as the result of social pressures and attitudes which make school unpalatable to certain sections of the population who are only able to think in terms of short-term objectives, rather than long-term ones.

It is suggested that the poorly motivated, low ability child does not have the prospect of a "prestige" job, but a dull, repetitive one in a factory, and that they should be prepared for such a job. This is a contentious point which many educationalists would take issue with, for

what is really being suggested is not only that low achievers can be identified, but can be identified with sufficient certainty to be prepared for a certain type of job. It is worth noting that micro-electronics will, of course, affect these low achievers, not only by changing the society in which they live, but also by removing some of the job opportunities which might otherwise have been available to them.

Barlock recognises that changes in technology may produce an increase in leisure time and he suggests that the alternative curriculum for low achievers should offer them opportunities for personal development which, he believes, they are denied at the moment. Some of the elements of Bantok's alternative curriculum are:

(1) Aesthetic Expression through body movement

Bantok sees education through movement as an alternative vehicle for expression for those who are not articulate and find difficulty in expressing themselves adequately (i.e. those whom Bernstein would regard as having a restricted code).

(2) Twentieth Century Media

Here, Bantok suggests that media such as television, radio and films should form an important part of the curriculum so that children can develop a heightened consciousness. This would form part of a process of personal development and an increased awareness of the arts and other cultural activities.

The low achiever is at one end of the educational spectrum while, at the other, is the very able child. The low achiever would be expected to be affected by changes in technology via, for example, change in employment which will eventually be open to him. Some of the changes could be direct; for example by jobs disappearing and some could be indirect via more general changes in society. Bantok's concept of an alternative curriculum sees the low achiever as being prepared for adulthood by being made ready to accept a mundane job, increased leisure; Bantok does not specifically mention unemployment as the source of some of this increased leisure, but it is suggested by inference. This preparation is to be achieved by developing an aesthetic appreciation utilising physical achievement and twentieth century media.

This solution would be opposed by some as elitist and socially divisive, but is it unreasonable to suggest that different groups in society might have different needs? Furthermore, it is sensible to assume that different social and ability groups might be affected in different ways by changes resulting from the introduction of new technology. It would seem reasonable to assume that microtechnology will, in addition to having different effects on different sections of the community, might have some common demoninator such as an increase in leisure time.

An elite curriculum

Bantok has suggested that some low ability children will be adversely affected by the introduction of microtechnology, but it is also true to say that very able children will also be affected. In a

highly technological age it seems likely that, in some areas of employment, fewer workers will be required, but those who are required will need to be highly trained and more skilled than at present. It is against this background that the future demands which society will make against the able child need to be examined.

When the development of our present curriculum is traced, it becomes apparent that initially it was intended for an elite section of society. From the time of Alfred the Great until the middle of the nineteenth century, only a small number of people were educated. Even by the middle of the nineteenth century only a relatively small part of the population was educated, and even the universities were modelled on those of the Renaissance, with a "classical curriculum" based on the great works of ancient Rome and Greece. At this time education in the public schools was based largely on that of contemporary universities and was also of a classical nature. When schooling for the children of the working classes was introduced, it was very much of an "elementary" nature, with the emphasis being firmly on the basic skills of numeracy and literacy. The curriculum has gradually widened and other subjects have been added. The 1944 Education Act recognised that children of different abilities needed different schools and it was not until the decades of change in the 1960s and 1970s that there was great reform. It was in the 1960s and 1970s that the egalitarian movement towards comprehensivisation was in full flow. Not only were children of all abilities taught in the same school, but features such as mixed ability teaching became popular.

The philosophy for many schools has been based on the idea of a common curriculum; the emphasis on knowledge has moved from rote learning to skills such as understanding and critical thought and classical languages in state schools are almost extinct. Modern languages, according to Bantok, have been stripped of their literature and reduced to tourist, conversation exercises. Despite the fact that these practices have not been universally accepted, they have spread rapidly. According to Bantok, changes in the skills which will be needed to meet the challenges posed by the microchip revolution provide an ideal opportunity to examine critically current egalitarian attitudes, to determine whether or not they provide a good environment, for the preparation of the able child to meet future challenges.

A basic question which needs to be considered is: how are the demands which changes in technology and society will place on the able child to be met? There are perhaps two related facets of this question to consider:

(i) Direct skills : some people will require direct skills or what are sometimes referred to as "hi-tech" skills. This would include things like computer programming, systems analysis, etc.

(ii) Indirect skills : in a technological age some people will be needed to exercise creative skills, which are intellectual and non-vocational.

A highly technological society will undoubtedly need people with specific skills to design and operate high technology equipment, but many people will also operate the new equipment without necessarily understanding the principles on which it operates. Much of the current

effort of training at the present time seems to be directed towards teaching a few pupils the rudiments of computer programming. Training people to mee the indirect consequences of the microchip revolution, such as increased leisure, seems to have been largely overlooked. Seen in this context, an educational curriculum for what Bantok would call an elite group, would not only include vocational training, but a development of the mind in a more general sense.

Professor Bantok has suggested that many current curricula teach at a very general level, which encourages mediocrity. He suggests that the emergence of a pluralistic society has been associated with a series of fragmented educational experiences. He believes that able children require a specific curriculum with a rigorous application of it. Bantock has suggested that many pupils would benefit from an exposure to the traditional literary and humanistic subjects. He does not mention science and mathematics, but he would, presumably, include these.

It is an interesting feature of the current situation vis-a-vis the microchip revolution that the new technology could, at a stroke, demand new scientific and technological skills, while at the same time encouraging traditional classical subjects. The aim of a liberal education was to free the mind; could the microchip free the curriculum?

Power and the Curriculum

One factor recognised by both the political left and right is that education is linked to power. Knowledge has long been accepted as being directly linked to power and the educational system plays an important role in deciding who shall be allowed access to what knowledge.

The microchip revolution threatens to add a new facet to the debate about power and knowledge, because the microchip threatens to be such a powerful tool. Access to books was at one time the key to the acquisition of knowledge, but the computer offers the knowledge contained in books combined with a data processing facility. Access to computer facilities and an ability to use them could give more power to certain sections of the community than was believed possible a decade ago. The microprocessor could enlarge the gap between those who possess knowledge and those who do not and thus polarise society even further than at present.

A further point is that the spread in computer facilities associated with the spread of the microprocessor could change the balance of power between government and large commercial concerns on the one hand, and the private citizen on the other. It is now possible to collect together so much information about a citizen and store it in instantly retrievable form in a computer; therefore the position of the individual could easily be compromised. The effects of the microprocessor on society will be widespread; those individuals involved in framing curricula should be concerned with these facets as well as the direct and easily identifiable ones.

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* * *

CONCLUSION

CONCLUSION

This dissertation has been concerned with some of the implications for our educational system of technology based on the silicon chip. It has been pointed out in this dissertation that our educational system is in a state of continuous flux but that, at certain times, changes occur particularly quickly. The microchip revolution may act as a catalyst and lead to a quickening in the rate of change over the next few years.

Changes in education do not occur in isolation from events in society, but the two are in dynamic equilibrium. At the present time the pervasive spread of microelectronic technology is being hailed as the second Industrial Revolution and it would be surprising if it failed to have far reaching effects on our society and on our educational system. The nature of the response to the change and challenge posed by the introduction of new technology is an interesting one and one which prompted the writing of this dissertation.

A number of erudite books and reports on the microelectronics industry and some of the effects of microtechnology have appeared in the last few years and have been referred to in this dissertation, including those by Braun and MacDonald (1978), Barron and Curnow (1979), Forester (1980) and Marsh (1981). However, these works have concentrated mainly on the devices themselves or their general social effects. Some publications such as those by Hines and Searle (1979), Jenkins and Sherman (1979) and Showler and Sinfield (1981) have concentrated on the specific social effect of unemployment. There does not appear to have been a detailed consideration of the educational implications of the microprocessor revolution.

In the first chapter, some of the work of the philosophers and sociologists of education was considered. This was done in an attempt to identify important theoretical considerations of our education system and to look at the implications of their work in a wider sense; for example, to consider their relevance to problems such as increased leisure time. The work in Chapter One was presented as a review of selected authors whose work was of particular relevance to the development of our current education system or the microelectronics revolution; it was not intended to stand as a definitive resume of collected educational theory.

One theme which was of interest was that of the place of leisure in education. In Britain, entry into work is often restricted to those in possession of formal educational qualifications such as Ordinary or Advanced Levels or a university degree. It is natural that schools should have the burden of preparing pupils placed on them as part of their educational brief. They are also charged with the task of inculcating attitudes and values which will enable their pupils to fit into the work situation and into society in general.

In Chapter One the views of some philosophers were looked at vis-a-vis the role of leisure in education. It is interesting to note that some of the earliest recorded views on this were expressed by the Greek philosophers such as Aristotle. Aristotle recognised the value of leisure which he saw as being a virtuous way of life.

Rouseau highlighted one of the major problems facing education today; namely, how far should a person be educated for himself and how far

should it be for the community in which he lives? It would be naive to pretend that our educational system was solely concerned with the welfare and needs of the pupils since society also places certain demands on the system. Society needs people with certain skills and the needs of industry, agriculture and commerce must be catered for; the health of the citizens needs to be looked after and the rules of society enforced. The educational system is intended to prepare each generation for adulthood. For much of the time there may be a considerable correlation between what is good for society and what is good for the individual but, at times, there may be a degree of dissonance between them. The problem would appear to be one of achieving balance, but it is a difficult area in which to make hard and fast rules as many of the factors involved may be difficult, or even impossible, to quantify in an objective way. In considering the social aspects of education, Rousseau was perhaps a forerunner of some of the present-day sociologists of education. From this school have emerged some challenging and provocative ideas on education.

M.F.D. Young (1971), a leading member of the Marxist school of sociologists, has discussed the relationship between knowledge and control, and has developed an interesting concept of "valid knowledge". Valid knowledge is seen by Young as that knowledge which is deemed to be of value by the middle and upper classes and is, in turn, a reflection of their cultures and values. Power is seen by the sociologists of the Marxist school as being closely linked to the access to certain knowledge and they suggest that, by limiting access to knowledge, it is possible to limit access to power.

In Chapter Two, some aspects of the relationship between work and education were considered in an historical perspective, by reviewing some of the changes which occurred in education at the time of the Industrial Revolution.

Today, almost all adults in our society are able to read and write, and it is easy to forget that this has not always been the case. From the Middle Ages, the ability to read and write was confined to an educated minority of the upper classes and the clergy. The ordinary working-class person did not need to be able to read and write in order to work and carry out his day to day business. Even had he been able to read and write it is doubtful whether he could afford to buy books.

The Industrial Revolution brought a change in the lifestyle of many members of the working classes and there was a movement from agriculture to the manufacturing industries in the towns. The working classes evidently began to desire education in order to learn the skills of reading and writing. In part, this may have been prompted by the availability of a popular press, which was in itself a product of the new technology of the Industrial Revolution. Another factor which may have stimulated the demand for literacy may have been a desire to write to relatives following the fragmentation of family units after migration to the towns.

In Chapter Two some of the changes which led to the establishment of schools and their subsequent development were discussed with a view to answering a question which was asked in the Introduction; namely, is there a link between industrial change and educational change? The

evidence, reviewed in Chapter Two, suggests that the major changes in technology which occurred at the time of the Industrial Revolution were followed, after a lag phase, by educational change which eventually led to universal education. This was not easily achieved and there would appear to have been a good deal of resistance to the principle of a universal working class education from some quarters such as the Church and the upper classes. However, the establishment of working class schools was perhaps, in retrospect, a logical and inevitable consequence of the process of industrialisation.

The social changes resulting from migration to the towns and the desire of the working classes to read the popular press can be readily appreciated as factors stimulating a desire for literacy. Additionally, as industry became more technologically sophisticated, it will have demanded greater skills from an increasing proportion of its workforce; for example, to read technical drawings, to follow written instructions, and to work with increasingly complex machinery. Increased literacy and numeracy will have been essential for some jobs. However, a more subtle pressure for the development of an educated working class may have been that as the products of industry became more complex then the consumers needed to become more sophisticated to use them. In other words, education is not only necessary to create the skilled workers required in industry, but also to help create a market for industrial products.

When the current situation, with regard to the microprocessor, is examined it becomes apparent that there are some similarities between the present situation and some of the changes which occurred during the

Industrial Revolution. For example, in both cases technological breakthrough enabled great increases in productivity to be made. At the time of the Industrial Revolution, labour displaced from agriculture or a traditional industry such as home weaving was, in general, accommodated elsewhere, but a disturbing feature of the current situation is that this does not appear to be happening at the present time. It is possible that the consequence of this may be prolonged mass unemployment in the western world. This is the view taken by commentators such as Jenkins and Sherman (1979), Hines and Searle (1979) and Showler and Sinfield (1981).

If unemployment in Britain is to remain at high levels - currently over three million - for a long time, and the trend towards spending less time at work continues, then society may face severe problems since, at the moment, it appears to be based on the work ethic. Education is geared to work and has traditionally been based on the premise that the pupils of schools or other educational institutes will be able to find work when they leave.

Some people have always had a substantial element of leisure in their lives, such as certain members of the upper classes, but the working classes have become accustomed to relatively long working hours, coupled with short holidays.

The relationship between work and leisure is further complicated by the fact that it is not always possible to draw a sharp distinction between the two. For example, are professional sportsmen engaged in a leisure-time activity or at work? Furthermore, some types of work may

give a high degree of job satisfaction which may have a carry-over into leisure time. This is in contrast to some jobs such as, perhaps, those on a factory production line where the main satisfaction may be in the money which is earned and will later be used in part to finance leisure-time activities. However, it is worth noting that Parker (1980) has suggested that the opportunities for creativity and self expression at work are becoming fewer and this may be leading to reduced job satisfaction. The introduction of microprocessors into industry threatens to further de-skill certain jobs; for example, a computer-controlled lathe compared to a manually operated one, and will erode even further the job satisfaction and this may produce an even greater dichotomy between work and leisure.

The concept of education for leisure as opposed to work is not a new one and it could even be argued that education has never been carried out with employment in mind. Subjects such as music and games are usually in the curriculum of most schools and these would appear to be leisure orientated subjects. However, as Basini (1975) has pointed out, education for leisure has often been a reflection of the norms and values of those holding economical and political power in society and has been elite-orientated. For example, school music has been based mainly on an appreciation of classical music which is not generally a working class forte. Similarly, games have been based on the elite concept of participation, whereas working class participation tends to be at the level of spectator.

Education for leisure does not simply involve teaching a few skills such as sports or gardening which could be used as leisure-time

activities but in the wider sense of developing attitudes and values which will be required to spend leisure time profitably in the future. Roberts (1970) has pointed out some of the problems involved in educating for leisure including the difficulty of inculcating values that pupils will be able to apply throughout their lives and predicting attitudes and values which will be required in the future. Part of the task of educators in the future may be to re-appraise the relationship between work and education from the point of view that it is not only work which is a virtuous occupation and that to be unemployed need not be a cause for shame. That is not to say that the recognition and encouragement of achievement should be discouraged but rather that education per se should be enjoyed and valued for its own sake and not simply be seen as a passport to employment.

To adopt an approach in which education is not necessarily work-orientated could create difficulties; for example:

(i) Overcoming the natural conservation of teachers, employers and society in general.

(ii) The motivation element could not be reduced for some pupils if there is no direct link between educational attainment and employment.

The technology of education changes constantly but from time to time there may be major innovations. In the 1950s there was a brief flirtation with teaching machines and programmed learning, especially in the U.S.A., but these electro-mechanical devices, which were programmed in line with Skinner's ideas, had limited scope and application. The micro-

processor can also be used as the basis of a teaching machine but offers the possibility of almost infinite flexibility, rapid response and massive access to information. The early electro-mechanical teaching machines operated with linear, Skinner-type programs, but as Hooper (1977) has explained, there are other types of program which permit alternative learning strategies based on the work of theorists such as Bruner and Gagne to be employed. This was discussed in some detail in Chapter

Writers such as Doe (1982) have suggested that revolutionary methods may be required for teaching with and about microelectronics and that traditional classroom methods might have to be scrapped. A problem which will, undoubtedly, arise here is how will the teaching force respond to the introduction of microelectronics? Most teachers have not been trained to cope with microelectronic devices and, in the present economic climate, are hardly likely to be; in fact, money for in-service training seems to be becoming even scarcer. Even the modest proposals outlined in the James Report (1973) were not implemented. So what chance is there now, despite the fact that the need is probably more urgent than ever before?

It is also probably worth noting that while hardware tends to be of good quality there appears to be problems with some of the software; this has been discussed by Trigger (1981), Sweeton (1982) and Thorne (1982). Clearly, the application of computers to the teaching situation will be limited to some extent by the quality of the software available. This problem is, of course, exacerbated by the lack of teachers trained in the skills necessary to produce their own software.

If it is accepted that the microelectronics revolution is likely to bring widespread changes in employment and society in general, it is prudent to enquire as to the nature of the response which can be expected of the educational system. There are, perhaps, two areas which merit special attention; these are changes in the content of education, i.e. the curriculum and changes in the pattern of provision of education. This latter point might be expected to include questions about the role of schools and whether they will be necessary in the future.

The sum of the activities of the school is often collectively referred to as the curriculum and some of the possible responses of the curriculum to the microelectronics revolution were discussed in some detail in Chapter Five. The main point made was that the curriculum is never static, but is in a constant state of flux. How the educational system should respond to the microprocessor revolution is very much an open question but possible answers have been put forward by both the political left and right. Perhaps somewhat predictably, the left have suggested that the curriculum should be broadly based on developing social qualities and promoting the personal development of the individual. The attraction of the left's proposals is that they offer a curriculum which is not work-based and, as jobs become increasingly scarce, their proposals could become increasingly attractive. At the other end of the political spectrum, Professor Bantok has suggested that perhaps two curricula are needed, one for the academically elite and one for those who are not so gifted. Elements of both political persuasions could perhaps be amalgamated to produce a worthwhile model for a future curriculum which is not specifically work-based.

The answer may lie in an approach in which the development of personal qualities for all children is ascribed an important role, but not the only role. Those who do have a high degree of academic ability need not be restricted in the breadth and depth to which their cognitive abilities in the academic field are developed. There is something to be said for Bantok's ideas of traditional cognitive development which trained the mind in general rather than training with specific and applicable skills in mind. For example, training children to use a microcomputer might be less important than developing a receptive and analytical mind which is ready to assimilate new skills and information in the future.

In the 1960s and 1970s there was considerable interest in the concept of changing the fabric of the educational system by either abolishing schools altogether (deschooling) or producing drastic changes (reschooling and freeschooling). The microprocessor revolution makes it worthwhile to look again at some of these ideas vis-a-vis the relevance of schools in a new technological age.

Some progressive educationalists such as A.S. Neill, who established Summerhill, believe that it is not the presence of schools per se which is the problem, but that the fault lies with the activities carried out within the school. Neill, for example, wanted to create happiness for his pupils and refused to ascribe an important role to the learning of basic skills.

An extention of the progressives who would subscribe to ideas of reschooling or freeschooling are the ideas of the deschoolers who believe that schooling in any form is doomed to failure. The deschoolers have

taken a step beyond the free schools and progressive schools and writers such as Goodman (1971), Illich (1971) and Reimer (1971) have suggested that even the most progressive methods are doomed to failure because they are still in the institutionalised setting of a school Illich (1971), for example, has argued that the institution creates certainties and drives out creativity and awareness. An interesting concept which has been discussed by Illich is that of the "hidden curriculum". Illich believes that all schools, regardless of their geographical location or political or religious persuasion have certain things in common such as a teacher, in a room with about thirty pupils, and that the pupils are subjected to a persuasive hidden curriculum. For example, the hidden curriculum would inculcate habits of obedience and respect of authority. The aims of the deschooler can at best be seen as benevolent in that they would like to see a world based on freedom and justice and believe that pupils cannot learn under compulsion. Their views are not always respected and have been condemned by some as irresponsible (Barrow 1978).

The deschoolers have, therefore, suggested that schools are bad because they stifle creativity and imagination and that the hidden curriculum is an unhealthy influence. The microchip has given us a very powerful learning tool, the microcomputer, which is also cheap and adaptable. Perhaps a question which educators should address themselves to is "Will the microcomputer lead to the redundancy of the school?" Easy to operate, microcomputers are now available for home use and the limiting factor to their educational application seems to be poor availability of good quality software. It is not beyond the bounds of possibility that in the future,

ıools will simply not be necessary because learning opportunities can
better provided by a computer in conjunction perhaps with resource
ıtres such as libraries and museums.

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