The effects of microelectronics on employment and education

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THE EFFECTS OF MICROELECTRONICS ON EMPLOYMENT AND EDUCATION

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ABSTRACT:

THE EFFECTS OF MICROELECTRONICS ON EMPLOYMENT AND EDUCATION

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This dissertation is an argument for simultaneous, radical and innovative technological and attitudinal change.

Attitudinal change is dependent upon the qualitative and quantitative persuasive effectiveness of those regrettably few academics, trade unionists, journalists and hopefully some politicians who actually believe that the development of an activity/leisure/play ethos is not only feasible but extremely desirable. This treatise is intended to enhance the two-fold argument for change by persuasive advocacy, evidential illustration and by promoting further, extensive and lively discussion.

The thesis is divided into 3 principal sections: historical-contemporary, contemporary and contemporary-futuristic analyses; these sections are in turn sub-divided into a series of individual chapters.

Section 1: A Historical-Contemporary Perspective considers the history of automata, microelectronics and work in order to (a) set in context and (b) trace the development of microelectronic technology and the concomitant opportunity for change.

Section 2: A Contemporary Perspective - Chapter 4: The Microelectronic Technology Employment Debate examines the fundamental argument as to whether or not microelectronics can create as many jobs as it destroys. Chapter 5: discusses my own case study research which focuses upon north eastern office complexes (from various administrative/executive/clerical sectors) particularly susceptible to computerised automation.

Section 3: A Contemporary-Futuristic Perspective - Chapter 6: reviews the current state of school computerisation. Chapter 7: looks at the author's research into primary and secondary schools. Chapter 8: argues for the development of a massive computerised/microelectronic orientated education industry incorporating a comprehensive range of subjects and activities. A re-definition of what we mean by traditional education. An education industry for anyone to learn about anything. Chapter 9: continues this theme and argues for a radical re-definition of our traditional concept of work and leisure; and proposes a revolutionary solution to the unemployment problem.

THE EFFECTS OF MICROELECTRONICS ON EMPLOYMENT AND EDUCATION

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INTRODUCTION*

"... the idea of duty in one's calling prowls about in our lives like the ghost of dead religious beliefs." (Weber, 1968, p.182)

In 1952, an Englishman, Professor G.W.A. Dummer of the Royal Radar Establishment, Malvern, suggested the revolutionary hypothesis that it might be possible to put more than one micro-transistor onto a small square of germanium. Dummer's proposal gave Britain a tremendous opportunity to lead the world in microelectronic hardware and software technological engineering. The opportunity was squandered.

Now micro-technology itself has presented Britain with another unprecedented opportunity to lead the world in social engineering: to radically re-define what we mean by 'work', to implement unreservedly microelectronic technology and to adopt what I would term an 'activity ethic' where everyone participates in the activity of their choice and receives a substantial leisure income for doing so.

This dissertation is an argument for simultaneous, radical, and innovative technological and attitudinal change. The following is a brief outline of the principal propositions that are to be discussed fully in subsequent chapters.

Economic survival in a competitive world will ensure that technological change is inevitable. The problematical issue is to determine when the gradual proliferation of microelectronic technology is likely to reach its critical mass, explode on an unprecedented scale into every sector of society and within perhaps 5-15 years, attain a level of total saturation.

Amy D. Wohl (March, 1978) has graphically described this 'critical mass' effect. "The current situation in computerised automation is somewhat similar to the situation of television in the 1940's: until many people could receive TV programmes, no one wanted to spend money on programming; but until there were programmes to receive, there was little incentive to buy a TV.

Now the situation is that everyone will watch to see who else is buying advanced microelectronic systems. Fortunately, the experience with TV suggests there will be a point when a 'critical mass' is reached and many firms will almost simultaneously begin broad use of the new technology." (Wohl, March 1978, in Forester, ed. 1981, pp.288-289).

Attitudinal change is dependent upon the qualitative and quantitive persuasive effectiveness of those regrettably few academics, trade unionists, journalists and hopefully some politicians who actually believe that the development of an activity/leisure/play ethos is not only feasible but extremely desirable. This treatise is intended to enhance the two-fold argument for change by persuasive advocacy, evidential illustration and by promoting further extensive and lively discussion.

I believe that the microelectronics revolution could have a much more significant effect upon British society than either the agricultural or industrial revolutions - specifically because of (a) the inexorable progression of computerised automation or the 'law of (micro-)technological inevitability'; and (b) its unprecedented potential to totally overturn and displace the attitudinal doctrine of the Protestant/Puritan work ethic (see discussion in Chapter 3; Anthony, 1977, Part 1: Foundation of an Ideology, Chapter 2: The Protestant Ethic, pp.39-51 and Weber, 1968) in favour of a new activity or leisure orientated ethos. The alternative to this attitudinal change would be a disastrous, apathetic and inflexible 'unemployment ethos' - the determined political retention of the work ethic in its most scandalous, cruel and pitiless form. The executive technocrats would receive all the considerable advantages of micro-technology: increased wealth, leisure, happiness, and self-actualisation whilst the (potentially, I believe, 10-12 million by 1994-1999) unemployed would miss out on everything, except the disadvantages: infinitesimal social benefits, poverty, boredom, misery, frustration, stultification and a governmental and self-belief that employment is still the principal societal goal.

I would compare this 'law of (micro-)technological

inevitability' with the following extract in which microelectronics can be seen as being analogous to 'Death', British society as corresponding to the servant and 1984-1994-1999 as representing the 12 hour time-scale:

"Death speaks: there was a merchant in Bagdad who sent his servant to buy provisions and in a little while the servant came back, white and trembling, and said 'Master, just now when I was in the marketplace I was jostled by a woman in the crowd and when I turned I saw it was Death that jostled me. She looked at me and made a threatening gesture; now, lend me your horse and I will go to Samarra and there Death will not find me.' The merchant lent him his horse and the servant mounted it, and dug his spurs in its flanks and as fast as the horse could gallop, he went. Then the merchant went down to the marketplace and he saw me standing in the crowd and he came to me and said 'Why did you make that threatening gesture to my servant when you met him this morning?' That was not a threatening gesture, I said, it was only a start of surprise. I was astonished to see him in Bagdad for I had an appointment with him tonight in Samarra." (O'Hara, 1934, in Gershuny, 1978, p.2)

Microelectronic technology could facilitate an unprecedented level of activity choice. For the first time since the era of the Greeks and Romans the majority of the British population could be afforded the opportunity to pursue a pleasurable activity and therefore the opportunity for increased personal happiness, self-development and fulfilment - the opportunity to enjoy, as far as possible, a worry-free, agreeable, comfortable and contented life-style.

I believe the only doubt about the comprehensive proliferation and penetration of microelectronic technology and the necessarily concomitant enormous displacement of labour from within traditional employment sectors, is the implementation time-scale. I would suggest that voluntary technological saturation, and the parallel development of an activity/leisure ethos, could be achieved by around 1989-1994; compulsory technological saturation (for economic survival in the international market), the parallel retention of the work ethic

and mass unemployment, will probably be reached by 1994-1999.

The impact of microelectronic technology will be as devastating as it is comprehensive - it affects virtually every area of society: factories, offices, education, medicine, home education, information, entertainment, leisure etc.

The technology has the capability substantially to:

(1) increase efficiency

(2) increase productivity

(3) reduce labour costs

(4) decrease capital expenditure

(5) improve quality

(6) create wealth automatically.

Computers, communicative workstations and advanced robotic systems and their 5th generation super-machine successors, should be fully implemented within and throughout every sector of society; and consequently permitted to displace workers in all forms of employment, improve efficiency, productivity, cost effectiveness, quality, create wealth, help educate, tutor, advise and entertain. But time is running out - the correct decisions must be made quickly if we are to avoid severe industrial and social disruption and a divided society of wealthy, contented, executive technocrats and financially insecure, discontented, mass unemployed.

The thesis is divided into 3 principal sections: historical-contemporary, contemporary and contemporary-futuristic analyses; these sections are in turn sub-divided into a series of individual chapters.

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By their very nature, many of the sections and chapters overlap and inter-relate and should therefore not be considered in total isolation. For simplicity and variety the terms microelectronic technology, computerised automation, microelectronics, computer, new, information, integrated circuit and semiconductor technology are all used on a synonymous and interchangeable basis.

INTRODUCTION*:

In addition to the source references already quoted the previous account was based upon information gleaned from:

Marsh, P. (1981), The Silicon Chip Book, Abacus, Sphere Books Limited, London.

SECTION 1:

A HISTORICAL-CONTEMPORARY PERSPECTIVE

CHAPTER 1: AUTOMATA*

"One evening I was sitting in the rooms of the Analytical Society at Cambridge ... with a table of logarithms lying open before me. Another member coming into the room, and seeing me half asleep, called out 'Well Babbage, what are you dreaming about?' to which I replied, 'I am thinking that all these tables might be calculated by machinery'."

Charles Babbage (1792-1871) Lucasian Professor of Mathematics, Trinity College and Peterhouse, Cambridge. (Babbage in Evans, 1981, Preface).

The first universally recognised calculating machine was the abacus - it evolved originally in the Tigris-Euphrates valley approximately 5,000 years ago.

The next significant development did not come until 1642 when Blaise Pascal devised a mechanical adding machine (in order to aid his father's tax collection) that operated by a system of dials attached to wheels, numbered indicators (0-9) above the dials presented the results in the form of a continuous read-out digital display. The device was however limited to additions only. In 1671 Gottfried Wilhelm Leibniz invented a stepped-wheel mechanism that could subtract, multiply and divide as well as add. Unfortunately the technology of the period was not as advanced as the principles of the Pascal/Leibniz machines and as a result neither calculator was particularly accurate.

The idea of a difference engine was originally postulated by Muller in 1786 and subsequently progressed considerably by Babbage (discussed later) who was the first to utilize coded cards in a calculating machine. However, this development and all subsequent developments originated with a set of theoretical papers on automata some 22 centuries ago.

These plans were calculated by Hero of Alexander in the 2nd century B.C. and outlined an extremely sophisticated system of water and air drive machinery. His writings were passed on by

the texts of Aldus Manutius of Venice in 1457. The Italian aristocrats of the period, seeking lighthearted fun/entertainment and prestigous acclaim, developed Hero's automata designs in the form of intricate, beautiful and expensive water gardens. The most famous of these is the Villa d'Este at Tivoli near Rome, built in 1550 for the son of Lucrezia Borgia. The gardens were tiered - a series of sluicegates and valves regulated the water flow and the subsequent velocity of the fountain jets. There were also numerous grottoes with water powered figures either moving, playing or spouting.

In August 1981, I visited the equally impressive pleasure-palace and water gardens at Hellbrunn on the southern outskirts of Salzburg. Built between 1612 and 1619 they were based on the original designs of the Villa d'Este at Tivoli.

Archbishop Marcus Sitticus devised the lay-out of the water gardens with the specific intention of creating an exquisite and entertaining pleasure palace. Strategically hidden and secretly operated water jets and fountains concealed along the borders of the many pathways, within stationary and moving figures of men, women and animals principally from Greek and Roman mythology and submerged within beautiful garden pools, would suddenly and unexpectedly spray unsuspecting guests with water or soot. But perhaps the two most remarkable pieces of automata at Hellbrunn are the small puppet theatre, where miniature mechanical figures depict everyday life in a small baroque township (burghers, craftsmen working, a butcher killing a calf, gypsies dancing with a tame bear, a band of guards marching in front of the town hall, etc.) and the beautifully crafted water-organ that simultaneously plays a pleasant chorale. These two examples of superb craftsmanship are, like all the other ingenious mechanical devices at Hellbrunn, water-driven.

The automatic water-organ worked by appropriately positioned cams rotating on a water-wheel driven cylinder activating a series of levers, uncovering the tops of the organ pipes; the water-pressure-induced compressed air which was released, produced the musical note. Different compositions could be played simply by rearranging the positions of the cams on the

cylinder. The musical scores included works by Mozart and Haydn written specifically for the automated machine.

The French silk weaving industry in Lyon provided the next significant advance in the history of automata. Established in 1466 by Louis XI, the industry was assisted considerably by the introduction of John of Calabria's silk loom. However, by 1725 a heavy demand built up for extremely complicated patterns and the weavers, whilst keeping up to date with the latest fashion designs, could not maintain the output of bedcovers, tablecloths, hangings etc. required. The necessarily radical solution was simply the adaptation previous and existing water-driven technology.

The principles of the automatic water-organ were adopted by organ maker's son Basile Bouchon in the development of his new automated silk loom. A sequence of holes cut out of a roll of squared paper, determined where the cams should be placed on the cylinder and controlled the patterns to be woven. The paper roll invention was improved upon by Falcon in 1728 who decided to divide up the pattern by using separate cards thus helping the weaver match up the arrangement of punched holes exactly. The existence or non-existence of the holes in the punched paper/card memory formed the principles of the yes/no on/off two digit binary code system and were in effect the first computer programs.

In 1741 Jacques de Vaucanson took Bouchon's ideas a stage further. He cut holes in the cylinder itself and then placed the paper around it. The wires on the loom that remained stationary were threaded through the holes in the cylinder, when the cylinder rotated via a ratchet against the wires it clicked onto the next series of holes thus advancing the coded weave pattern. The prospect of the automated loom replacing the Lyon silk weavers had a two fold effect: the weavers rioted and the Vaucanson loom was abandoned, moved to Paris, where, for more than 50 years, it stood in the city's Museum for Arts and Crafts.

In 1800, a Lyon silk weaver and inventor Joseph Marie Charles Jacquard improved and re-constructed Vaucanson's forgotten loom. Jacquard returned to Falcon's idea of using separately coded

paper cards. Circulating continuously, each linked card was 'read' by a rotating prism - a la Vaucanson's cylinder. Initially the automated looms produced uproar among the European artisans, exemplified in Britain by the Luddites. This time however the new technology was not completely deserted and was subsequently used comprehensively throughout Europe.

In 1812, 26 years after the Muller difference engine hypothesis, Charles Babbage developed and expanded upon Muller's original proposals and designed his own complex automated calculating machine - the Babbage Difference Engine. And in 1822, with £17,000 governmental assistance he substantially improved upon his prototype model and successfully built a difference engine with a capability of evaluating logarithm tables to 6 decimal places and of compiling accurately, for a 50 year period, a series of life expectancy statistical projections. During the years 1833 and 1834, Babbage conceived an even more sophisticated machine - his Analytical Engine: this involved the automation of all mathematical calculations. But the project failed at the working model stage - the complicated component designs required precision engineering techniques and were too advanced for the technology of the 1830's.

Notwithstanding these setbacks Babbage's work continued and culminated in the invention of his Universal Digital Calculator - but he died in 1871 before the machine could be completed. Yet through his notes Babbage had formulated a series of automated component parts that were the mechanical equivalent of the present day micro-computer. The calculator consisted of:

(1) An arithmetic unit whereby a series of cogs, gears, levers, rods and wheels combined to perform the calculations.

(2) A store or memory that retained all mathematical data before and after it was calculated.

(3) A control unit that integrated the memory with ongoing calculations.

(4) Input and Output devices through which the relevant mathematical problems were set and consequently answered.

In order to control the functions of the machine, Babbage also employed the Bouchon/Falcon coded card method of differentiating between the required programmed mathematical information. English engineers saw the advantages of the coded card idea and, in 1847, Richard Roberts translated the system into a procedure for controlling rivetting machines. (Depending upon the required task, programmed cards could activate the necessary varying selections of multiple rivetting spindles). The rivetting machines were used in the construction of the Menai Straits iron rail bridge in North Wales - completed in 1850 - and in the building of the great iron ships that ferried large numbers of immigrants across the Atlantic to the United States in the 1870's.

This latter factor produced a considerable population increase in America and consequently the processing and tabulating of the 1880 census results took 8 years to complete. As the immigrant numbers continued to rise it became clear that there were going to be severe problems 10 years hence. The solution was initiated in 1880 by Dr. John Shaw Billings, a lieutenant-colonel in the U.S. Army, and officer in charge of the health statistics division. When supervising the count of the first returns to the Baltimore census building he realised there was an urgent need to speed up the entire operation. He suggested to engineer Herman Hollerith, also attached to the health statistics division, the development of the Jacquard coded card principle as a possible method of devising an automated counting and data collection system.

Using cards the size of dollar-bills, simply because dollar-bill holders were readily available, Hollerith advanced the theories of Bouchon, Falcon, Vaucanson, Jacquard and Babbage by programming the holes punched in cards so that they corresponded to the age sex, nationality, date of birth, family-size, location etc. data required. Along with the tabulator he also designed, the 1890 census information was consequently processed in 4 years instead of 8 and this saved the United States Government half a million dollars.

The Hollerith tabulator was used in the British census of

1911 and subsequently adopted by International Business Machines (IBM) giving them the world lead in automated computing - a lead now being challenged by Fujitsu of Japan.

In 1876, mathematician, engineer and natural philosopher, Lord Kelvin (William Thomson, 1st Baron, 1824-1907, Peterhouse, University of Cambridge and the University of Glasgow) established the theoretical principles of an analogue differential analyser. Unfortunately his theories were not realised until the mid 1920's when American engineer Vannevar Bush constructed a working model of the analogue device. The Babbage Difference and Analytical Engines were however far superior principally because the results from his machines were measured in separate digits, for example: the abacus, the digital watch and computer (the vast majority of modern electronic computers are digital) - whereas the results from the Kelvin/Bush analogue machine were measured by reading indicators in conjunction with a continuous gauge, for example: the slide rule and the traditional watch.

Two pioneers of British computing Professor Douglas Hartree and under-graduate Arthur Porter visited the United States to study the Bush machine - and as a result, at the University of Manchester in 1939, built a full scale replica of the analogue computer. But these machines still operated mechanically and were therefore at an impossible disadvantage when in competition with valve computers that calculated information by means of a continuous stream of electrical pulses.

The need to solve complex mathematical equations during World War Two gave an added and urgent impetus to the development of the valve computer, for example: the prodigious mathematical computations inherent in atomic research at Los Alamos, New Mexico, complicated missile guidance systems and in deciphering sophisticated German Enigma codes.

The world's first electronic digital computers (introduced between 1939 and 1945) were the Colossus series of British computers developed specifically for clandestine code de/en-cryption calculations at Bletchley Park, Buckinghamshire, and the United States ENIAC Electronic Numerical Integrator and

Calculator machine also developed (probably) for secretive code de/en-cryption work. ENIAC was completed in 1945 at the University of Pennsylvania by physicist John W. Mauchly, electrical engineer J. Presper Eckert Jr., and 50 scientific and technical staff. The computer weighed 30 tonnes, covered 3,000 cubic feet, contained 18,000 valves and consumed 148 kilowatts - the equivalent power of a steam engine.

Yet, the ENIAC computer still operated on the conventional decimal number system. As the mechanical difference and analytical engines depended upon geared wheels representing each digit, correspondingly the electronic computer depended upon 10 valves representing the numbers 0-9. Both machines, therefore, operated on similar principles and both were exceptionally good at performing arithmetic number-crunching calculations.

Running parallel with these innovations, computer programming, inspired originally by Bouchon, Falcon, Vaucanson, Jacquard, Babbage and Hollerith, developed considerably (during the 1930's and 1940's) through the theoretical work of British mathematician Alan Touring and American Emil Post. In 1936 they wrote simultaneous, yet independent research papers concerning computers governed by coded programs on paper tape capable of an infinite variety of mathematical computations. Their research was subsequently applied to the Colossus series of Enigma code de/en-cryption machines at Bletchley Park, Buckinghamshire, in the 1940's.

However the crucial breakthrough in computer programming had been proposed 100 years earlier in the late 1840's. George Boole, an English logician and mathematician from the University of Cork, calculated that the conventional decimal numbering system could be reproduced in the form of a binary two digit code. During 1945-1950 John von Neumann, a Hungarian/American engineer at the University of Pennsylvania, developed Boole's ideas by adding that either of binary code's two digits could also represent electric current on and electric current off and was therefore extremely efficient when applied to the yes/no potential decision making switching of on/off current inherent within all electronic computers. The culmination of von

Neumann's work resulted in the development of his stored-program hypothesis.

On 21st June, 1948, scientists and engineers led by Professor Tom Kilburn and Sir Frederick Williams at the University of Manchester constructed the world's first binary stored-program computer, the Mark 1. A year later a University of Cambridge team built the EDSAC Electronic Delay Storage Automatic Calculator machine. On receipt of a government contract, the Manchester based company Ferranti Electronics developed a production model of the University of Manchester's Mark 1 machine - the first computer manufactured specifically for the commercial market. The Mark 1, (the Manchester Electronic Computer), which required 4,000 valves housed in a series of fridge-freezer sized cabinets, was built in November, 1948, and delivered in February, 1951, marginally ahead of the United States UNIVAC (1952), EDVAC (1953) and SEAC (1953) machines.

Whilst it was theoretically possible for automata and microelectronic technology to have converged during the 1830's through the work of Babbage and Faraday and during the early 1900's through the work of Hollerith and Fleming, the twin strands of technological development did not actually converge until 1953 when Ferranti Electronics built the world's first transistor based electronic computer.

AUTOMATA*:

In addition to the source references already quoted the previous account was based upon information gleaned from:

Burke, J. (1978), Connections, Macmillan London Limited, London and Basingstoke.

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CHAPTER 2: MICROELECTRONICS*

Interestingly, the history of semiconductors can be traced back to the 1830's approximately the same time as Babbage was constructing his Analytical Engine. Yet these twin strands of technological development progressed totally independent of one another and did not come together until 1953. Had Babbage been alive in 1904, when Fleming invented the thermionic valve and contrived to use it in one of his calculating machines, the valve computer might have been invented 40 years ahead of its time.

(Conducting materials, such as copper and steel, are extremely good at allowing electrical pulses to pass through them, whilst insulating materials like plastic and rubber are extremely bad and effectively stop the electron path from continuing. Semi-conducting materials, such as germanium, silicon and gallium, represent the balance between the two extremes - they can regulate the flow of electrical pulses by a series of insulating 'gates' (operated by electronic switches) which are either open or closed - hence the yes/no on/off, mode of operation which is necessarily and conveniently concomitant with the two digit one-zero binary system).

Michael Faraday (Fullerian Professor 1833-1867 at the Royal Institution) proved, through his explanation of electromagnetic induction in 1831 and subsequent experimental research (1830-39) into electricity, two fundamental scientific laws:
(a) the conductivity of silver sulphide is heightened with an increase in temperature, and conversely
(b) the conductivity of metallic conductors is lowered with an increase in temperature.

Another sub-strand in the development of semiconductors was initiated in 1839 with Becquerel's work on photovoltaic cells. Becquerel observed that a beam of light fired at particular metal and salt compounds could transform them into an explosion of electrical current - thus creating potential semiconductors.

These results were instrumental in assisting Ferdinand Braun in 1874 to develop the world's first solid state device (later used in the detection of radio signals), the tuned electrical circuit and consequently the beginnings of radio itself. The early solid state semiconductor devices comprised almost exclusively of a mineral derived from lead sulphide - galena crystals (non-moving parts). When John Ambrose Fleming invented the thermionic valve in 1904, it quickly superceded the semiconductor technology used in the crystal radio sets. The valve wireless became commonplace.

Nevertheless the major discoveries during this period continued to trace the evolution of microelectronics: 1895: Rontgen discovered X-rays and subsequently worked on the conduction of heat through crystals; 1897: J.J. Thomson discovered the first sub-atomic particle - the electron. 1900: Max Planck postulated quantum theory and in 1905 Einstein explained Becquerel's photovoltaic effect. (For which he won the Nobel Prize for Physics, he did not win it for the theory of relativity). The culminiation of this thinking came in 1933 when Berlin physicist R.W. Pohl forecast the displacement of the traditional valve by miniature pieces of crystal through which it would be possible to regulate the path of electronic pulses.

On 23rd December, 1947, three scientists, John Bardeen, Walter Houser Brattain and William Shockley working at the Bell Company Laboratories in New Jersey, applied the theories originally postulated by Faraday - six months later in June, 1948, they succeeded in developing the first germanium based transistor. Their discovery earned them the 1948 Nobel Prize for Physics.

The first computer to use transistors was built by Ferranti Electronics in 1953 - but it was not until 1959 that transistor sales overtook those of valves and the 1960's before they were commercially mass produced and universally adopted by computer manufacturers. The Americans were slow to recognise the inevitable consequences of a now obsolete valve industry and the Japanese quickly took the world lead in transistor production.

As mentioned earlier, the idea of putting more than one transistor or BInary digiT of information onto a very small chip

of germanium was originally postulated in 1952 by an Englishman: Professor G.W.A. Dummer of the Royal Radar Establishment, Malvern. A year later Robert N. Noyce of the Fairchild Camera and Instrument Corporation, Jack S. Kilby of Texas Instruments Incorporated and Jay W. Lathrop of the Diamond Ordnance Fuze Laboratories perfected and realised Dummer's proposed techniques.

However germanium transistors proved ineffective when they became very warm and in 1955 the U.S. Army gave William Shockley $15 million to develop a transistor made out of silicon that could withstand battle conditions. Shockley left the Bell Telephone Laboratories and moved to Stanford University in southern California where he assembled a team of 8 brilliant scientists and established Shockley's Semiconductor Laboratories in nearby Palo Alto. It was here that he produced the first revolutionary silicon based transistor. (Silicon is an element found in sand and is therefore in plentiful supply. The substance is purified by chemists and physicists to a degree of one alien grain in one thousand million).

After two years the scientists defected from Shockley's organisation to the Fairchild Camera and Instrument Corporation in the Santa Clara valley at the southern end of San Francisco Bay. With their assistance and under the general managership of Robert N. Noyce, integrated circuit technology was invented and the United States subsequently regained the world lead in microelectronics.

The microelectronics industry began to expand rapidly as several senior scientists left Fairchild to form their own companies. The spectacular growth of firms such as Aqueonics, General Devices, Signetics, Siliconix, Intel, National Semiconductor, Advanced Micro Devices plus numerous others totalling over 40, all originally or presently owned and run by the Fairchildren, transformed the Santa Clara Valley into a luxuriously modern industrial estate. 'Silicon Valley', as it became known, afforded the wealthy population (Noyce has a personal fortune of $50 million and 30 of his employees are multi-millionaires) an agreeably congenial environment with excellent educational, leisure and entertainment facilities.

To ensure superiority over the Soviet Union in the development of guided missiles and space technology, the United States Defence Department and the National Aeronautics and Space Administration (NASA) required minute, dependable computer systems capable of being fitted into the severely restricted areas within nuclear/conventional weaponry and space capsules and shuttles. Thus, whilst the number of integrated circuits needed to be multiplied substantially, the dimensions of the silicon chip base had to remain fixed. Consequently, the U.S. Government injected immense financial support into defence and space programmes and as a result microelectronic technology was driven forward at an astonishing rate.

It is possible however that the accelerated development of microprocessor power and micro-miniaturisation was not principally due to guided missile and space technology but to the urgent, Soviet Union inspired, necessity for extremely efficient clandestine de/en-cryption (de/en-coding) work at the National Security Agency at Fort Meade, Maryland, U.S.A. (Sponsored by the U.S. Defence Department, International Business Machines (IBM), the Massachusetts Institute of Technology (MIT) and the Radio Corporation of America (RCA)).

The single silicon based transistor or binary digit of information was developed at Fairchild in 1959 by Kurt Lehovec and Jean Hoerni - by 1964 the chip could accommodate 32 transistors. The Director of Research at Fairchild, Gordon E. Moore, noted this doubling effect and projected the trend into infinity, forecasting that the number of bits per chip would continue to double every year. This astonishing prediction became known as Moore's Law and proved to be, and still is proving to be, exceptionally accurate. The acceleration effect is not diminishing and is not likely to do so until the finite limits of molecular micro-transistors are reached.

In 1970 there was an increase from 256 to 1,024 components per chip; as these figures were becoming unmanageable 1,024 bits of computer information was abbreviated to 1 Kilobit or 1K. 1972 saw the introduction of the 4,096 bit chip (4K), 1973 the 16,384 bit chip (16K) and in 1976-77 the 65,536 binary digit chip - the

64K was launched.

These developments have enabled the production of integrated circuits containing numerous overlapping and interconnected transistors on a wafer thin silicon base. Collectively these integrated circuits are known as microcircuits and this kind of technology is called microelectronics. A microprocessor is compiled by etching the intricate circuitry of an entire computer system through several layers of exceptionally fine translucent film called photographic printing masks onto a chip of silicon 5 millimetres square.

At each stage of the process the photographic printing or photolithography is flooded by ultraviolet radiation leaving the required and necessarily coated electron conducting circuitry engraved upon the chip - the uncovered sections are chemically dissolved leaving the prescribed diagrammatical pattern thus providing a non-conducting area. The link between the conducting and non-conducting areas is made by microscopic electronic switches or transistors. These on-off switches are called BInary digiTs or bits of computing information. Each chip is reproduced approximately 250 times from one wafer of silicon.

The technology for miniaturisation at this level is referred to as Very Large Scale Integration (VLSI). The world leaders in VSLI technology are the Nippon Telegraph and Telephone Corporation. In NTT's Musashino Laboratories scientists are attempting to discover the finite limits of VSLI. In 1982 they succeeded in developing the world's first 256K chip containing 262,144 bits of computer information; this, despite intense competition from all the major electronic companies and at a time when the 64K chip is still in its infancy. It was Hitachi however, (also in 1982) who made the first commercially available 256K chip - the chip is now being mass produced by many semiconductor manufacturers: Hitachi, NTT, Nippon Electric (world's largest integrated circuit (chip) manufacturer), Fujitsu, Toshiba, Texas Instruments, Motorola, National Semiconductor, Intel, Fairchild, Signetics, Advanced Micro Devices, Mostek, RCA, Harris, Matsushita Electric, Mitsubishi Electric, Sony, Fuji Electric, Sharp, Tokyo Sanyo Electric, Oki

Electric, GEC-Marconi, Plessey, Ferranti, etc.

On 23rd February, 1984, Nippon Telegraph and Telephone announced the successful development and test manufacture of the world's first million bit chip: the megabit or 1,000K chip. Accommodating one million bits of computer information, this new chip has 4 times the memory-power of any microprocessor currently available.

A magnetic bubble memory, a sub-strand of microelectronic technology, can store 4 million bits and potentially 100 million bits of computer information (or the text of 3 Bibles) on a chip approximately 1 centimetre square. The magnetic bubble memory consists of a series of infinitesimal pockets of magnetism (the bubbles) that can be transmitted across communication links etched on a minute sliver of garnet crystal. A magnetic field initiates the firing of the microscopic bubbles (4/10 of a micron or 1/10,000 of a centimetre in diameter) past numerous de-coding areas that translate the existence or non-existence of the bubbles into the two digit binary code system.

(Computer memory chips are categorised as follows:
(1) Random access memory (RAM) is essentially the memory space (for programming) available to the user. Unless stored on disc or cassette all data is erased when the power is switched off.
(2) Read-only memory (ROM) is a pre-programmed chip with a memory store that can only be read from - it cannot be altered or written into.
(3) Magnetic bubble memory stores and retains all data even when the power is switched off.

Computer information can be stored/accessed via:
(a) Conventional tape cassette: capacity approx. 72,000 characters on 30 minutes of tape.
(b) Floppy discs (8 and 5.25 inch diameter), micro-floppy discs (3.5 and 3 inch diameter): capacity approx. 5,000,000-320,000 characters.
(c) Magnetic bubble memory (1 square centimetre) capacity approx. 3,000,000-500,000 characters.

(d) Winchester hard disc (5 inch diameter), Winchester micro-hard disc (3 inch diameter): capacity approx. 30-5 million characters).

Very Large Scale Integration has reached the stage where optical miniaturisation techniques are unsatisfactory. At such microscopic levels the light waves used in wafer fabrication tended to bend; therefore to avoid light refraction, much shorter wavelengths had to be utilized and this involves X-ray and electron-beam lithography.

The diagrammatical maze of integrated circuitry is drawn using Computer Aided Design (CAD) on a scale of about 10,000 times the size of the actual microprocessor. The reasons for such massive amplification are that the numerous connections measure only one micron across which is approximately 1/50 of the width of a human hair.

The integrated circuitry on today's silicon chip is comparable to a map 5 millimetres square representing the clearly defined street network of a city the size of San Francisco - the future silicon or gallium chip will remain 5 millimetres square but the clearly defined street network will represent a city the size of the entire North American continent.

Furthermore, in 1982, Nippon Telegraph and Telephone developed an electron beam capable of etching gold wire integrated circuit bars 0.20 of a micron in diameter or 5/1,000 the width of a human hair. In a few years this infinitesimal micro-miniaturisation will facilitate the development of the 4 million bit chip or the 4,000 K chip followed in 1990 by the 10 million bit chip or the 10,000 K chip; and eventually the 1 billion bit chip or the 1 million K chip.

To progress further it would be necessary to accelerate the electron velocity throughout the ultra-fine gold wiring. Scientists at Fujitsu found that the element gallium, which has proved to be a better semiconductor than silicon, provided the answer. Gallium permits the electrons to be fired around the circuitry 30 times faster than conventional silicon ...

As a senior Fujitsu physicist has pointed out: "... to

fabricate the transistor we form a highly purified layer of gallium arsenide; on top of that we add a layer of aluminium gallium arsenide. On the boundary between these two layers is formed a very special region where the electron gains very high mobility. We can use this as the channel of the transistors. The electrons move very fast so we get a high switching speed transistor." (Senior Fujitsu physicist, 15th March, 1982, in Taylor, 15th March, BBC2 TV, Horizon).

Brian Josephson of the University of Cambridge won the 1962 Nobel Physics Prize for his theoretical work on freezing, to a temperature of -273 degrees Centigrade or absolute zero, the atoms and molecules in microelectronic integrated circuitry. At these temperatures the electrons encounter no resistance when they are fired around the circuitry network, similarly the metal electronic switches encounter no resistance - the electrons become superconductors and can therefore transmit messages at a velocity measured in 1-10 picoseconds (or millionths of a millionth of a second). Physicists at IBM, the Bell Telephone Laboratories and Hitachi etc., are researching into the finite limits of the Josephson Junction effect, unfortunately however, for the super-fast switching to be effective the circuits must be immersed in liquid helium at -269 degrees Centigrade. In September, 1983, Hitachi announced the development of an experimental (1.5 microns square) Joseph Junction fabricated from niobium capable of operating at switching speeds of 5.5 trillionths of a second.

The Josephson Junction computer could facilitate 250 million operations per second. Yet, if the intervening atoms and molecules, that impinge upon the path of the electron, could be 'frozen' by artificially re-arranging the regular atomic structures rather than via temperatures of -273 degrees Centigrade, then I believe it will probably be this former method that will produce the first commercial super-fast chip ...

The dimensions of conventional microprocessor structures are approaching the limits nature provides in its own regular atomic arrangements, but if these limits could be transcended in the form of an artificial super-lattice structure measuring only a

few millimetres thick yet consisting of a million atom-fine layers of different materials, (produced via molecular beam epitaxy layering) it may be possible to fabricate an ultra thin chip that could fire super-fast electrons around its integrated circuitry via what physicists call 'ballistic transport'.

The development of ballistic transport is dependent upon reducing the distance the electron has to travel across the microelectronic device and the probability of it colliding with any intervening atoms. Any deviation from the electron's path impinges upon its efficiency. Therefore an increasingly short atom-free electron path will correspondingly increase microprocessor efficiency and power. Molecular beam epitaxy layering applied in conjunction with an electron-beam could produce the world's first microscopic super-fast chip; and theoretically switching speeds of perhaps a thousandth of an attosecond (a millionth of a picosecond or a thousandth of a trillionth of a second, 10^{-21}) which are approaching the speed of light.

Physicist Dr. Michael Pepper (16th January, 1984, in Gilling, 16th January, 1984, BBC2 TV, Horizon) of the Cavendish Laboratory, Department of Physics, University of Cambridge, has pointed out that this degree of super-micro-miniaturisation puts semiconductor technology into a completely new regime of physics where some conventional scientific laws do not apply.

On 1st December, 1983, Plessey announced a £50 million investment programme into the development of the miscroscopic gallium arsenide super-chip. Their plan is to become the world leader in gallium arsenide chip fabrication, and intend to obtain 15 per cent of the world market by 1989. The chip or microprocessor Plessey have just launched has gold wire connections 0.25 of a micron in diameter or 1/200 the width of a human hair.

Moreover, in the Engineering Department Laboratory at the University of Cambridge, Dr. Haroon Ahmed (1983) has succeeded in etching lines 0.05 of a micron in diameter or 1/1000 the width of a human hair onto slivers of silicon and gallium. This micro-miniaturisation could accommodate 100 million infinitesimal

squares onto a single microscopic dot of silicon or gallium, alternatively the entire text of the Bible could be reproduced 20 times on a piece of silicon or gallium the size of a pin-head.

The ultimate in micro-miniaturisation could well depend upon the proficiency of research chemists to synthesise three-dimensional micro-transistor switches from inorganic chemicals. The chemical transistor switches that have already been constructed are smaller than a Bacillus Bacterium measuring 2 microns or 79 millionths of an inch. (Some scientists consider these transistors to be almost large).

Dr. Forrest L. Carter, a research chemist at the United States Naval Research Laboratory in Washington D.C. estimates that by 2010 it will be possible to accommodate ...

"... a million billion molecular switches within the area of one cubic centimetre, more, probably, than all the transistors ever made." (Carter, October, 1982, in Boraiko, October, 1982, National Geographic, p.444).

The principal scientific inventions and discoveries inherent within the parallel histories (since about 1830) of automata and microelectronics culminated in the development of integrated circuit technology - thus pulling together for the first time the twin strands of automation and modern electronics.

Yet, because of these parallel histories, it would be wrong to asssume that the digital computer is an intrinsically electronic device - indeed, it is now theoretically possible to construct an optical computer capable of utilizing the concentrated light of laser-beam radiation as opposed to conventional electric current communication.

By firing photon particles around an infinitely complex network of optical micro-circuitry the accelerated velocity of the laser-beam radiation may be able to operate the optical micro-transistor switches 1,000 times faster than the most efficient microelectronic computer. Optical computing originated in the 1880's and 1890's through the work of French physicists Charles Fabry and Alfred Perot - principally because of their invention in 1896 of an ingenious optical device designed for

measuring the wavelength of a particular spectrum of colours. The Fabry-Perot interferometer, as it became known, proved to be a superb example of optical precision engineering and was subsequently used extensively throughout the field of optical science.

However it was not until about 1974-1976 that it became technically possible to transmit binary computing signals by laser-beam radiation rather than electric current. (The leading reseach centres are Heriot-Watt University, Edinburgh; Bell Telephone Laboratories, New Jersey and the University of Arizona).

Eitan Abraham, Colin T. Seaton and S. Desmond Smith of Heriot-Watt University in Edinburgh have already built a crystal based optical 'transphasor' (1982-83) capable of operational switching analogous to that of the conventional transistor. But whereas the fastest microelectronic transistor switches operate in less than one nanosecond or one billionth of a second, 10^{-9}, (except via the Josephson Junction effect and via ballistic transport, see previous examples) the optical transphasor could operate at approximately one picosecond or one thousandth of a billionth of a second, 10^{-12}. This would result in one trillion computer operations per second. Because the optical computer (which could be completed by 1993) would use laser-beam radiation, firing photon particles at (theoretically) the speed of light (186,000 miles per second) around the optical circuitry the finite velocity of transmitting computer-information will have been reached.

The transmission of laser-light has already been developed and utilized in the form of the microelectronic associated technology - the optical fibre communication link. Conventional electrically governed wired cables are relatively cumbersome - they can only transmit an extremely limited amount of computer information, and can only handle a comparatively small number of telephone calls and cable television channels. Individual links are susceptible to electrical interference from parallel wiring and require constant maintenance.

The operational mode of fibre optics is to fire laser-light at ultra high speed through exceptionally fine fibres of glass

the diameter of human hair - microprocessors at either end of the link decode the laser-light information so that the computer, telephone or television can receive the unscrambled data immediately. The system is significantly faster and more efficient than conventional wiring, interference-free and consumes a minimal amount of power.

Table 1: CHANNEL CAPACITIES (APPROX.)

COMMUNICATION CHANNEL	NUMBER OF TELEPHONE CIRCUITS	COST PER TELEPHONE CIRCUIT	NUMBER OF TELEVISION CHANNELS
PAIRED CABLE	500	$200	1
COAXIAL CABLE	30,000	$ 30	30
TERRESTRIAL-MICROWAVE	10^5	$ 15	100
SATELLITE - (INTELSAT 5)	10^5	$ 30	100
WAVEGUIDE (TEO 1)	10^5	$ 1	100
FIBRE OPTICS	10^8	?	10^5

(Source: Adapted from Cawkell, July, August, 1978, in Forester ed. 1981, p.258).

I believe that the most graphic examples of developmental and actual speed of microelectronic technology are as follows:

In comparison with the 1945 ENIAC electronic digital computer the 1984 micro-computer has considerably more computing capacity, is considerably faster, has a much larger memory, consumes the power of an electric light bulb as opposed to a steam engine, is about 10,000 times more reliable, occupies 1/30,000 of the volume and costs 1/10,000 as much. If the motor industry had enjoyed a developmental acceleration similar to that of the microelectronics industry, a Rolls Royce would cost less than £2, run for about 25 years on 1 pint of petrol and deliver the same power-thrust as those turbine-engines driving the QE2.

Microprocessors release about 1 bit of computer information every 30 billionth of a second - the equivalent of reading the

entire Bible in 1.5 seconds. The electrons are fired around the integrated circuitry in a few nanoseconds or a few billionths of a second. Light, which takes approximately 1.25 seconds to reach the Moon (from Earth), can only travel 12 inches in one nanosecond.

Table 2: GENERATIONAL DEVELOPMENT OF COMPUTERS

APPROXIMATE DATES	GENERATION	TECHNOLOGY/ELEMENT
1939 - 1953	1	Valve
1953 - 1959/1964	2	Germanium/Early Silicon Transistors (Small Scale Integration, SSI)
1959/1964 - 1976	3	Silicon Transistors (Medium Scale Integration, MSI - Large Scale Integration, LSI)
1976 - 1990?	4	Silicon/Gallium Micro-Transistors (Very Large Scale Integration VLSI)
1990? - ?	5 6 7 8 ?	Silicon/Gallium Micro-Transistors (Immense Scale Integration, ISI) Crystalline Material Based Optical Transphasor

A third parallel, yet inextricably associated and interconnecting strand, is that of work. Automata has already affected the pattern of work considerably, but only now, for the first time, in the late 1970's and early 1980's have all three elements automata, microelectronics and work, dramatically fused together to provide the opportunity to change our conventional attitudes to work irrevocably.

MICROELECTRONICS*:

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CHAPTER 3: WORK*

"The church developed a new doctrine of the importance of work but strictly as an instrument of spiritual purpose. The Benedictine rule emphasised the spiritual danger of idleness and ordered regular work at fixed times of the day in order to reduce it. The church also recommended labour as a penance on good scriptural authority emanating from man's fall. Work was a discipline, it contributed to the Christian virtue of obedience. It was not seen as noble, or rewarding, or satisfying, its very endlessness and tedium were spiritually valuable in that it contributed to Christian resignation." (Anthony, 1977, p.37).

"If work were a good thing the rich would have found a way of keeping it to themselves." (An old Haitian proverb). (Jenkins and Sherman, 1981, p.50).

"I like work; it fascinates me. I can sit and look at it for hours." (Jerome, 1968, p.144).

The ancient Greeks and Romans considered work to be a punishment, debasing and a curse that had a corrupting effect upon the mind, however the pursuit of leisure was thought to provide man with a chance to exercise his mind and spirit: an opportunity for contemplation.

Greek philosophers accepted, albeit reluctantly, that agricultural work was a necessity because it provided sustenance and independence. Work "was not assigned the moral value which it has gained from 20 centuries of Christianity ...

"... to be sure, the illiberal arts ... are spoken against and are, naturally enough, held in utter disdain in our states. For they spoil the bodies of the workmen and the foremen, forcing them to sit still and live indoors, and in some cases to spend the day at the fire. The softening of the body involves a serious weakening of the mind." (Mosse, 1969, on types of work

in Xenophon, p.25, in Anthony, 1977, p.15.)

The Hebrews believed work to be arduous and disagreeable toil but it was nonetheless a means of atoning for sin and regaining lost spiritual dignity.

Mediaeval Christianity stressed the degradation and low importance of work, yet admitted that it did allow charitable endeavour and the purification of the body, soul and mind - and thus prevented infiltration of any "evil thoughts and habits". (Fox, 1971, p.3).

Contrary to the parallel development of Protestantism, the doctrine of early Catholicism (16th century) declared that ideally there should be no work as this would allow contemplation and a spiritiual life. Indeed pure contemplation was regarded as being more important than even monastery work.

The Protestant work ethic was initially derived from the immensely influential teachings of the German religious leader Martin Luther (1483-1546). Whilst agreeing at first with the Catholic precept of work being the scourge and misfortune of the wicked, the Lutheran movement asserted the holiness, sanctity and goodness implicit in man's daily labours. An individual's work within their profession must be totally faultless. The definition of profession was further developed into an individual's 'calling' ... to work at one's 'calling' was to serve God and attain spiritual salvation. Increasingly, the Protestant ethos of work was inculcating the individual with the extremely powerful and persuasive belief that work was "the base and key of life". (Parker, 1971, p.3).

And in the mid - second half of the 16th century Catholic teachings moved much closer to those of the Protestant work ethic by admitting that work was also a means of acquiring and displaying charity, goodness and purification. The righteous ethic of honest endeavour was beginning to indoctrinate the societal consciousness.

John Calvin (1509-1564) the French Protestant theologian and Geneva based Swiss Reformer, concentrated, amplified and extended these beliefs with his notion of predestination and election to salvation. He believed that a minority of men "are predestined

unto everlasting life, and others ordained to everlasting death"; (Anthony, 1977, p.41) any deviation from this edict would be in direct contravention to God's eternal decrees and imply that the precept of predestination could be reversed by means of human intervention.

Calvin considered it virtuous to remain within the class or profession to which one was born ... it is the will of God that all men (no matter how wealthy) should work. Austerity was deemed to be good and righteous. The financial rewards and luxuries gained through work should be discarded - the only inherent value of any labour was if it "helped establish the kingdom of God on earth". (Fox, 1971, p.3). He predicted the destruction of "any kingdom which is not ruled by the sceptre of God, that is by His divine word". (Calvin in Bonnet ed. 1854, in Henderson, 1959, Chambers's Encyclopaedia Vol.II p.800). For Calvin, work was not just economically essential, it was a moral necessity.

But as Weber (1967) pointed out there was never any specific directive from the Bible ordaining such a philosophy. Indeed the notion of one's calling or wordly activity could be said to be repudiated in the Lord's Prayer ('Give us this day our daily bread') and treated with at best indifference and at worst hostility in the New Testament. Moreover, Weber argues that Luther's initial teachings were in fact perfectly consistent and in religious alignment with the aforementioned biblical principles. The acquisition of material wealth beyond that of personal need was regarded as a sign of absence of grace. However, as Luther became more involved in secular activities "... he came to value work in the world more highly". (Anthony, 1977, p.41). Also contrary to Calvin, Luther believed it possible to forfeit a state of grace and subsequently recover it without loss of dignity.

Weber contends that it was the Calvinistic interpretation of one's calling "that was essential to the development of capitalism and has become symbolized in the phrase 'the Protestant ethic of work'". (Anthony, 1977, p.41)

And the Puritan ethos that evolved from Calvin's teachings

further accentuated the Protestant work ethic to the point where it became directly opposed to the leisure and pleasure principles of the Greeks and Romans. Although the religious connotations inextricably associated with work largely disappeared with a 19th-20th century capitalist industrialised society geared to economic growth and technological advance, the predominantly secular, puritanical ethos of hard work became an end in itself and a principal and inherent feature of Britain's societal value system in particular and national consciousness in general.

The Puritan middle class ethos determined that to work was to be good, honourable, sober, industrious, conscientious and law abiding. Work was thought of as being central to an individual's self-identity. Not to work (this philosophy was, and still is, directed specifically at the working classes) was to be evil, dishonourable, disreputable, idle, indolent, unscrupulous and wicked. Conversely the upper classes who did not work were termed 'gentlemen of leisure' (see later).

Conditions of grinding squalor and penury meant that the working classes, as Fox (1976, in Esland and Salaman, eds. 1980) has said, regarded work as primarily an extrinsic, material necessity. Only a small minority of skilled craftsmen could ever hope to enjoy any intrinsic pleasure out of their work. The middle classes believed in both the extrinsic values of work - wealth, status and power; and the intrinsic values of self-advancement, enhancement and fulfilment. The extrinsic and intrinsic values of work were however virtually the characteristic necessity and compulsion of the working and middle classes; the aristocratic 'amateurs' treated the ideas of the lower classes with distaste and disdain, the activity of leisure was the exclusive preserve of the upper classes - the 'gentlemen of leisure'.

Csikszentmihalyi (1977) has pointed to the fascinating paradox that the very people who regard(ed) conventinal leisure with suspicion and displeasure and ascribe(d) to the Puritan ethic of work are/were themselves indulging in, and enjoying, an activity which to them is practically leisure or play "Weber himself - probably because he also accepted the play-pleasure

versus work-unpleasure dichotomy - never saw clearly that the ascetic withdrawal from all pleasure can in itself be enjoyable." (Csikszentmihalyi, 1977, p.187).

"... in the United States the pursuit of wealth, stripped of its religious and ethical meanings, tends to become associated with purely mundane passions, which often actually give it the character of sport." (Weber, 1930, p.182). Ironically it is these characteristics of sport and pleasure that this thesis contends should be the regulating criteria for future activity-employment.

It was within the context of a developing 19th century capitalist industrial society overwhelmed by the Puritan 'hard work' ethos that both Marx and Engels condemned and rejected the notion that goodness, honour and diligence are implicit in, and necessarily associated with, the activity of work.

First Marx ... in contrast to communist society ... under capitalism - the necessity to work for someone else results in exploitation and subsequent alienation ...

"... work is external to the worker, it is not a part of his nature and consequently he does not fulfil himself in his work but denies himself ... he has a feeling of misery, not of well-being, does not develop freely a physical and mental energy, but is physically exhausted and mentally debased. The worker therefore feels himself at home only during his leisure, whereas at work he feels homeless. His work is not voluntary but imposed, forced labour. It is not the satisfaction of a need, but only a means for satisfying other needs." (Marx in Bottomore and Rubel eds., 1963, p.177, in Fox, 1971, p.5).

Similarly Engels affirms:

"*As voluntary, productive activity is the highest enjoyment known to us, so is compulsory toil the most cruel, degrading punishment.* Nothing is more terrible than being constrained to do some one thing every day from morning until night against one's will. And the more a man the worker feels himself, the more hateful must his work be to him, because he feels the constraint, the aimlessness of it for himself. Why does he work? For love of work? From a natural impulse? Not at all! He

works for money, for a thing which has nothing whatsoever to do with work itself; and he works so long, moreover, and in such unbroken monotony, that this alone must make his work a torture in the first weeks if he has the least human feeling left." (Engels, March, 1892, reprinted 1952, pp.118-119, italics added).

Capitalism, they maintain, engenders the division of labour in which " each man has a particular, exclusive sphere of activity, which is forced upon him and from which he cannot escape. He is a hunter, a fisherman, a herdsman or a critical critic and must remain so if he does not want to lose his means of livelihood; while in communist society, where nobody has one exclusive sphere of activity but each can become accomplished in any branch he wishes, society regulates the general production and thus makes it possible for me to do one thing today and another tomorrow, to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner, just as I have a mind, without ever becoming hunter, fisherman, herdsman or critic." (Marx and Engels, 1968, p.45).

A similar premise of pleasurable, self-enhancing, intrinsically valuable activity-employment is proposed by Maslow (1954) and Herzberg (1968) of the self-actualisation school of psychology. This also, necessarily, excludes the indoctrinating moral and religious legacy of honest miserable endeavour and the puritanical virtues of hard unpleasant work. The authors suggest that work should develop the individual's personality and facilitate choice, creativity, responsibility, self-fulfilment and enjoyment. "A musician must make music, an artist must paint, a poet must write if he is to be ultimately happy. What a man can be, he must be. This is what we call self-actualisation." (Maslow, 1954, in Cotgrove, 1978, p.135).

My argument is that microelectronic technology, irrespective of political complexions, generates wealth and can therefore facilitate the release of virtually everyone from the constraints of forced labour within one particular sphere (see Chapter 4). It gives men and women the opportunity to hunt, make music, write a computer program or play golf in the morning; fish, paint, learn Sociology or French via computer program, cable or

satellite television or video cassette, or play chess in the afternoon; and raise cattle, criticise, write poetry or prose, study photography, learn wine-making, watch television or video in the evening. The individual, given a leisure income, would be just as free, probably much more so, than Marx claims he is within communist society and therefore has the best chance possible of attaining some degree of self-actualisation.

If we could establish a society where highly sophisticated microelectronic automation provided the option to replace virtually any form of traditional work then the individual would be free to partake in an infinite variety of occupations or hobbies - the activities of their own particular choice. Therefore the whole notion of whether we live within a capitalist, socialist, state socialist or communist system becomes irrelevant - what actually matters is the technology itself and our attitudes towards it.

American author and journalist Hazel Henderson agrees that it is simply no longer germane to talk in terms of a left versus right political struggle.

"This new technology is going to completely change politics in industrial societies I think it already has. The first big change is that it no longer plays out in terms of the 19th century capitalism versus communism or Marxism ... because it is no longer a matter of who owns the means of production - *the means of production themselves have changed everything*. It is the extent to which the means of automated production can fit with the natural system, the extent to which they can be made to fit human requirements and the needs of human societies ... and our ability to adapt. The politics of virtually every industrialised country no longer plays out as left versus right ... and this has caused a great deal of confusion. Throughout the industrialised world the old consensus is breaking down. It is certainly happening in the United States where there are almost two minority parties - the Democrats and the Republicans. 48 per cent of the registered voters no longer even vote. The sentiment that you get in the U.S. is that we do not have two political parties any more - we have two football teams owned by

the same owner." (Henderson, 17th October, 1982, BBC1 TV, Will Tomorrow Work? Italics added).

Britain has, in successive General Elections, experienced a similar form of political apathy and disenchantment.

1951: 97 per cent of the electorate voted either Conservative or Labour.
1979: 61 per cent of the electorate voted either Conservative or Labour.
1983: 52.6 per cent of the electorate voted either Conservative or Labour.

1974: The Labour Government was elected by 28.5 per cent of the total electorate.
1979: The Conservative Government was elected by 33 per cent of the total electorate.
1983: The Conservative Government was elected by 31.6 per cent of the total electorate. 28.3 per cent of the electorate did not vote at all.

(Sources: BBC1 TV, 17th October, 1982, Will Tomorrow Work? The Guardian, 11th June, 1983, p.1)

Henderson continues that this is the general political trend among the majority of industrialised countries ...

"... the two old parties that used to be in opposition are basically talking in the past about the same old issues." (Henderson, 17th October, 1982, BBC1 TV, Will Tomorrow Work?)

So unless we radically re-structure wealth and income distribution the consequences of this technological phenomena will be to establish a new non-political but equally divisive societal re-alignment. What Henderson describes as the "bureaucratic people versus the anti-bureaucratic people - a bureaucratic centrist technocracy versus the rest of us: people on the receiving end of the technology who feel disenfranchised by the technocracy. The elitists will be the technocrats ... and it will not matter whether the technocrats are technically

socialists or marketeers ..." (Henderson, paraphrased, 17th October, 1982, BBC1 TV, Will Tomorrow Work?)

This analysis is subscribed to by Francis Pym, former Secretary of State for Foreign Affairs. In a Cambridge University Conservative Association lecture, he pointed out that "the two most prevalent philosophies to deal with the microelectronic revolution and the employment issue - laissez-faire and socialism - are both inadequate" (Pym, 10th October, 1983, The Guardian, p.9). Significantly, and unlike the majority of the conservative optimists (see Chapter 4), Pym is careful not to dis-associate technological change with attitudinal change ... "we are at the dawn of a change so momentous that it will force us completely to revise our traditional attitudes to employment and to how it is structured and organised". (See Chapter 4) (Pym, 10th October, 1983, The Guardian, p.9). Specifically, Henderson believes that a substantial guaranteed income would allow people some choices about how they want to re-deploy themselves. "This is the kind of flexibility we are going to have to create." (Henderson, 17th October, 1982, BBC1 TV, Will Tomorrow Work?)

However, unless we eradicate the indoctrinating moral evaluations we invest in and associate with hard work and loyalty (the Victorian virtues espoused by Prime Minister Margaret Thatcher) the unprecedented potential for activity or leisure to displace work as society's primary self-identifying ethos will never be fully realised. As Len Murray, General Secretary of the Trades Union Congress, suggests, the work ethic is one religious legacy we can do without ...

"... it was the 18th century that really intensified the ethic of work. Not to work became literally wicked. Degredation went with not having work and it was said that it was your own fault if you could not find a job. *This is the prime heresy - to make income dependent upon work* and to say you are wicked if you do not work and for being wicked you suffer in income terms. This is the mould we must break ...

... nor can we tolerate inflicting full-time leisure on millions of unemployed - *on a poverty income*. Our objective

must be to free more people from toil. That could mean a longer period of education, earlier retirement, a shorter working week, longer holidays; and pensioners given a fairer deal relative to the rest of society ...

... I would like to see a social consensus through which, primarily, it is recognised that people have needs because they are people. The fact that they require food entitles them to a fair income - this must be the pre-requisite, not the fact that they are capable of work. We therefore require a social wage ...

... *I have nothing against unemployment - in one sense.* What is bad is loading all the leisure onto 4 million unemployed and saying 'you can have all that', yet at the same time saying 'you can also have living standards of one-third of what everyone else gets *in work*'. The real issue is how much are we going to say a man, woman or family, outside conventional employment, is entitled to ..." (A compilation of Murray, 30th March, 1982, BBC1 TV, Everyman, and Murray, 27th August, 1983, in Harper, 27th August, 1983, The Guardian, p.26, italics added).

Actually attempting to define exactly what we mean by work is in itself a complex task. Is work to be regarded as purely a synonym for paid employment? Or can work be considered as the act of discharging day to day household tasks: cooking, washing, ironing, infant and parental care, shopping, decorating, home care and maintenance, gardening, washing the car etc? Or perhaps voluntary work?

According to Ann Oakley (1975) women who perform unpaid physically demanding yet mentally monotonous housework certainly regard their mundane household tasks as work. But clearly, household activities are no different to any other form of activity in that they are all subject to an idiosyncratic individualised definition.

Yet Stanley Parker (1971) would disagree - as he indicates in his schematic diagram that categorises the various components of what he calls 'life space':

WORK TIME		NON-WORK TIME		
Work	Work obligations	Physiological needs	Non-work obligations	Leisure

(Source: Parker, 1971, p.27)

Work obligations include additional duties associated with work, voluntary overtime, travelling to work, a second job etc. Non-work obligations are what Joffre Dumazedier (1974) calls semi-leisure; and significantly Parker classifies domestic work within this same category. Leisure itself is the time when the individual can do as he/she pleases and is free from obligations to either him/herself or to others.

Parker further re-organises his initial schematic diagram into a plan that incorporates both the dimensions of time and activity:

	ACTIVITY		
	Constraint		Freedom
Work	Work (employment)	Work obligations (connected with employment)	'Leisure in work'
TIME			
Non-work	Physiological needs	Non-work obligations	Leisure

(Source: Parker, 1971, p.28)

Clearly, Parker, by the very nature of his structured classifications excludes housework from the category of conventional work thus forcing it into the rather ambigious section of non-work obligations or semi-leisure. This is a purely subjective and arbitrary differentiation and as such unreliable and unsatisfactory - but, nevertheless, conforms to the established and official norm.

Because women are not paid for working in the home their duties are excluded from the national statistics and are therefore not considered as being traditional work.

"It has been calculated in Sweden that 2,340 million hours a year are spent by women in housework compared with 1,290 million hours in industry. The Chase Manhattan Bank estimated a woman's overall working week averaged 99.6 hours." (Mitchell, 1971, p.102).

So are household tasks work? Despite the irrefutable illegitimacy of the official national statistical evidence, the conventional answer would be no - simply because the definition does not conform to the traditional norm of the majority. As indicated earlier, there *is* no all embracing correct answer; increasingly, the argument will become purely a problem of semantics therefore the particular definition will become wholly dependent upon the individual concept of the specific activity.

For example, there is no reason why the transition of the sportsman or woman from amateur to professional status should automatically correspond to the parallel transference from a state of leisure to a state of work. Financial reward should not be necessarily synonymous with work. The terms work, play, leisure or activity should mean what we want them to mean - whether it be traditional factory or office work, vocational, educational, cummunity, recreational or sporting activities, household tasks, love, sex, friendships etc. - and used therefore on a completely interchangeable basis. And increasingly, any attempt to categorise these activities into a generalised societal definition of what is work or leisure - such as the 24 hour structured time-division described by Stanley Parker -

immediately precludes any individualised conceptual disagreement and is, by implication, totally misleading.

Mihaly Csikszentmihalyi, of the University of Chicago, agrees that "... you cannot put a boundary to 'play' by specifying the activity like love, companionship, sex or work. You have to put the boundary within the experience of the person ... that is what defines play. We may lose sight of what is the real thing that is missing from our lives and that is 'playfulness'. Playing leisure-orientated game sports become artificial situations in which people try to experience playfulness but they separate it from the rest of their lives ... I think playfulness ought to be a condition that one can experience everywhere." (Csikszentmihalyi, 6th April, 1982, BBC2 TV, Fields of Play).

Unofficially, the generally accepted definitions of work are (a) paid employment, (b) self-employment, and (c) domestic and voluntary work etc. However these definitions become obsolete if the individual obtains pleasure, enjoyment and satisfaction from their work - *to the extent that they consider it to be play or leisure.* At present only a select minority can claim to receive an income for an activity which is also their primary interest. By necessity both official and unofficial definitions of work are too generalised and ignore the particular subjective experience. Admittedly, current productive activity and our attitudes to it still conform to the substantive and theoretical strictures of the Protestant/Puritan ethos of work. My suggestion in this treatise is that the proliferation of microelectronic technology linked to a simultaneous attitudinal shift toward an activity or leisure based ethos can, and should remove the Protestant/Puritan work ethic forever.

Wealth generating microelectronics will facilitate the establishment of a leisure income with concomitant financial security, (comparable, at least, to average national earnings - displacing all social benefits and pensions) and will allow everyone to participate in the psychologically self-actualising, as well as the financially productive, activities of their choice. Once computerised automation has removed the conventional divisions between work and leisure, the traditional

meanings we invest in both terms will, irrespective of context, be determined only by the psychologically subjective evaluation of the particular individual. These sentiments are echoed by Jenkins and Sherman:

"Ultimately the aim has to be to obliterate the distinction between work and leisure ... as time goes on so the emphasis has to shift on to personal and family security within which work and leisure become indistinguishable. The present system of unemployment pay and supplementary benefit will have to be both amended and improved quantitatively and qualitatively before being replaced. An income of at least national average earnings should be available to all. It is no use attempting to solve long-term unemployment problems by providing incomes which can sustain subsistence and little more. People want and expect more from life than this and additionally they expect it to improve year on year." (Jenkins and Sherman, 1981, p.82).

Traditionally, as we have seen, work has been inextricably associated with varying degrees of moral evaluation. If the individual is in work he/she is described as being 'gainfully employed' but if the individual is out of work then he/she is described as being idle - yet idleness is not simply a synonym for unemployment - it is concomitant with moral disapproval. And this moral disapproval often degenerates into aggressive prejudice with the terms scrounger and sponger becoming commonplace.

The high, medium and low prestige labels (profession, vocation, calling or job) of white and blue collar employment are the exclusive guide to an individual's societal status - it provides our principal source of self-identity. For example doctors, dentists, lawyers, solicitors, politicians, top civil servants, company directors, executives, lecturers, teachers, clergymen, architects, nurses, actors, actresses, broadcasters, entertainers, personalities, sportsmen and women etc. are all accorded high or medium social status; whereas skilled, semi-skilled and unskilled workers, clerical and staff, sales representatives and assistants etc. are all given relatively low

prestige labels. The unemployed are accorded no prestige or social status at all.

Moreover, Professor Marie Jahoda (1982) believes that it is the *quality* of our working life that is of paramount importance irrespective of the actual number of hours worked. "The psychological benefits of employment are not tied to an eight hour day or a forty hour week. They would accrue even in the improbable case for this century that working hours could be halved without lowering the standard of living." (Jahoda, 1982, p.99). Therefore, she argues, the more satifying the experience work becomes for the individual the less likely they are to lose the will to work if he/she becomes unemployed.

I would agree with this analysis if by work Jahoda defines it as meaning self-enhancing activity-employment of the individual's choice and not tediously dull, monotonous traditional work. To provide enjoyable humanising employment the concept of work itself needs to be re-defined to mean an activity of choice. Self-enhancing and fulfilling activites can only become available to the vast majority of the population if the individual has the facility of choice: numerous pleasant and satisfying activities; options, with under-written financial security determined by pleasure rather than monetary values.

Levels of contentment, happiness and enjoyment are dependent upon the pleasure we derive from a particular activity; whether or not that activity happens to be what we traditionally call 'work' or 'leisure' is immaterial. I believe therefore, that we should endeavour to raise the pleasure threshold and content of all paid activities to a level comparable to the paid activities that already enjoy (albeit varying degrees of) work-leisure synonymity.

The following examples illustrate some personal concepts of those activities that could be simultaneously and interchangeably termed work and/or leisure. (They are in ascending order of total work-leisure synonymity).

Several Liverpool women who check pools coupons at Littlewoods and who play bingo in their spare time, find it almost impossible to differentiate between the activity content

of their work and the activity content of playing bingo.

Littlewoods employee 1 (paraphrased): "... Bingo's similar to marking off pools coupons ... you need more concentration marking off than you do playing bingo ..."

Littlewoods employee 2: "... You're just looking for numbers ..."

Littlewoods employee 3 (paraphrased): "... I like doing this type of activity in my leisure time as well as at work ... I don't think there's much difference between checking coupons and bingo cards ..."

Bingo player 1 (paraphrased): "... I always play 9 cards at once - its too easy playing 7. I like to make the checking more difficult ... I know someone who marks the cards side-ways on - just to complicate things ..." (Some women bingo payers even turn the cards upside down simply to make the checking increasingly difficult). "... My work involves adding up ... I come here to relax ... in a way I do for pleasure here what I do at work ..."

Bingo player 2 (paraphrased): "... I'm a packer and checker in a metal item factory ... that's what I like about bingo - it's just like working at my normal job ..."

Bingo Hall female employee (paraphrased): "... I would regard looking after my baby as work ... I find it enjoyable watching the women checking the cards ... playing bingo is very much like 'work' because you have to study hard just to keep up ..." (BBC2 TV, 6th April, 1982, Fields of Play).

Some of the staff at a Chicago games factory are employed specifically to play space-invaders and pin-ball in order to test the reliability and quality of the machines.

Do the workers regard their time at the factory as 'work' or as 'play'?

Female employee 1: "... I love playing space-invaders ... I get to be real good at it now I can sit and do it at work ..."

Male employee: "... Playing pin-ball is *fun* not work ..."

Do the girls think of their employment as disagreeable, wearisome work or as simply playing space-invaders?

Female employee 1: "... Playing space-invaders ..."

Female employee 2: "... I play chess and aqua-sports in my spare time. Chess gives me a similar challenge (to space-invaders) ... I play space-invaders at work and chess in my free time ... I prefer space-invaders ..." (BBC2 TV, 6th April, 1982, Fields of Play).

Margaret Talbot, of Trinity and All Saints College, Leeds, and author of the Paper 'Women and Leisure', believes that because of her own middle class, academic life-style the division between work and leisure has become almost indistinguishable.

"I find it very difficult to differentiate between work and leisure because they diffuse one into the other. Much of my work could be said by other people to be play. And that is one of the reasons for the low status of subjects like leisure studies, sports studies and physical education - other people see them as play and not as 'hard work'. Much of what I choose to do in my so called non-work time is related to my 'work' because I'm interested in it.

There is a whole continuum of activity between things which I would label purely work and things which I would label purely play which is blurred - certainly the division between them is very blurred indeed. And this is essentially the privilege of people who are middle class and creative ... even in terms of physical space ... we can get up and move about and talk to other people - we're not on a production line" (office or factory) "governed by repetition." (Talbot, 6th April, 1982, BBC2 TV, Fields of Play).

The definition of what Margaret Talbot is actually doing is a purely personal concept - her occupation allows her to indulge in the luxury of 'paid-activity-enjoyment', a prerogative granted to only a small select minority of the population. We may soon have the opportunity, through microelectronic automation, to extend this 'paid-activity-enjoyment' privilege to a majority rather than a minority of the British population.

International film and television actor, Robert Wagner: "... not a day goes by without me thinking how lucky I am to be doing this. How can we call this work? Travelling the world, working with people you care about, who care about you. This business

has been so good to me. I really don't know where I would be without it ..." (Wagner, 1983, TV Times, 22nd-28th October, 1983, p.10).

International actress, Kim Basinger (Domino Petacchi in the 14th James Bond film 'Never Say Never Again'): "... I loved playing Domino ... I was intrigued by the role because she's a dancer and so am I. I saw a great deal that I could do with the part rather than just being a pretty girl in a bikini. I really feel the Bond has a new kind of love interest in this film ..." (Basinger, 1983, in Dewson ed., 1983, "My Name is BOND", Argus Specialist Publications Ltd., pp. 28-29).

International actress and former top Paris and New York model, Maud Adams: "... it must be about five years ago that I decided I wanted to concentrate on acting instead of modelling. There are no regrets; it certainly has paid very well. I would love to play in another Bond film" (she has starred in two: 'The Man with the Golden Gun', 1974 and 'Octopussy', 1983) "... I would love to work with Richard Attenborough ... I would certainly like to work with some of the great Swedish directors ... I also want to play comedy ..." (Adams, 1983, in Zimmerman ed., 1983, The Official Octopussy Movie Magazine, Starlog Theater Merchandising Group, p.30).

International actress, Barbara Carrera (SPECTRE'S assassin Fatima Blush in 'Never Say Never Again'): "... I loved playing Fatima ... I based her character on the ruthless Indian Hindu goddess of death: Kali - the destroyer. Fatima finds Bond terribly attractive ... she's thrilled that she's the one who has been chosen to give him what she thinks of as the ultimate thrill: death. She sees the act of murder as a sort of ceremony and thinks of herself as a composite of Kali, a black widow spider and a praying mantis; so before she kills her victims, she must make love to them ..." (A compilation of Carrera, paraphrased, 1983, in Dewson ed., 1983, "My Name is BOND", Argus Specialist Publications, p.28 and Carrera, paraphrased, December, 1983, BBC1 TV, Pebble Mill at One).

Veterinary surgeon and best selling author, James Herriot: "... there was everything here (Yorkshire); wilderness and

solitude breathing from the bare fells, yet a hint of softness where the river wound along the valley floor. And in all the green miles around me there was not another human being to be seen. I got out of the car and sat on the springy grass as I have done on countless occasions since then. I was captivated, completely spellbound and I still am to this day. I was in my early twenties then and this was only the first inkling of the glories my veterinary work was to unfold for me ..." (Herriot, 1979, p.12).

Former British Olympic coach, sports writer and BBC sports broadcaster Ron Pickering: "... I work 90 hours a week ... that's what I want to do ... a lot of what I do I would have done as my hobby, for nothing ..." (In conversation with the author).

Broadcaster, cricket commentator and author, Brian Johnston: "... I have been lucky enough to earn my living from what is really my life's hobby ..." (Johnston, 1978, p.27).

International tennis player, John McEnroe: "... the matches are like work and play, sometimes they're play, sometimes they're work ..." (McEnroe, 6th April, 1982, BBC2 TV, Fields of Play).

The aforementioned occupations set extremely high pleasure threshold and content levels and are therefore, the work-leisure synonymity criteria all other forms of paid activity should aim for. For the majority of the population to even approach these high work-leisure synonymity standards (which I believe is both possible and desirable) the convergence of automata and microelectronics in the form of sophisticated microelectronic technology would need to impinge directly upon traditional employment and education. I believe they do, and it is the degree of these effects and the opportunities they create that are the concern of this thesis.

The purpose in charting the historical development and parallel strands of automata, microelectronics and work is to set in context their cumulative evolutionary effect. The technical progress of automata and microelectronics, especially over the last 30 years, has resulted in, I believe, the most revolutionary technology the world has ever known. Revolutionary not just in terms of sheer technological effectiveness: power relative to

size, efficiency, reliability, pervasiveness, but in terms of its potential to revolutionise our attitudes to work. Computerised automation could free the individual from the constraints and stultifying effects of traditional work facilitating him/her with a comprehensive choice of activities in which to participate. The conflicting half of the equation however, sees, and forecasts, new technology as being a source of yet further conventional employment thus perpetuating the social conditioning of the Protestant/Puritan work ethic. The following chapters discuss the varying shades of opinion couched within the arguments of the principal protagonists involved in the microelectronics employment debate and the potential of the technology itself.

WORK*:

In addition to the source references already quoted the previous account was based upon information gleaned from:

Morgan, D.H.J., and Ward, R. (1978), Chapter 6: 'Work, Industry and Organisation', in Part 2 in Worsley, P., ed. (1978), Introducing Sociology, 2nd Edition, Penguin Books Limited, Harmondsworth, Middlesex.

Whitehorn, R.D. (1959), Luther, in Chambers's Encyclopaedia (1959), New Edition, Volume VIII, George Newnes Limited, London.

SECTION 2:

A CONTEMPORARY PERSPECTIVE

CHAPTER 4: THE MICROELECTRONIC TECHNOLOGY EMPLOYMENT DEBATE*

The starting point of the microelectronic technology employment debate can be traced back to two particular studies. The first was a feature article in Scientific American - September, 1977, by Robert N. Noyce entitled 'Microelectronics' and the second was the BBC2 television Horizon programme 'Now the Chips are Down' written by Ed Goldwyn and first broadcast on 31st March, 1978.

The Horizon report focused specifically upon the potentially enormous microelectronic induced labour displacement in offices and factories and the lack of any form of governmental response to the problem.

Since then there have been a succession of various state financed support, training and educational awareness programmes, a microprocessor manufacturing company - INMOS, an office equipment business - NEXOS and the 1982 Information Technology year. Their cumulative effect has been minimal but more importantly perhaps, the emphasis has been directed almost exclusively into the area of the technology itself. The social implications of microelectronics evoke at best a scant regard, but more usually no attention at all from any of the major political parties. This research has been left almost entirely to a small number of academics and trade unionists. The principal issues arising out of the technological revolution: shorter working hours, extra holiday, early retirement, a leisure income or social wage and the expansion of educational, health, social, leisure, and sports services are rarely, if ever, discussed with any degree of serious political intent.

There are 3 possible reasons for this apparent complacency: (1) the belief that full employment is an attainable goal and therefore social problems will not arise, (2) simply a lack of foresight as to the speed of technological saturation or (3) and more disturbingly - the sheer political fear of what the technology may do.

Until the issues are given urgent consideration and maximum

priority the complacency will remain - exacerbating the social dangers. My proposed solution involves the radical re-organisation and re-structuring of the educational system and is discussed fully in the next section of the thesis. My immediate concern however, is with the conflicting opinion and evidence that constitute the microelectronic technology employment debate.

The principal protagonists in the microelectronics employment debate can be divided into two distinct and totally polarised groups (within which, however, there are varying shades of opinion).

The first group could be described as adopting a conservative optimistic approach. Essentially, they argue that employment losses due to micro-technology will be adequately compensated by employment gains in direct and related microelectronic applications and in indirect service sector employment (entertainment, sport, tourism, restaurants, hotels etc.) generated by the demand for services and goods as a result of increased individual wealth created through the implementation of microelectronics.

The opposing school could be characterised as adopting a radical pessimistic approach. Whilst disagreeing about time-scale and numbers, they are in no doubt that microelectronic technology will, sooner or later, bring about unprecedented levels of unemployment. They maintain that direct and related new technology employment will be minimal and will not even come close to solving an enormous unemployment problem. This approach argues for a political (principally governmental) CBI and TUC initiative declaring the necessity and virtues of new patterns of employment, specifically the wealth creating qualities of microelectronics and its potential to enhance our lives significantly through a massive expansion of educational, health, social, leisure and sports services. However this indirect employment development can only be achieved through specific governmental directives; i.e. positive discriminatory employment expansion within the aforementioned critical areas, rather than simply disregarding the potential employment increases in

education, health, social, leisure and sports services, and relying totally upon new technology inspired market forces feeding what is left - a relatively small pool of service sector employment. The very nature of our education, health, social, leisure and sports services and the immense value of the innovatory supplementary assistance micro-technology can provide make this an exclusive people-centred employment sector; and as such should become (a) easily our largest source of conventional employment, this would necessitate an infinitely innovative and extensive activity programme; (b) an industry in its own right; and (c) be accorded maximum priority and attention.

THE CONSERVATIVE OPTIMISTIC APPROACH

The fundamental conservative optimistic argument and its concomitant shades of opinion could, I felt, be exemplified concisely by concentrating specifically upon two major comprehensively representative statements: the Central Policy Review Staff report - 'Social and Employment Implications of Microelectronics' 30th November, 1978, and a speech to the Royal Society of Arts by Kenneth Baker, Minister of State for Information Technology entitled 'IT and its Impact on Industry and Employment' 10th May, 1982.

Speaking at a special conference in Nice (September, 1978) on the employment implications of microprocessors, Carolyn Hayman of the Central Policy Review Staff, the Government 'Think Tank', said that "... we reach the conclusion that the service sector industries will continue to absorb the labour that is displaced from manufacturing". (Hayman, 16th November, in Forester, 16th November, 1978, New Society, p.388). Her contention is that market forces will solve all our problems and that there will be a greater need for hotel, restaurant, sports and travel services resulting in an increase rather than a decrease of service sector jobs.

Support for her analysis comes from former Employment Secretary Albert Booth. He takes a historical perspective as an

indicator to subsequent change. Booth argues that "... the economy had ample time to adjust" to the introduction of main-frame computers and it follows that there will also be ample time to adjust to microelectronic technology. (Booth, September, 1978, in Forester, 16th November, 1978, New Society, p.387).

The Central Policy Review Staff ('Think Tank') Report - 'Social and Employment Implications of Microelectronics' published two months after Carolyn Hayman's speech, agrees with her optimistic analysis. The report, whose predictions cover a 15 year period from 1978-1993, states that:

"A number of forecasts appearing in the press have given the employment effects of microelectronics as a rise in UK unemployment to 3-5 million. But these forecasts have (a) overestimated the speed at which microelectronics is likely in practice to be applied in the UK; and (b) underestimated the possibilities for job creation through new applications if we remain competitive. (CPRS, 30th November, 1978, p.4). (Unemployment in 1984, due primarily to economic recession, officially stands at about 3.2 million).

"We may indeed have employment problems but at this stage in our work we have yet to be convinced that microelectronics will be a major factor for the worse, unless the general prospects for employment make for an increased unwillingness to accept technological change. This may seem a relatively complacent view on the dangers of technological unemployment 1978-1993 but the all-important variable *is the adaptibility* of the UK economy." (CPRS, 30th November, 1978, p.5, italics added).

The report argues that, "... the real employment gains will accrue to those countries which can translate microelectronic innovations into new, attractive, inexpensive products for mass consumption". (CPRS, 30th November, 1978, p.6). Those made redundant will be able to find new work in the areas of either (1) the manufacture of microprocessors, micro, mini and main-frame computers; word processors and workstations, (2) software production, (3) the manufacture of microprocessor based products or (4) an expanding service sector.

The CPRS paper looked at various case studies and points out

that talk of mass unemployment, is in many cases, just a myth:

Twenty years ago computers were introduced into the Civil Service. The unemployment that was predicted did not occur, indeed the 'Think Tank' report points out that Civil Service computer related jobs rose during 1970-1977 from 170,000 to 200,000.

Government Departments have been able to provide new computer allied jobs and better governmental services to the community, i.e. the computerised payments of Unemployment Benefit and Supplementary Allowance by Giro cheque. The direct effects of computers are that they have allowed many workers to be freed to work elsewhere in non-computer related jobs. In 1977 14,000 people were directly involved with computers and those released from such work totalled more than 50,000.

"... the conclusion is that the employment effects of computers in the Civil Service has been at best to restrain the growth of clerical employment and certainly not reduce it." (CPRS, 30th November, 1978, p.7).

Cecil Marks, Director of Systems Training at the Civil Service College goes even further ... "automation in the office has increased employment and I expect that trend to continue". (Marks, 30th November, 1978, in Financial Times, 30th November, 1978).

Work measurement studies on word processors, the report says, indicate over 100% gains in productivity but although there has been an employment reduction in individual typing pools - the possible overall losses of 50% have not occurred. Instead word processors have filled gaps where there has been a shortage of girl-power and the new machines themselves provide a new range of services. Firms are more interested in new services such as prestigious advertising in the style of the personalised standard letter than any possible savings in staff.

So as with the Civil Service example the paper reiterates the point that "the potential productivity gain does not translate at all directly into actual job loss". (CPRS, 30th November, 1978, p.8).

The microelectronic systems used in warehouses aid stock

control rather than make workers redundant. Automatic warehouses have enabled improvements in the removal and stacking of stock and also provide a better working environment.

"The main gain from microelectronics in cash and carry warehouses comes from the reduction in capital tied up in stock rather than from any direct effect on employment." (CPRS, 30th November, 1978, p.9).

In the car industry most of the applications in the production field involve design, monitoring, production tooling, testing etc. and have resulted in few reductions in staff. With regard to the applications of welding and paint spraying, where automation has been introduced on a step by step basis onto the assembly line employment effects have been small.

The report admits that entirely new production lines may mean more unemployment but temper this by saying "... the actual fall will depend crucially upon market conditions, the UK market share and so on". (CPRS, 30th November, 1978, p.11)

If we are able to supply foreign buyers with microelectronic based products then there will be few job losses, if not then there will be an adverse effect on jobs and on our balance of payments.

David Allen (23rd March, 1982), the co-author of a Paper on microelectronics compiled for the Manpower Services Commission, agrees with the 'Think Tank's findings. He examined a Nissan car factory in Japan.

Robots are principally employed in the welding of car bodies, the distribution of parts along the appropriate conveyor belt and the transporting of goods around the factory floor "... the vast majority of the jobs on the production line - screwing on the various parts of the car, fixing windscreens and wheels into place - are still largely done by people ... only a small fraction of the car production is actually affected by robots". (Allen, 23rd March, 1982, BBC Radio 4, Study on 4).

The software required to enable robots to recognise objects through tactile and visual senses, is, argues Allen, extremely complex. Unless robots can be programmed to perform intricate tasks "there will not be an enormous revolution in the great

majority of work in the manufacturing area ... people will still be needed to assemble things". (Allen, 23rd March, 1982, BBC Radio 4, Study on 4).

Moreover, Allen contends that what will halt new technology development generally is the lack of good software in Britain. Sophisticated computer programming is highly labour intensive, extremely time consuming and at present there are no indications as to how software production can be accelerated.

Returning to the CPRS study:

The change over from mechanical equipment to that of microelectronics in telecommunications switching gear has been cited as the perfect example of silicon chip induced unemployment. The alarmists claim that only 10 per cent of the present labour force would be needed to operate the present equipment. However, after taking into account the number of engineers required to design the exchange systems, the country-wide manufacture of components and the possibilities of microprocessor controlled products linked to the telephone systems, indicates that there will probably be a smaller number of job losses than predicted. Again, the amount of unemployment is dependent upon the speed with which the new technology is introduced, the size of the exports and the growth of subscriber terminals, etc.

This conservative optimistic line of reasoning would point to the development of the Mercury telecommunications project as a prime example of new technology employment "... a licence was awarded to the company by Her Majesty's Government to establish and operate, through Mercury Communications Limited, an additional telecommunication network covering both national and international services ... Mercury Communications Limited is operated with our partners British Petroleum and Barclays Merchant Bank". (Sharp, 1982, Chairman and Chief Executive, Cable and Wireless plc Report, p.4).

The installation of microelectronic systems into hotels has improved efficiency, service and cost effectiveness regarding reservations, guests' accounts and stock and ledger control. Furthermore, such innovations have not displaced staff, rather

they decrease paper work and make general hotel administration much more interesting. Computerised automation within food processing plants has led to increased productivity, savings in the amount of raw materials used and a higher quality product.

The main benefits accruing from the introduction of micro-technology into an engineering factory have been specifically connected with the contraction of the production cycle and a subsequent growth in export sales. The number of clerical staff involved in the running of the production control system has, the paper admits, been cut - however these savings are negligible when compared to the economies gained through less continuous work in progress via shorter production cycles. Moreover, the study asserts that within the clothing industry the major effects of computerised automation will be "better quality and product standardisation as well as improvements in the efficiency of production and management methods; the effects on labour are expected to be minimal". (CPRS, 30th November, 1978, p.10).

Jonathan Sleigh, co-author (and head) of the CPRS report and currently Midland Regional Director of the Manpower Services Commission, not surprisingly concurs with its emphasis on the opportunities for growth within the service sector.

"Applications, particularly on the service side, often lead to possibilities for new or improved services that were not foreseen before the applications were made. These will tend to reduce the scope for staff saving and may more than offset it ... technical growth does not lead to the loss of employment ... increased productivity will increase people's wealth and will not initiate their job loss ... people will spend more on new products like home computers and TV games.

Microprocessors are usually installed as part of a process of automation and mechanisation. The major changes will not necessarily be on the numbers employed but on the organisational structure and product range.

The penetration of microprocessors into products and processes is a great deal less advanced (in competitor countries and in the UK) than many people assume. Far from being

immediate, as has been suggested by some commentators, the technological changes in most industries are likely to be evolutionary rather than revolutionary, and the consequent employment effects are likely to be slow to show themselves and in most areas offer reasonable opportunities for planned adjustment. Higher productivity will allow firms to expand their services rather than cut back on labour." (A compilation of CPRS, 30th November, 1978, p.13 and Sleigh, 16th November, 1978, in Forester, 16th November, 1978, New Society, p.387).

This hypothesis is expanded upon by Neville Cooper, Director of Adminstration at Standard Telephones and Cables (STC) and by Kenneth Baker, Minister of State for Information Technology. Cooper is in no doubt that there have been gross exaggerations about the number of possible job losses. Existing jobs, he argues, may be lost through the arrival of microelectronics but what people forget in the technology debate is the market for unforeseen and unforeseeable work ... in 1900, phrases such as microelectronic integrated circuitry or microprocessor controlled workstations would have been regarded, even by the most eminent scientists of the time, as complete gibberish. 30 per cent of the workforce were employed in agriculture at the turn of the century, now the figure is 3 per cent and production has increased by 1,000 per cent - yet we do not have an unemployment rate of 27 per cent. Some of those 27 per cent manufacture micro-circuits ... we do not know what this new technology will provide. "... I am quite convinced that people are going to need and want many new things which are made possible by new technology." (Cooper, 16th March, 1982, BBC Radio 4, Study on 4).

Similarly, Baker (10th May, 1982) concedes that there will be an initial employment contraction due to micro-technology. In a speech to the Royal Society of Arts he outlined many such cases: robotic welding in Volvo and BL factories has resulted in an 80 per cent reduction in the welding labour force ... Yamatake-Honeywell's flexible manufacturing system (FMS) the integration of a series of robots, materials handling equipment, and numerically-controlled machines (involved in the machining of

valves) has enabled them to cut their staff from 40 to 4 ... microelectronics displacing 90 per cent of mechanical watch components and subsequently large numbers of people ... labour cost reductions of 50 per cent in printing and publishing ... word processing productivity increases of over 100 per cent and so on.

However, the pessimistic analysis, he argues, invariably stops here. They ignore what Baker terms the "compensation effects" (Baker, 10th May, 1982, p.24) which, he says, judging from historical experience, appear to be inevitable. For example, the pessimistic Victorian sociologists of 100 years ago recording the imminent demise of the horse and carriage would have no doubt predicted the wholesale disappearance of blacksmiths, postillions, bridle-makers, stable-men, ostlers, grooms, hay carters - bankruptcy among horse breeders, financial losses for farmers, shortages of manure, poor crops, and the eventual breakdown of rural society. What they could not predict was the invention of the horse-less carriage and the concomitant associations of an enormous employment potential.

Exactly the same principles apply today ...

"Japanese assembly workers in the watch industry were re-deployed to diversified product lines and a similar tale can be told about Japan's major TV manufacturers. Slower market growth combined with a simplification and reduction in the number of components, and automatic insertion led to a fall in employment in TV manufacture during the 1970's. In 1975 TV sets represented 37 per cent of Sony's output, by 1981 only 24 per cent. But Sony had got their skates on. They introduced large scale production of video tape recorders and look what happened to employment. Even though they were making proportionately fewer TV sets, Sony's employment rose from 22,000 to 38,500. This shows what a company like Sony can do by keeping pace with developments. They moved from televisions to video recorders and they were of course one of the few companies in the world that realised that you could make products for joggers, i.e. the Sony Walkman with anticipated world sales of 3 million.

In services, the expansion of banking, insurance and clerical

labour was brought about, in part, by the application of technology increasing the number of new and diversified tasks which previously could not be contemplated. In addition the introduction of the technology requires it to be serviced. The doubling of computer services employment over the last ten years is an illustration of this.

Broadening the analysis to encompass the whole economy, increased productivity and improved product quality can improve competitiveness. This may be enjoyed in a variety of ways - higher profits, higher wages, higher output or some combination of all these - all of which provide the basis for expansion of employment." (Baker, 10th May, 1982, p.30-33).

The Minister reinforces his argument by referring to two studies examining the impact of microelectronics on employment. A report by the Policy Studies Institute talks of the correlation between increased employment and the proliferation of attractive and competitive microprocessor based products. The number of jobs lost through microelectronic automated processes will, the Institute predicts, be adequately compensated for by the growth of new products. The overall effect will be a very slight employment decline.

The possible employment effects of microelectronics have also been discussed in a series of research projects collated in a report by the Organisation for Economic Co-operation and Development (OECD). The British study, conducted by the Manpower Research Group at the University of Warwick projected an increase in the rate of technological acceptance and concluded that by 1990 there would be a net increase of about 80,000 jobs. However, the paper stressed that this would only be possible if British products improved in quality and sophistication - and consequently in trade competitiveness.

These studies are indicative of the rapid growth of jobs within information based occupations. In 1880 the information sector (see later) accounted for only 10 per cent of the United States labour force whereas today it represents nearly 50 per cent. According to OECD reports this shift in working patterns is being repeated and accelerated throughout many other

industrialised countries. Moreover, in Britain the trend towards an increase in the overall 'information sector' share of the total workforce is becoming especially significant:

Table 3: Information Sector as a percentage share of the UK workforce:

1957: 27 per cent
1961: 32 per cent
1971: 36 per cent
1979: 40 per cent

Source: (Baker, 10th May, 1982, p.12).

40 per cent equals 10 million information based jobs (an increase of 1 million since 1972) - Baker categorises them into the following occupational groups: "teachers, journalists, librarians - scientists, consultants, and accountants - managers, administrators, supervisors - office staff: public and private, postmen, telephonists and printers". (Baker, 10th May, 1982, pp.13-14).

He strongly supports the view that failure to implement vigourously, develop, market and sell the new tehnology will almost certainly result in disastrous unemployment - on a scale far greater than any the new technology itself might provide.

Furthermore, he contends that as the demand for information operatives increases so will the need for clerical staff. When computers were first installed into offices, in the late 1950's and early 1960's, they were expected to displace large numbers of workers - the reverse happened. In 1960, there were 10 million United States clerical staff, by 1980 the total had risen to 18 million - 19 per cent of the workforce. A similar trend is reflected in Britain: in 1961 there were about 3.5 million clerical staff - today there are some 4 million. "In both countries, the number and proportion represented by clerical occupations is forecast to increase." (Baker, 10th May, 1982, p.17).

And within the clerical sector those typists and secretaries who are now using word processors have not only increased productivity but have also been able to undertake a much wider, more responsible and consequently more complex and demanding range of duties. This will boost job interest, job satisfaction and provide a better service qualitatively and quantatively.

Apparently satisfied and contented with the forecast that the goods and services yet to come will satisfactorily compensate for any job losses, Baker's speech concludes with a powerful yet paradoxical advocation for increasingly rapid factory and office automation.

"It's to the second round compensation effects that we look for employment growth from IT - to increased markets for better and cheaper products, and for those new goods and services which are as yet no more than a twinkle in an innovator's eye. The microchip is going to be one of the main sources of wealth for the world well into the next century. It will create a lot of jobs, some in manufacturing but many more through its application. Many new services will spring up - ordering holiday bookings via a teletext screen, mobile telephones, electronic publishing, pocket televisions, mobility aids for the elderly and handicapped and lessons by video. There is no received wisdom on how strong these second round effects are likely to be. Some tend to conclude that the overall net effect of IT on employment could be small but a crucial influence here is that the extent to which a country keeps pace with the rest of the international field.

If we don't produce the technology domestically other countries will supply it: if we are slower in applying IT other countries will gain an increasing competitive edge in product price and quality. The more rapid adoption of IT will make demands on management and labour but the alternative has been put rather boldly by the OECD:

'A low level of application in any individual country may lead to its domestic economy becoming increasingly uncompetitive, and this may in turn lead to secondary effects on employment that could be far more serious that the direct displacement effects.'

It is an opinion I share: the message is automate or liquidate." (A compilation of Baker, 10th May, 1982, pp.36-38 and Baker, 27th May, 1983, The Guardian, p.12).

I would argue however, that Baker's assertions can be criticised on 8 vital points and will outline these critical omissions later.

Baker's advocation to automate or liquidate is wholly reliant upon the creation of new employment based either directly or indirectly on the rapid growth of microelectronic technology. And I do not feel that Baker or the CPRS report satisfactorily answer this assumption. I believe that direct and related employment gains from computer hardware and software will be minimal, measured in thousands rather than millions, as discussed later.

More problematical is the question of indirect employment gains, i.e. within the service sector. I would argue that any employment increases within this area will be extremely limited - confined principally to entertainment, tourism, hotels, restaurants, leisure/sports complexes and programme and film making for cable, satellite, video and conventional television and the cinema. As Liberal Party Leader David Steel has said "... the Tories seem to have convinced themselves that we can get by as a race of waiters, bookmakers, tourist guides and video salesmen". (Steel, 6th January, 1984, in Langdon, 6th January, The Guardian, p.1). The areas with the greatest potential for an almost unlimited employment explosion: education, health and social services are, unfortunately, contracting rather than expanding.

The conservative optimistic line of reasoning is also followed by the majority of the Conservative, Labour, Liberal and SDP parties, the CBI and the TUC. They all appear to ignore or reject the idea, possibly because of, as indicated earlier, sheer electoral fear, of attitudinal change. The minimal amount of attention that is given to the subject concentrates almost exclusively upon technological change. They seem to cling desperately to the belief that conventional full employment, or something approaching it, is still an attainable and desirable goal. They all maintain that unemployment levels can be reduced

- the actual figures vary from reductions of approximately 2 million (Labour) to around half a million (Liberal/SDP Alliance).

There are however five notable exceptions to this general regrettable rule. There are two Conservative Cabinet Ministers, a former Conservative Cabinet Minister, a former Labour Cabinet Minister and the Leader of the Labour Party, who actually direct and focus their analyses upon attitudinal change. Although their views are perhaps not quite as extreme as those of Stonier (1983) and Jenkins and Sherman (1979, 1981), they do form a significant shift away from the traditional conservative optimistic approach and as a result constitute a slightly deviating shade of radical pessimistic opinion. Their views form part of the radical pessimistic approach and will be outlined later.

THE RADICAL PESSIMISTIC APPROACH

"People-to-machine jobs, irrespective of whether the machines are lathes or typewriters, will decline. In contrast the people-to-people jobs will increase. The largest growth will be in the areas of education and health care." (Stonier, 28th March, 1984, The Guardian, p.19).

In the 1978 J.D. Bernal Memorial Lecture at the University of London's Birbeck College, Professor Chris Freeman likened the ubiquitous characteristics of microelectronics to those of steam power and electricity calling them the 'heartland' technologies of their particular era. But *does* the microprocessor represent a quantum leap in scientific discovery? And if so, how quickly will saturation point be reached?

Professor Tom Stonier, Chairman of the School of Science and Society at the University of Bradford, believes that the rate of technological saturation will be comparable to that of the medicinal saturation of anti-biotics.

"The pace at which a new technology displaces an existing one is strictly a function of how much better it is. The steam locomotive, for example, the historians tell us, was about 50 per cent more efficient than horses. So that transition took several

decades. At the other extreme there is the case of anti-biotics which during the 1950's swept the world to such an extent that their introduction was simply a matter of how fast they could be produced and distributed. Initially, the first computers built in the 1950's were reasonably unreliable, absorbed an enormous amount of energy and were very expensive to run ... but in the case of microelectronics ... that is much closer to the anti-biotics experience. I think micro-technology is going to move very rapidly and people are just whistling in the wind if they don't think it's going to happen ... because if it doesn't happen here it will happen in other countries. That is true for certain service areas and not just the manufacturing sector ..." (Stonier, 16th March, 1982, BBC Radio 4, Study on 4, and Stonier, 1979, Employee Relations Vol.1 No.4 pp.27-28).

Put in percentage terms: he suggests that with only a 10 per cent improvement on existing technology, new technology might not be adopted at all. A 50 per cent improvement would take decades. Microelectronic technology improves the existing technology by 1,000 per cent and displaces it in a matter of months.

The conservative optimists, however, would argue that the rate of technological change does not and never will confirm Stonier's analogy with anti-biotics. Over half of all British companies do not even use electric typewriters let alone word processors. A report by the National Computing Centre and Heidrick and Struggles (1982) suggests that whereas the service sector is beginning to implement new technology fully, manufacturing industry is simply not interested.

The authors sampled 156 firms (with assets ranging from £50 million to £4,000 million) employing 10 per cent of Britain's total labour force. Although 66 per cent had approved micro-technology in principle, only 33 per cent actually had a planned coherent strategy. The study found that just 47 per cent used word processing extensively - an average of one machine for every 385 people - and only 18 per cent used personal micro-computers. All the indications are that implementation will be on a deliberate, cautious, piecemeal basis.

The radical counter to this argument can be found in Japan,

and is described extensively in an advertisement article by Dr. James C. Abegglen, Professor of International Management at Sophia University, Tokyo and Akio Etori, Managing Editor of Saiensu (the Japanese language edition of Scientific American) in the October, 1982, edition of Scientific American.

During 1970-1979 the principal focus of Japanese computerised automation concentrated specifically upon the factory - developmental progress in office automation had been exceptionally slow. The reason for this was the Japanese language ... The Japanese use three separate, yet interchangeable, language systems: two inherent phonetic scripts and one derived from China. Because each script contains some 50 symbols, there are never less than 2,000 characters - usually 3,500-5,000 characters in the Japanese language (Japanese typewriters are about the same size as a traditional office desk). This is why word processor development in Japan has been slow. The problems of input, output and retrieval posed by the mass of symbols and characters proved almost insoluble.

Sluggish progress in word processing channelled even more Japanese research and development into other areas and produced some positive compensatory effects: a continuing world lead and further massive input into robotics, a world lead in the production of facsimile and copying machines (in 1981 Japan produced 900,000 copiers - Ricoh have a 40 per cent plus share of the world market) and increased production of main-frame, mini, micro/personal home computers. (Fujitsu, the second largest computer manufacturer in the world intend to displace IBM as world number one and are a world leader in office automation. Japan's largest computer manufacturers are (1) Fujitsu (2) Nippon Electric and (3) Hitachi).

Facsimile machines, that transmit hand written documents quickly and efficiently, and copying machines, that are smaller, cheaper to run and usually faster than their Western counterparts, were developed specifically as a ferocious technological response to their relative failure in word processing.

Moreover, the phenomenal growth of increasingly powerful

memory chips has now virtually eradicated even these problems. The recovery began in 1979 when Toshiba announced their first word processor at a cost of $30,000. The high price did not stop production rising from 2,500 units in 1980 to 10,000 units in 1981. The cost of word processors declined as their sophistication grew and by 1982 the price had fallen by a factor of 7 to just $4,000 whilst production rose to 60,000 units and is expected to triple each subsequent year. The output of personal home computers also almost tripled in the year 1980-81 with 320,000 machines being manufactured in 1981, an increase over 1980 of 290 per cent.

Contrary to the National Computing Centre and Heidrick and Struggles report (1982), a survey by Nihon Keizai Shimbun (1982), examining the rate of Japanese technological penetration, demonstrates the enormous potential for rapid technological growth: of the 78 respondent companies 58 or 74 per cent had an aggregate total of 792 word processors - an average of about 14 per company (this, even with an exceptionally slow developmental rate) and 55 or 70 per cent an aggregate total of 3,210 personal computers - about 58 per company. These results should and could easily be extrapolated to and reflected within British offices and factories.

Had the Japanese spoken English, I am confident that all 78 respondents would have used word processors extensively and their aggregate total would probably have been in the region of 7,920 rather than 792 - and even this may be a gross under-estimation.

With the production of office computers and facsimile machines tripling annually, the logical continuation was to integrate all the machines into highly automated electronic systems. In 1982 Nippon Electric installed a network of fibre optic highways facilitating digital and voice communication and storage between the various office machines, the integration of telephone exchanges and building maintenance systems.

The office revolution was hampered in Japan by language problems and in Britain by lack of foresight. Japan now have plans to inter-mingle the English and Japanese language for use on their word processors and related equipment. The very fact

that Japan had initial problems has resulted in an office automation boom and the transformation of inefficient offices, at a much greater rate than the already productive factories, into highly efficient work places.

But despite the Japanese experience the conservative optimists' reply is disappointingly predictable. Historically technological innovations, such as the steam engine and the horse-less carriage have created new forms of employment. Microelectronics, say the optimists, will follow the same pattern. Moreover, predictions of widespread technology induced unemployment are nothing new.

The 1950's main-frame computers raised speculative fears about large scale unemployment and a subsequent society of leisure. Both forecasts proved to be inaccurate but as Colin Hines of Earth Resources Research Limited, suggests, the predictions were premature rather than wrong.

"... it was simply that the visionaries concerned had failed to allow for the time needed for such developments to gain social and economic acceptance, and for the necessary accompanying technological improvements like microprocessors to be developed ... What has to be faced over the next few years is that vast sections of the industrial and service sector will be automated and millions may lose their jobs ... it is likely that the miseries and upheavals of the 1930's will pale into comparative insignificance should Britain continue to drift on as at present, and find itself in the situation where 4, 6, even 7 million are out of work ... whatever happens the effects of automation will be felt at every level of our society and to prevent it from being torn apart will require the commitment of expertise and resources on a scale probably not seen since the war. The big difference is that this problem certainly will not disappear after 6 years." (Hines, 1978, pp.6-7).

In 1680 about 90 per cent of the British population were employed in agriculture supplying food to the remaining 10 per cent. Technological developments in farming: sophisticated combined harvesters, new fertilizers and insecticides, hybrid seeds and improved crop rotation, weather forecasting and storage

techniques etc., over the past century have reversed the ratio. Moreover farmers can now utilize the most advanced automated agricultural machinery currently available: sensor and/or camera regulated automated tractors operating non-stop 24 hours a day and automated crop sprayers (using radar to detect wind direction) providing efficient and consistent chemical distribution. In the 1980's 2 per cent of the labour force are employed in agriculture (and along with food imports) can provide food for the remaining 98 per cent of the population. Stonier (1983) claims that a similar revolutionary reversal is now occurring within the manufacturing sector and within sections of the service sector, but whereas the agricultural revolution took 300 years, the microelectronic revolution may take only 25-30 years. He suggests that by 2005 the provision for all our material needs: food, clothing, housing, water, electricity, gas, furniture, textiles, household appliances and car prodduction etc., could be met by 10 per cent of the labour force. The majority of these people will probably have post-graduate computing/engineering degrees enabling them to control and maintain advanced computerised robotic systems.

Table 4: Workers employed in the manufacturing industry as a percentage of the total labour force:

1961: 38 per cent
1971: 36 per cent
1980: 29 per cent

(Source: BBC1 TV, 21st September, 1982, Will Tomorrow Work?)

Sir Clive Sinclair, Chairman and founder of Sinclair Research, has said that this 1980 figure of 29 per cent "will fall to less than 10 per cent by the end of the next decade". (Sinclair, 7th October, 1982, BBC2 TV, Futures).

Sinclair's prediction is echoed by Stonier who is in no doubt: "... the manufacturing labour force will continue to decline drastically and any argument that says there is going to

be an up-turn in industrial jobs is a delusion. *It is not going to happen.* Either the manufacturing companies will not be able to compete and will therefore go out of business which means no jobs at all, or, if they do compete, it will be because of a high level of productivity which they can achieve only by using advanced automated systems *that do not require a lot of people.*

What workforce is left will need to be educated to a much higher standard than at present. It will not be enough to know about specific pieces of hardware or software because within a year they may become obsolete. So the individual will need to know the theoretical principles governing microelectronic technology .... therefore the remaining manufacturing labour force will need to be educated to graduate or post-graduate level, not just trained but educated ..." (Stonier, paraphrased, 19th September, 1982, BBC1 TV, Will Tomorrow Work? Italics added).

Stonier's (1983) overall analysis suggests a potential unemployment level of 19 million by 2005-2010. Similarly Barrie Sherman (December, 1981, BBC1 TV, Pebble Mill at One) Director of Research at the Association of Scientific, Technical and Managerial Staffs, has spoken of a possible 15 million jobs that are at risk.

"... Wherever one looks, people, or rather jobs, are vulnerable. Draughtsmen, legal clerks, accountancy staff, administrative and clerical staffs in hospitals, local authorities, the finance industry and the Civil Service must all be prime targets of the encroaching technologies. Those who retain their jobs will in all probability need considerable retraining or will have learnt the new skills at school or college.

As the new information systems will be causing all these changes, it is vital that we get accurate and up to date information as a raw material. Data base compilers and maintainers, latter-day librarians, along with conventional librarians, will gain importance if not status, and will increase in numbers. The management of information itself will become a key job. Information system managers will become spring-boards

to bigger and better things, even to the most senior of levels, as a combination of the responsibility and the overall perspective needed is recognised.

In short, creative jobs will remain; decision-making jobs where the decisions are based on non-predictable factors will remain, job designing, installing operating and servicing the new systems will remain. Those of us unable to perform these tasks will be at some degree of risk. Self-employment, especially on a part-time basis, will increase and much of it will be associated with the electronics industry itself. The concept of a job will itself start to alter ..." (Sherman, 10th October, 1983, The Times, p.33).

Nevertheless both Stonier (1983) and Sherman (1979, 1981) believe such immense unemployment levels can be avoided. Their solution would be a massive expansion of the education system, health and social services and leisure and sports services. It is these key areas of the service sector, what Stonier calls knowledge or information based industries, that will determine our future employment.

"From an employment point of view" argues Stonier, "health and education are 'infinite sinks' for employment. For example, the number of nurses per patient in hospital could go from 1:10 to 1:5, to 1:2, to 1:1, to 2:1 to ...? Who would not like to be fussed over by one nurse specifically assigned to you? During a 24 hours period, 4 shifts, coupled to a four day week, would actually produce a nurse to patient ratio of 7:1. Furthermore, there is a wide range of skills required for running a good health service.

What is true for the health service as far as labour intensive employment is concerned, is equally true of education. However, an investment in education will be economically more productive, generating the wealth necessary to finance the expansion in public service employment.

Education, when done properly, is labour intensive and will provide substantial employment. An effective education system will encourage young people to remain in education and attract older people back into it, (a cradle-to-grave education system)

thereby keeping a significant percentage of the potential workforce off the labour market. An expanded and improved education system will produce a more versatile labour force of more skilled information operatives which, when coupled with research and development, will produce new knowledge, new technology, new industries and, in consequence, new wealth." (A compilation of Stonier, 19th October, 1979, The Third Industrial Revolution: Microprocessors and Robots, pp.19-20; Stonier, 1982, in Richards ed., 1982, p.289, and Stonier, 1983, p.210).
Moreover, Stonier (1983) argues for a 10 per cent, graduated reduction in the working week every 5 years. This would provide a 36 hour week by 1985, 32.5 by 1990, 29 by 1995, 26 by 2000, 23.5 by 2005, 21 by 2010 and an 18 hour week by 2015 (4.5 hour day, 4 days a week).

Clive Jenkins and Barrie Sherman (1979, 1981) advocate similar proposals. They say it is ridiculous to work continuously from the age of 16, 18 or 21 to 60 or 65 and only then experience and enjoy a substantial period of leisure time - indeed many people die at this very threshold or within their first retirement year. The notion of job security should be replaced by 'whole life security': people should not be penalised financially and psychologically for being out of work. The authors suggest that unemployment pay should become comparable to the average national income. (In Holland and France Unemployment Benefit is approximately 80 per cent of average national earnings, in West Germany it is 70 per cent but in Britain it is only 29 per cent).

They claim that the 35 hour week is too limited ... a 4 day week on an 8 hour day basis would create more employment than taking an hour off the present working day ... this would lead to a 3 day week 8 hours a day by the year 2000. There should be sabbaticals for all occupational groups similar to those available to lecturers, teachers and journalists ... an extra 4 weeks annual holiday, flexible retirements and equivalent retirement ages for men and women.

And taking only a slightly less extreme view than Stonier (1983) and Jenkins and Sherman (1979, 1981), as indicated

earlier, are two Conservative Cabinet Ministers, one former Conservative Cabinet Minister, one former Labour Cabinet Minister and the Leader of the Labour Party. Former Labour Cabinet Minister, Tony Benn, initiated the political radical pessimistic approach when, in 1978, he stated that: "The changes in society will be absolutely phenomenal and could make the 1980's politically very difficult to handle". (Benn, 1978, in Large, 1984, p.5).

The Secretary of State for Northern Ireland, James Prior, and the Secretary of State for Energy, Peter Walker, expressed, in 1979 when in opposition, some of the most radical opinions on our attitudes towards microelectronic technology of any politicians, irrespective of party allegiance.

Prior said in March, 1979, that "we may have to move away from the Protestant work ethic and think of payment for life for not working. It would be quite wrong to talk of a return to the employment levels of the 1950's and 1960's. If we do have to face higher unemployment, let's not despair. It may well be that in the next 10, 15 or 20 years we will have a new philosophy towards unemployment." (Prior, March, 1979, in Large, 18th October, 1983, The Guardian, p.19).

Walker's contention is even more vociferous: "Our attitude towards automation verges on the lunatic. We should rejoice and create a society in which the machine works twenty-four hours a day ... Uniquely in history, we have the circumstances in which we can create Athens without the slaves." (Walker, 1979, in Large, 18th October, 1983, The Guardian, p.19).

Unfortunately we have had to wait 4 years for a similarly radical declaration for attitudinal change and this has come from the former Secretary of State for Foreign Affairs, Francis Pym: "... Over recent years, new technology has come out of the science-fiction books into our lives. The advance in computers, in robotics, in micro-chip technology generally, has meant that human functions can be performed by machines in a way that is out of all proportion to previous mechanical developments. A fully-automated factory is what it says: fully automated.

And this is only part of it. What we used to think of as

mental functions - functions of logic - are being performed by technology as well. Even the supervisory function is being eroded by technology, as equipment is developed that not only manufactures something, but is able to diagnose faults in the materials or errors in the system.

This whole process will have the most profound influence on the working lives of everyone in this country, and indeed in the developed world. *We are at the dawn of a change so momentous that it will force us completely to revise our traditional attitudes to employment and to how it is structured and organised* ...

... The reduction of the working life would be a great benefit to us all, but it will only be so if we find staisfying things to do with the increased leisure time. In a way, the most frightening freedom of all is the freedom to choose what we do with our time, because it forces us to fall back on our own inner resources, to use our time creatively and not to succumb to a life of boredom and inertia ...

... If, in 15 years time, we need half the working hours that we need now, it can be achieved in many other ways than by halving the working population. It can be achieved by a reduction in the working day, by a reduction in the working week, by longer holidays, by earlier retirement - or, as is more likely, by a combination of all these things ...

... So much will depend on how the whole subject is presented to people and received by them. I know that we are near the dawn of 1984 and I am more than aware of the dangers of Newspeak. Yet I am being neither menacing nor facetious in suggesting that where we now read 'unemployment up a million', in years to come we may read 'leisure time doubled for two million'.

In a way, that statement would be the epitaph of success, because we would have changed the entire way in which we think about our working lives. Of course, it will only be possible if we continue to create wealth. But if we do that, and if we then learn to share both employment and the fruits of employment on an equitable basis, we have the makings of a different society ...

... The first thing we should be doing is trying our best to

understand more precisely the nature of these profound changes and the effect they are likely to have. I am not an economist; still less am I a technologist. I do not need to be either to identify the changes that are happening and to understand some of their ramifications. But it will take people with these specialist skills fully to understand where the technological revolution is leading us.

However, ultimately such issues should not be confined to private groups of specialists. *What we are discussing is a social change of such profound importance that it ought to be the subject of a national debate.* That is the second thing that needs to happen.

The third is for the Government to plan a concerted strategy that encompasses all the issues I have raised and no doubt, others beside. I know that there is grave suspicion within the Government of anything that sounds like economic interference or social planning, and with good reason. But some things are of too overwhelming and pervasive importance to be left to the natural ebb and flow of life. This is one of them.

The Government has already demonstrated its commitment in this area through the enormous assistance given to new technology in recent years. This is greatly to be applauded. *Now it must turn its attention to the consequences of it all.* There is still time. But the opportunity will fade and only the problems will remain - and the Government will be both the creator and the inheritor of those problems, and it will be some legacy.

The final thing that needs to happen is for both industry and the trades unions to be involved in this debate. Industry will understand better than Government how the changes are going to happen, because it is through industry that they will happen. Without the understanding and the co-operation of industry, working in harness with government, there is no chance of the changes taking place harmoniously.

For the unions the technological revolution opens the opportunity for their members both to be materially better off and to lead much fuller and freer lives. If union leaders can see the opportunities of the future, rather than the problems,

they can make it immeasurably easier to go through the transition into the new age, and they will have performed an immeasurable service.

There are signs of some of these things starting to happen in a small way, but it is too little and, unless this changes soon, it will also be too late. *The real scale of the issue has yet to be appreciated.*" (Pym, 10th October, 1983, The Guardian, p.9. Edited from an edited extract from a Cambridge University Conservative Association lecture, 9th October, 1983, italics added).

But perhaps the most crucial affirmation of radical pessimistic approach alignment was a January, 1984, assertion by Neil Kinnock, Leader of the Labour Party:

"... My firm belief is that technological advance does provide the means to liberate the people of the world from poverty and drudgery, to fulfil the highest abilities and aspirations of humanity and to awaken talents that at the moment lie dormant in millions throughout the world. But that change can only produce such benefits if it is mastered by the general population.

That requires a spread of confident understanding of the technology - its potential, its limitations and its implications. No small group of technological priests or merchant princes will voluntarily ensure that. They require the mass of the population to be mechanically competent and voraciously consuming. But, in general, they have no strong desire to share the power which comes from ownership of the means of producing technology. Education - both by formal tuition and by informal self-instruction - is the obvious but as yet under-used means of achieving that power-sharing ... *Technological change requires social change, and that new scientific development must be matched by new economic and social organisation* ..." (Kinnock, January, 1984, in Large, 1984, Foreward, italics added).

As the majority of the Conservative and Labour Parties seem to adhere to the CPRS/Baker analysis, these five declarations are all the more surprising. They appear to be the first politicians of any major political party to fully realise the critical

importance of re-defining our attitudes to work and, Pym at least, recognises that there is an urgent necessity for a comprehensive social debate on the subject involving every sector of society. None of the politicians, however, (except perhaps Pym) would go so far as to actually formulate any long-range pessimistic unemployment forecasts - this problem of calculating future unemployment trends has been left to the more vehement and radical advocates of the pessimistic school of thought.

Such unemployment projections are, by their very nature, much more diverse and subjective than their conservative optimistic counterparts. What all radical pessimists are agreed on however, is that forecasts of 3 - 3.5/4 million unemployed by 1990 appear to disregard the impact of new techology altogether and are as a result, totally unrealistic. For example: whilst at first appearing to support the radical pessimistic approach, computer projections indicating continuing unemployment in excess of 3 million by 1990 calculated by the Institute of Employment Research at the University of Warwick (1982), in fact, only pre-suppose a diluted form of conservative optimism. This view is reinforced by the Cambridge University Department of Applied Economics (1979) who have estimated that there are about one million people in Britain who are unregistered unemployed - the majority of whom are women who leave work to have children and fail to re-register. They would therefore conclude that unemployment in Britain is probably approaching 5 million.

Stonier (1983) has suggested the possibility of unemployment levels reaching 19 million by 2014, Sherman (December, 1981, BBC1 TV, Pebble Mill at One) has talked of a possible 15 million jobs that could be at risk, Malik (23rd December, 1982, Channel 4, How To Succeed With Sand) puts the total at 10-12 million (both over an approximate time-period of 20-30 years); Pym (10 October, 1983, The Guardian) implies a total of 10 million by 2000, the Science Policy Research Unit at the University of Sussex (1978-79) have calculated potential unemployment of 7-8 million by 1994 and Sir Clive Sinclair (7th October, 1982, BBC2 TV, Futures) has said that we will need to find 7 million jobs by 1992. Interestingly, Clive Jenkins (24th August, 1983, in

Radford, 24th August, 1983, The Guardian), General Secretary of the Association of Scientific, Technical and Managerial Staffs, has devised a personal, yet wholly realistic, statistical grouping for determining a more accurate representation of UK unemployment. He has simply classified those who register and those who do not register for employment (600,000 do not register for Unemployment or Supplementary Benefit and over 360,000 are on youth employment schemes, source: BBC2 TV, 4th June, 1983, Newsnight) grouped them within one single specific category and calculated that the 'job gap' will reach 6 million by 1985.

On 19th May, 1978, the French L'Informatisation de la Societe report, written principally by Simon Nora, Inspector General of Finances, (commissioned 20th December, 1976, by President Valery Giscard d'Estaing), concluded that microelectronic technology would eliminate 30 per cent of all French banking, insurance and finance staff. And a 1978 research study by Siemens, the giant West German electronics company, suggested that by 1990, 40 per cent of all West Germany's office work could become automated.

Earlier, I referred to several critical omissions contained within Kenneth Baker's (Minister of State for Information Technology) conservative optimistic speech to the Royal Society of Arts (10th May, 1982); these omissions are couched within two fundamental issues which Baker totally ignored: (a) clerical staff in general are more susceptible than any other group of workers to technological change; and (b) women clerical staff in particular will be displaced in greater numbers than any other section of the UK workforce.

The majority of female office staff are concentrated into a restricted number of secretarial/typing, clerical and cleaning based jobs. For example: women constitute over 98 per cent of all secretaries and typists, 74 per cent of all clerical staff and 91 per cent of all office cleaners. Yet only 11.5 per cent of British company managers are female.

Office automation is having, and will have, four dramatic effects on the traditional status/staffing levels of female employment.

(1) Word processors - with their automatic rectification functions (see office automation) introduce 'power typing' into the office and subsequently de-skill the brilliant girls' fast and accurate typing, enabling those girls with average accuracy levels to compete with the best typists in the department.

(2) 'Power typing' speeds have superceded the necessity for immediate accuracy, consequently word processors have increased productivity/efficiency by 100-500 per cent - with subsequent 30-50 per cent reductions in typing staff.

In a 1980 research project for the equal Opportunitites Commission, Dr. Emma Bird, an industrial psychologist, calculated (rather cautiously I believe) that, in Britain, by 1990 computerised office automation will permanently displace 170,000 secretarial and typing jobs or 17 per cent of the current secretarial-typing labour force.

(3) If the secretaries, who can already control integrated multi-functional workstations with an internal computer cable link, telephone or interactive cable television communication, are given executive-power decision making responsibilities, the displacement of the technologically illiterate managerial classes by executive-secretaries is only a matter of time.

There is a direct correlation between the accelerating development of office automation (word processors, computers, communicative workstations, etc.,) and the number of technologically proficient executive-secretaries.

Table 5: WORD PROCESSORS IN BRITAIN

1975:	6,500
1981:	28,500-30,000 plus
1983:	40,000

(Source: Naughton, 14th November, 1983, The Observer, p.25).

The incentive to reach the level of executive-secretary is clearly enormous - however, the very fact that it is now eminently possible for women to attain this executive grade (because of their technological expertise) also means that the vast majority of secretaries and typists will find that not only have their traditional grades disappeared but their jobs as well.

(4) In a few years computerised automatic 'voice sensitive electronic typewriters/word processors/workstations' will have the capacity to translate executive/managerial dictation directly into typed text - keyboard skills of any kind become unnecessary and the entire principle of the secretarial and typing grade completely disappears.

Baker's generalised assumptions appear to have ignored these 4 crucial factors. He has also overlooked 4 vital issues concerning female factory employment (which presumably means repetitive, tedious production line work which is in itself an indictment of the way we apportion female employment).

(1) Increasingly microelectronic components are being assembled by women in South Korea, Taiwan, Hong Kong and Japan.

(2) Microelectronic components are themselves particularly susceptible to computerised automation.

(3) It is simply uneconomic to maintain even the lowest paid women factory workers when sophisticated robotic systems are, overall, much more cost effective and efficient.

(4) In the field of computer programming, systems analysis, computer consultancy and sales employment there is a disproportionately small number of female staff - for example, less than 25 per cent of computer programmers are women and only 10 per cent of systems analysts are women.

Having examined the conflicting and seemingly intractable argumentative positions, it is important to establish exactly what microelectronic technology is capable of. To do this satisfactorily I have attempted to find instances of computerised innovation that examplify the leading edge of current technological research and development. My intention is to demonstrate that the representative (ideal type) illustrative examples chosen, are by no means extraordinary and therefore eminently capable of being extrapolated to British factories and offices. The following illustrations, I believe, represent, in embryo, the inevitable future - a future we should welcome.

To argue that robotic systems will not radically affect manufacturing and (some) service industry employment is to assume that the technology will remain static. Currently the majority of robots are used in the moderately straightforward operations of spot welding and paint spraying - this situation is changing rapidly.

Rowntree-Mackintosh are researching into the possibility of automating the sorting and packing of chocolates using 160 Puma robots. Similarly, Cadbury-Schwepps, in an extensive £125 million computerised automation programme at their Bourneville chocolate manufacturing complex in Birmingham, use advanced robotic systems operating 24 hours a day, 7 days a week, 52 weeks a year, to pack small individual sweets/chocolates into different sized confectionery boxes. As a direct result Cadbury-Schwepps have reduced their 7,000 workforce by 3,400.

The Ford Motor Company has an operational robot that can assemble a 13 component motor governor in a third of the time it takes an exceptionally efficient human worker. These machines can now be used for general assembly line work, running machine tools and arc welding.

The Japanese electronics group Hitachi have developed a two armed robot capable of processing visual and tactile information. It incorporates 7 television cameras linked to a Hidic 500 and a 150 mini-computer. The robot can assemble a spherical vacuum cleaner in 2.5 minutes. IBM have designed robots that can assemble a multiplicity of small to medium sized products:

staplers, toasters, typewriters etc. In tests their machine constructed the 8 sub-sections of a typewriter in 45 seconds. In 1981 Nippon Electric developed assembly robots capable of manipulating and inserting components into holes measuring 0.5 millimetres in diameter and of ultra-fine precision laser-welding.

Fiat's automated Regata and Strada Robogate assembly lines at their Cassino, (near Naples) and Rivalta, (Turin) factories have reduced the workforce from 10,000 to 6,000 and 125 human welders to 25 supervisors respectively. 20 robots run each production line at an initial cost of just 30 per cent more than under the previous manual system. Automation "may 'humanise' the work for those that remain but the robotic systems very nearly dehumanises the entire operation". (Keegan, 1978, The Guardian).

The Mitsubishi Motors plant in Nagoya, Japan, built in 1977, boasts a 90 per cent automation level on all their robotised assembly line work. General Motors' Zaragoza factory in north east Spain, currently manufacturing the Vauxhall Nova, claim a slightly higher level of automation on their new assembly lines.

The giant Nissan Motors Corporation, however, (Japan's largest robot employer with over 1,000 units) claim a 97 per cent automation level on their assembly lines at their Zama factory - just south of Tokyo. The factory produces over, 20,000 Datsun Sunny car bodies every month - with 100 human workers and approximately 150 robots. One section of the conventional assembly line had previously required 100 workers - the robotic replacement system requires only 6. Nissan have also automated 70 per cent of their engine, gear box and axle assembly operation. Although Nissan robots are at a similar developmental stage (spot welding, paint spraying etc.) to those at Fiat, Mitsubishi, General Motors, Toyota, Renault, Volvo, Volkswagen, Saab, Daimler-Benz, Chrysler, Ford and British Leyland, their hardware and software specialists believe that there is nothing sophisticated robotic systems could not do. They (and Fiat) confidently predict that by 1987 Nissan (/Fiat) will have developed robots technically proficient in every department of automobile construction and installation - including a car's entire electrical system (robots can already assemble car

instrumentation panels, see Unimation/General Motors example) and all other operations currently defying automation. The workforce could be cut by a massive 90 per cent. In other words, blue and white collared workers are now being displaced by steel collared workers.

In 1980 British Leyland and Ford (UK) finally installed their first robotic systems in the Longbridge, Birmingham factory manufacturing Mini Metros and the Halewood plant respectively - well behind the majority of their major competitors. Initially, 16 robots replaced 250 workers at Longbridge - subsequent robot-induced man-power reductions have ranged from 80-13 on conventional assembly lines to 138-13 on complex assembly line operations. In 1984 Austin Rover, a division of BL, had over 100 robots manufacturing (including affixing windscreens) the Austin Maestro and the Austin Montego at their Cowley fabrication plant; (and a further 100 at their Longbridge and Swindon plants). General Motors meanwhile, (who have already cut their workforce by several thousand), in association with Fujitsu Fanuc, plan to have 5,000 robots in operation by 1985 and 14,000 by 1990.

In November, 1982, the Toshiba Corporation claimed to have developed the world's first commercially available robot with electronic vision and two ultra flexible manipulators that can totally replace the traditional production line worker. Toshiba's robots are already wiring and soldering electric fan bases. This level of flexibility and sophistication will, maintain Toshiba, enable the automation of entire, highly complex assembly line processes.

Unimation, in conjunction with General Motors, (both United States companies) have developed one of the most sophisticated robots currently in operation. The PUMA (programmable universal manipulator for assembly) is programmed via a calculator type touch pad - can work alongside humans, assemble products consisting of small parts and can work to a precision accuracy of 0.004 of an inch or 0.1 of a millimetre. Some of its more complicated tasks involved manipulating and fixing into place the lights on a car instrumentation panel. Furthermore, robotic milling machines at the almost totally automated McDonnell Douglas factory in St. Louis, Missouri, are capable of cutting

patterns into aircraft parts to a precision accuracy of 0.0025 of an inch.

Hitachi, Toshiba and Meidensha (a division of the Sumitomo electronics group) in association with 6 of Japan's 10 largest electric-power companies, are developing robots facilitating the automation of nuclear power plants including fuel-rod exchange, radio-activity inspection, floor de-contamination, steam safety valve re-assembly and accident inspection etc., operations. Meidensha claim to have manufactured robots with touch sensors that "approach the sensitivity of human fingers". (Meidensha Publicity, 1982, in Cusumano, 6th January, 1983, New Scientist, p.32).

Robots of this standard, functionally capable though they are, are still only moderately impressive and even the manufacturers themselves would openly admit that robots are still very much in their infancy and in many respects extremely crude. What advances then can we expect in the field of robotic technology during the next 5-10 years and just how close are we to the totally automated robotic-computerised factory?

Stanford Research Institute International at Menlo Park, California, is at the forefront of robotic research and development. The institute, which was originally developed from the pioneering work in microelectronics at Stanford University, currently encompasses and is directly associated with in excess of 2,500 projects from 50 countries - resulting in consultanmcy fees of $150 million. Their funding comes from the National Science Foundation Department of the US Government: $460,000 over 2 years and $30,000 over 2 years from each of the 30 contributing US companies - they include: IBM, General Motors, Xerox, Boeing, Cincinnati Milacron, Proctor and Gamble, and Kodak. SRI has now broadened its research parameters to include the rest of the world (at a cost of $40,000 per company for 2 years).

Robotics Department Director Dr. David Nitzan, says their primary concern is not specifically with machines with "arms that pick things up and put them down again" (Nitzan, 23rd June, 1982, in Charlish, 23rd June, 1982, Financial Times, p.10); rather it is with a microelectronic tripartite package Nitzan calls 'programmable industrial automation': flexibility - enabling the

automation of any task, trainability - ensuring the programming is easy for the remaining factory staff, and intelligence - the system's capacity to foresee problems and put them right.

This advanced version of a flexible manufacturing system is by its very nature not restricted to the inflexible ordered progression of the traditional assembly line. For instance a product moving along a conventional assembly line of, for example, 1-2-3-4 operational stages cannot deviate from that path even if it would be more efficient to do so. Flexible manufacturing facilitates an infinite number of product developmental stage permutations - 1-2-3-4, 2-3-4-1, 3-4-1-2, 4-3-2-1 etc. etc. The computer program determines the optimum efficiency path for the product - this may involve beginning product assembly/moulding/shaping where a formal assembly line would be finishing it.

The lack of the crucial intelligence element is the only factor preventing wholesale automation in factories (with flexible manufacturing systems) - SRI are confident they have solved the problem.

The research has focused upon controlling the path and direction of the manipulators; robotic languages and microelectronic cameras, which, by using their grey scale and binary black and white visual techniques, can locate, distinguish, position, differentiate and measure if need be, the various industrial components.

Inspections are carried out by the projection of a beam of light, known as 'structured light' presenting a three dimensional effect to a camera which then compares the relayed information to an original ideal type. These software, manipulative and visual units are employed in assembly, material handling and inspection - all have been factory tested in outside industry.

During 1981-82 SRI developed a computerised visual system that can memorise hole diameters, positional information, recognise flat parts and store parameter data as identified by cameras - and then estimate the object's identity in its entirity.

Stanford's next move was to develop fully the automated tripartite package in the form of a 'modular programmable

assembly station' - an integrated network of self-contained communicative hardware and software elements , a combination of which could execute any given task.

Software design engineers utilizing Computer Aided Design (CAD) interpret the shape and size of the product parts and how they relate to each other and feed the appropriate information into the computers. The computers then translate the designs via a code generator into a series of operational instructions for machine tool shaping and moulding and robotic assembly.

The elements of this particular flexible manufacturing system are as follows (although individual elements could be interchanged, adapted or improved) - an Auto-Place limited sequence manipulator including a servo controlled rotary base, a revolving table that could move in any programmed direction, a Puma 600 robot with gripper, a vision unit and a camera regulated tray feeder that sub-divides individual component parts into three channels whilst simultaneously rejecting any impurities. Moreover, the individual modules have their own built-in computers and are therefore complete in themselves - yet they can also communicate with each other via a 1 MHz Computrol Megalink utilizing a coaxial cable bus.

The apparently limitless versatility of the package gives the Stanford design considerable potential: it could be adapted to virtually any industrial assembly requirement. Using the aforementioned elements the modular package has already assembled a mains plug and fixed into place minute chassis components - e.g. the tiny component parts required in rocker switches etc. SRI are now researching into how to handle flexible materials, wires and cables etc., as part of their industrial automation programme.

Apart from the few software engineers who would supervise and co-ordinate operations via an external computerised control system any factory using the 'intelligent' Stanford system could become totally automated - the ultimate in flexible manufacturing.

The Japanese meanwhile are probably marginally ahead of the Americans in robotic developmental research and well ahead of them in robot production. Of the rest of the world probably only France comes anywhere near Japan and the United States in advanced robotic research and development.

In 1981 there were 100,700 robots fully operational throughout factories in Japan, although it must be stressed that comparing robotic production in Japan and the United States is notoriously difficult. This is because the American definition of a robot is extremely narrow, therefore US production figures are usually a considerable under-estimation of their actual total. The United Kingdom's cumulative robot total in 1981-1982 was 1,152 - a 300 per cent increase on the 1980 figure.

There are approximately 200 Japanese companies currently producing robots - the majority of which are for internal rather than external consumption. In order to accurately assess the state of the art and the intensity of development Nikkei Sangyo Shimbun conducted a survey of 63 leading Japanese robot manufacturers. The results, which were published in May, 1982, showed that robot production itself had become known as a 'doubling game' because of its incredible growth levels: 1980 value production surpassed that of 1979 by 108 per cent and 1981 value production surpassed that of 1980 by 107 per cent.

The 'doubling game' is of course nothing new: the manufacture and export of numerically controlled lathes doubled during the period 1970-79, video cassette recorders enjoyed a similar series of successes and the production of pocket calculators doubled each year from 1967-1973.

Hitachi employ well over 500 research scientists: Matsushita Electric 100 plus, Mitsubishi Electric 100 plus, Toshiba Electric 100 plus and Ishikawajima Harima 100 plus, all of whom are involved in the development of further micro-miniaturisation, accelerating electron velocity, vision and touch sensors etc. The robot value production of 24 of the surveyed companies was reported as being approximately $200 million in 1980 and $500 million in 1981. Some 34 companies are now exporting advanced robotic systems to the West - their market value has been

estimated by the Japanese Industrial Robot Association to be approaching $1 billion and they expect it to reach well over $2 billion by 1990.

Table 6:

NUMBER OF INDUSTRIAL ROBOTS INSTALLED
BY COUNTRY 1981-1982

COUNTRY	NUMBER OF UNITS
JAPAN	67,435
WEST GERMANY	11,400
SWITZERLAND	8,050
UNITED STATES	6,250*
U.S.S.R.	3,000**
SWEDEN	1,300
UNITED KINGDOM	1,152
FRANCE	950
ITALY	700
CZECHOSLOVAKIA	531

*Simple units are not included in the US numbers
**Estimate

(Source: A compilation of Nihon no Saishin Gijitsu Series, (Japan's Newest Technology), Robot Gijitsu Hyakka, p.16, in Abegglen and Etori, October, 1982, Scientific American, p.J8, and Brock, Secretary of the British Robot Association, December, 1982, in Large, 1984, p.121).

Currently the leading makers of robots and robotic flexible manufacturing systems include Yasukawa, Kawasaki, Hitachi, Fujitsu, Toshiba Electric, Nippon Electric, Matsushita Electric and Mitsubishi Electric of Japan and Cincinnati Milacron, Kearney and Trecker of the United States.

(In May, 1984, Cincinnati Milacron (UK) exhibited a showpiece

computer controlled flexible manufacturing system (FMS) utilizing unmanned sophisticated computerised machine tools, robotic washing, automatic inspection, and a wire-guided loading/unloading vehicle at their Birmingham factory. The factory's only staff will be highly qualified software engineers. Austin Rover and Jaguar are expected to purchase versions of the Cincinnati system, which is already in operation in several US plants. Since 1980 Cincinnati Milacron have reduced their UK labour force by 1,530 from 2,300 to just 770).

Table 7:

ROBOT PRODUCTION IN JAPAN

YEAR	UNITS	CUMULATIVE UNITS
1968	200	200
1970	1,700	2,300
1972	1,700	5,300
1974	4,200	12,000
1976	7,200	23,600
1978	10,100	42,300
1980	19,900	76,700
1981	24,000	100,700

(Source: Japan Industrial Robot Association, in Abegglen and Etori, October, 1982, in Scientific American, p.38).

(Japan has a 70 per cent share of the world robot market).

Moreover, the Japanese Ministry of International Trade and Industry, who have previously sponsored schemes involving fully automated factories and flexible manufacturing systems, believe that the journey towards the super-intelligent robot and the super-computer has only just begun. MITI are currently developing a plan equalled in scope only by the Very Large Scale Integrated Circuit programme of the 1970's - their proposals and

objectives are comprehensive, inventive and extremely ambitious.

"The Ministry of International Trade and Industry has decided to launch from fiscal year 1983 a semi-long range joint government-industry project to develop highly intelligent robots for scientific, economic and social purposes.

This is because it feels that the many different types of robots so far developed in Japan are still far from satisfactory or in the 'stage of infancy', although Japan's robot industry may be internationally rated as the best developed.

The seven-year project, starting from April, 1983, will involve spending 22 billion yen (about £45 million). It calls for spending 3 billion yen (about £6 million) in the first year for fundamental research and undertaking of the entire research and development job by a joint research association to be formed by the Electro-technical Laboratory of MITI's Agency of Industrial Science and Technology, and about 10 major robot, computer and machine makers.

The specific study themes will be to: (1) create a high-sensitivity sensor capable of 'seeing' and 'touching' for object recognition; (2) develop an ultra-midget high-efficiency processor to control its 'sense of vision'; (3) produce a new high-versatility robot arm placing everything at a high precision and moving everything including heavyweight objects; (4) develop a new high-efficiency motor specialising in working the wanted robots; and (5) reduce the weights of the proposed robots for below existing ones and find out the best materials to make the wanted robots. Universally applicable types of intelligent robots are the most desirable." (The Japan Economic Journal, 18th May, 1982, in Abegglen and Etori, October, 1982, Scientific American, p.J13. Note: figure of 22 billion yen up-dated from 17 billion yen - according to Cusumano, 6th January, 1983, New Scientist, p.31).

Factories and offices are the principal targets for the incisive penetration of microelectronic technology with factories, in general, currently slightly ahead in the race towards total computerised automation. In particular, it is in Japan that the automated factory is at its most advanced.

Lying in the shadow of the 12,000 ft. peak Mount Fuji, is one of the most automated factories in the world. Fujitsu Fanuc publicly declares that they have "... robots that make robots ..." (Fujitsu Fanuc publicity, BBC2 TV, February, 1982, The Money Programme).

Within the £20 million factory a series of exceptionally sophisicated highly efficient robots deliver parts for shaping to a set of advanced computer controlled machine tools. An external computer governs the amount and type of raw material transported by sensor and/or camera regulated computerised automated loading, unloading, stacking etc. driverless robotic vehicles from warehouses to the factory floor. Automated trolleys, guided by underground wires, then ferry the required hardware to the appropriate robots. (The trolley's locomotion has full priority - humans have to give way). Fanuc's planned extra and improved transport mobility and diversification will result in even greater robot flexibility. Computer controlled robotic systems regulate the machine tools and presses that make the various components - the finished parts are then conveyed automatically to an assembly area where highly intelligent robots construct highly intelligent robots.

The final link in the automation chain concerns the packaging (by robots) and the testing and distribution (all microelectronically monitored). Communication, co-ordination and instructional logistics data are all transmitted to the factory floor via a remote external computerised control system.

A moderately labour intensive conventional factory of this size would require approximately 500 workers - the Fanuc plant employs 100, the majority of whom are involved in final assembly work. Fujitsu Fanuc employees finish work at 5.30 p.m. (and return to their nearby company houses), but even when the factory lights go out and the heating is switched off, the robots keep on working - increasing production relentlessly and untiringly - the only visible lights are those flashing on the automatic trolleys moving remorselessly between the insatiable robots and the indefatigable automated driverless robotic vehicles.

A flexible manufacturing system (FMS) incorporating 24 machining stations plus several robots, automatic trolleys and vehicles would cost approximately £20-26 million depending upon equipment sophistication. I would expect this figure to be halved by 1988-1990. The Fujitsu Fanuc factory produces £37 million worth of highly sophisticated equipment, including 500 industrial lathes etc., and over 350 new robots, each month - so their initial outlay of £26 million was recovered in just one month's trading. Moreover the advantages of flexible manufacturing systems are not simply confined to increased profit margins. The University of Berlin has reported that these systems also remove the need for the expansive traditional factory lay-out of independent manually or computer controlled machine tools fed by a series of large manually driven fork-lift trucks, by requiring only 60 per cent of conventional factory space. (The excess floor space could either be sold off and/or more perceptibly turned into an educational/leisure/sports complex).

Currently, 70 per cent of the British manufacturing industry operate small batch production lines the majority of which still use traditional machine tools in a series of numerous independent developmental stages. The system is governed totally by the product it was designed for. If the product changes the system's inherent inflexibility can result in a painstakingly incremental and improvised journey (lasting days or weeks) around the appropriate machine tools. With computerised flexible manufacturing (programs can either be bought or hired for specific tasks) any product alterations are simply relayed to the computers and the necessary adjustments are implemented automatically.

Robotic systems dispense with lighting and heating bills - they do not require holidays, sick leave, lunch or tea breaks, 'substantial' redundancy payments, industrial injury compensation, unfair dismissal compensation or 'new technology - no redundancy agreements'. They are never involved in strikes or union disputes. They cost about 30-40p an hour to run, (or cost the company a wage of approximately £14 per week) will operate

for 99 per cent of their life - and will work with precision accuracy for 600 hours at a stretch, (even with breaks no human could possibly attain such levels of sustained accuracy) 168 hours a week, 52 weeks a year for about 25-30 years.

The automation cycle is complete - save for one technician monitoring the computer control system 60 miles away in Tokyo. Within a few years I fully expect the Fujitsu Fanuc factory to be totally unmanned, operating non-stop 24 hours a day, 365 days a year, at premium efficiency.

"It costs 5 million yen a year for a skilled man who works only 8 hours, 5 days a week. A robot costs 10 million yen but it works round the clock. No wonder everybody wants to automate." (Matsnda, President, Japan Robot Lease Company, 26th August, 1983, in Gates, 26th August, 1983, Daily Express, p.10).

(Fujitsu Fanuc are currently developing even more sophisticated intelligent robots in association with Siemens of West Germany).

Shoichi Ninomiya, Managing Director of Fujitsu, confidently forecasts the increasingly comprehensive use of computer controlled advanced automatic systems:

"Our developments in automation have come out of our own needs in the production of semiconductors and electronic devices. This is true not only of Fanuc in numeric controls and robots but also in our new company called Fujitsu Automation. Automation is an absolute necessity to bring costs down and allow variation in product.

There are of course a great many future applications of mechatronics (a combination of traditional mechanical technology and electronic technology). Take the example of vehicles. It is a nuisance to drive such vehicles as forklifts, bulldozers and power shovels. These are machines that require various kinds of manipulations. If electronics were introduced, it would become possible to operate them very simply. However, it could not be done with a simple program. There would be a need to change responses according to specific conditions. Thus it will be important to have the judgment of an on-time sensor.

It would be necessary to think both of an

information-providing sensor and of computerised controls. The computer would need to be small and cheap, rather like a personal computer." (Ninomiya, October, 1982, in Abegglen and Etori, October, 1982, Scientific American, p.J26).

Moreover, utilizing the same principles as the Fujitsu Fanuc plant, the Japanese have recently completed an almost totally automated £26 million factory at the state owned Mechanical Engineering Laboratory, at Tskuba City, near Tokyo. It was the intention of officials at Japan's Ministry of International Trade and Industry to link a comprehensive and advanced flexible manufacturing system to a series of conventional factory operations. This has been successfully completed and facilitates the computerised integration of:

(1) a forge that produces standarised pieces of metal for machine tool moulding
(2) moulding, cutting and drilling computerised machine tools
(3) computerised laser cutting machines
(4) robotic assembly stations
(5) product inspection modules, television cameras/sensors linked to computers
(6) advanced robotic systems
(7) computer controlled conveyor belts
(8) computer controlled testing machines

The entire flexible manufacturing process is co-ordinated and regulated by a sophisticated computer control system.

Peter Marsh, Industry Editor of New Scientist, has pointed out that "the components of the machinery in the plant have been built from standard modules. Workers will be able to take machines apart on the shop floor and re-assemble the bits to make different ones, rather like making models of Lego. This should increase the flexibility of the operation. According to the Japanese government, the plant will serve as a model for

engineers around the country. They will be able to visit it and pick up hints about how to build their own advanced factories. Crucially, many of the country's top engineering firms are building components of the new factory and so are picking up valuable experience in the advanced technologies involved." (Marsh, 1982, p.10). Japan's Ministry of International Trade and Industry fully intend totally automated factories to be developed extensively throughout the country by around 1987 and become commonplace by 1988-1992.

But if Japan lead the world in factory automation, why is their official unemployment rate only 2.7 per cent?
There are 4 specific reasons for this:

(1) unofficially Japanese unemployment is not 2.7 per cent - it is probably approaching 8 per cent. 4.5 million otherwise unemployed workers are kept on by their respective companies simply in order to maintain industrial harmony.

(2) unwanted staff and/or older employees are given 'substantial' redundancy payments

(3) potentially unemployed staff are sent to associated company factories

(4) the suspension of staff recruitment.

Automation has now superceded the economic recession as the principal reason for Japan's steadily decreasing labour force. Numerous industries that once employed, for example, 100 workers now only require 3, probably graduate software engineers, to control and maintain the sophisticated robotic systems.

A British factory automation project, first approved in 1977 by the Labour Government and subsequently constructed by the 600 Group of engineering companies, at last came to fruition on 30th November, 1982, when former Secretary of State for Trade and Industry, Patrick Jenkin, opened Britain's first unmanned factory

at Colchester in Essex. (30th November, 1982, in Large, 1st December, 1982, The Guardian).

The factory has a £3 million small batch production line 'manned' by robots and computer controlled machine tools manufacturing discs, gears and shafts in cast iron, steel and aluminium. However, although all the finished products are genuine - initially - the plant is unfortunately only functioning as a Conservative Government-sponsored showpiece

Sir Jack Wellings, Chairman of the 600 Group, (30th November, 1982, in Large, 1st December, 1982, The Guardian), enthused that previously the production cycle took human workers 10-12 weeks to complete, and involved approximately 50 separate manual handlings of the various small batch orders - the automated flexible manufacturing system completed the entire operation in 3 days, untouched by human hand.

Yet in spite of these prodigious productivity increases and the overwhelming evidence from Japan and the United States of inevitable massive manpower reductions both Wellings and Jenkin steadfastly maintain, almost unbelievably, that the main advantages of 'flexible manufacturing' are *not in the area of labour savings* but in the system's ability to: improve the production time-cycles, decrease the amount of on-site raw materials, react quickly and efficiently to market fluctuations in quantity and in the model/type of machinery, general flexibility, and its capacity to operate non-stop 24 hours a day (thus resolving the problem of unsocial hours).

Jenkin repudiates the suggestion that factory automation throughout the country will mean large-scale redundancies for all unskilled, semi-skilled and skilled workers. Unlike the traditional industries of steel, coal and textiles that are steadily contracting, new industries, as exemplified by the Colchester factory will, Jenkin argues, *expand because of automation and therefore increase employment*. He admits however that it would be a different kind of employment requiring re-training. What Jenkin does not say is that the new employment will be more suited to honours graduates and post-graduates in systems analysis and computer programming rather than to

unemployed steel, coal or textile workers.

Probably the most surprising dissenter (by implication at least) from the Jenkin argument comes from his former number two at the Department of Trade and Industry, Kenneth Baker, Minister of State for Information Technology:

"If we are to compete with the Americans and the Japanese, who are ahead of us in this area, then we will, in certain areas, have to have fully automated factories. And it is encouraging that certain companies are coming to us and recognising that fact. We do not want a big deluxe show-place which is just for show - that would be absurd. My task is to persuade many small and medium sized manufacturers in places throughout the country that to use robots and robotic devices and new production techniques is just as important for them as it is for the BL production line." (Baker, February, 1982, BBC2 TV, The Money Programme).

Warnings about Britain's technological unpreparedness were expressed by Dr. Bernard Capaldi, Managing Director of Pendar Robotics, in a speech at the opening of the Pendar robot manufacturing plant at Ebbw Vale, South Wales, on 18th July, 1982. (Capaldi, 18th July, 1982, in Reeves, 19th July, 1982, Financial Times). He said that Japan's one-time flirtation with robots had now been transformed into a full scale love affair. British industry, he declared, was not only in imminent and desperate danger of being overtaken by international competition but of being totally eclipsed by the year 2000 - unless it fully implements and utilizes robotic technology.

Pendar's immediate programme is to produce first generation robots (initially costing £13,000 each) whose principal functions are restricted to simple repetitive tasks such as paint spraying, palletising, machine loading and stacking and can therefore only displace workers in monotonous, tedious or hazardous occupations.

Capaldi however, clearly recognises the urgency of the situation which is why Pendar, in association with the University of Birmingham, are currently developing prototypes of the more advanced 'Locoman' robot - a machine capable of operating to, and complying with, the exacting standards of precision assembly

work. 'Locoman' robots will be in mass production by the mid-1980's.

But even when at maximum capacity (in about 3 years), the Pendar robot plant will only employ around 150 people - it now employs just 15. If these examples are fairly typical of new technological employment, as I believe they are, then they provide further damning evidence against, and a convincingly persuasive condemnatory rejection of, the naive conservative optimistic argument in general and the Jenkin/Wellings view in particular. The total automation concept of Fujitsu Fanuc is what inevitably lies ahead for Britain's manufacturing and (some) service industry.

Parry Rogers, Personnel Director of the Plessey Group, points out that if we are to compete with, or even challenge, Japan's increasingly automated levels of premium efficiency, UK factory automation is an absolute necessity:

"The capital assets per employee of the Japanese electronics companies are approximately 6 times the capital investment per employee we have in much of British industry. One sees immediately just how much more modern equipment there is for manufacturing purposes per employee. When we talk about improving our productivity the correlation between output per employee and capital investment per employee is such a striking one that it is quite clear that the only way we can get our output up to Japanese standards of productivity is by having the same number of assets per employee. The investment has to be very much directed to taking labour cost out of the product as a means of achieving that productivity." (Rogers, 16th March, 1982, BBC Radio 4, Study on 4).

Yet, if it is possible to produce the same amount of goods with fewer people, why not produce more and keep employment static? An example of why this is impracticable is given by Geoffrey Hubbard, Director of the Council for Educational Technology (16th March, 1982, BBC Radio 4, Study on 4) and was related to him by a senior manager of a British company. The company has a current added value per employee of £17,000 per year - this encompasses all the areas of the firm's activities

including a very large product making factory workforce. The company's intention over the next 19 years is to raise this added value per employee to £250,000 per year. This increase is in the region of a factor of 15. The entire staff would need to be extremely well qualified because virtually the entire factory floor would be automated. If there was only a 5 per cent increase in productivity per year then it would be feasible to increase markets by the same amount. However, microelectronics can increase productivity by 30, 40 and 50 per cent. Output on such a scale would be superfluous - unemployment would seem inevitable.

As we have seen the employment displacement effects of computerised automation in terms of cost and labour savings are, and could be, particularly dramatic; yet the effects of computerised automation on labour intensive office complexes are necessarily further accentuated and could be even more dramatic. The majority of factories manifest a predominantly *capital* intensive framework whereas the majority of office complexes demonstrate a concentrated *labour* intensive framework. Therefore, relative to factories, office capital expenditure is low and labour expenditure high.

In 1974, a US report stated that American administrative/clerical staff, whose labour accounted for 84 per cent of office costs, were estimated to have a capital investment value of $2,000 - factory workers however, had a capital investment value of some $25,000. (Similar totals for Western Europe). Throughout the 1960's office productivity increased by about 4 per cent - whilst factory productivity rose by 83 per cent. This unsatisfactory level of office productivity was seen as being one of the main reasons for the lack of sustained economic growth among Western industrialised societies.

Moreover in 1980, a United States survey produced a break down on American capital investment into offices country-wide: $27 billion was spent on data processing, $46 billion on office equipment as a whole and $373 billion on office staff wages and salaries. Executive director of the Bell Company Laboratories, Victor A. Vyssotsky (1980, in Forester, ed., 1981), has said that

with only a 2 per cent per year reduction in American office staff by the year 2000, unemployment in this area alone would reach 25 million.

In 1982 the wage bill for all the major US companies totalled approximately $1.3 trillion - 60 per cent of these costs were taken up by office staff. And a series of 1982-83 surveys of British office managers indicated a specific intention (because of increasingly prohibitive labour costs) to implement microelectronic automated systems as quickly as possible. Increasingly fierce international competition will prove, and is proving to be an overwhelming incentive for factories and offices to dramatically increase productivity, improve efficiency and drastically reduce labour costs by unreservedly implementing advanced automated computerised systems. Clearly automation is an economic necessity if Britain is to avoid being totally eclipsed in the world market and experience massive non-technological unemployment.

Therefore the natural progression will be to follow in the tradition of the factory and aim for the ultimate in microelectronic office automation - offices virtually devoid of clerical, typing, secretarial, lower and middle management staff, run by a small number of highly qualified managers and executive-secretaries either from the office itself or from home.

Office technology of the 1840's and 50's was still very much in the era of the quill pen and the scribe personified by Ebenezer Scrooge and Bob Cratchit in Charles Dickens' 'A Christmas Carol'. The technology of the period advanced initially with the steel nib pen and continued in the form of various types of 'writing machines', culminating in 1867 with the development of the first conventional typewriter: the Remington No.1 manufactured by E. Remington and Sons (the gunsmiths). The machine became commercially available in 1873.

The QWERTY keyboard arrangement was designed originally to prevent (by separation) the most commonly used letter-keys sticking together; this basic lay-out will probably be

perpetuated until the keyboard itself disappears. The author feels that an alphabetical keyboard configuration would simplify the learning of basic keyboard skills.

The extensive implementation of word processors will, I believe, prove to be as equally a significant initial development within the area of office automation as the introduction of the typewriter was for the development of office technology.

The word processor consists essentially of two memory chips, keyboard, visual display unit and line/laser-printer. Initially, the device requires no paper; paragraphs, words or letters can be moved around, deleted, converted or indented. In addition to editing, the word processor can determine, and therefore 'block' each line length of text (left and right), advise on the grammar, lay-out, style and tone of the letter, automatically count every word, and correct grammar and spelling mistakes. Once the first spelling error is amended the device will automatically search for, and correct, all subsequent instances of the mis-spelt word. (Similarly all grammatical errors). If a paragraph has to be omitted or inserted, the word processor can automatically re-arrange the text into the right order, onto the right pages and re-number everything. After checking and re-checking, standard paragraphs/letters/documents can be programmed and numbered into the processor's memory. The secretary then keys in the appropriate number and for the first time, the electronic text of a perfect personalised letter or document, (or paper, thesis or book) can be transferred and committed to paper, via a line/laser-printer firing the text onto the paper at about 500 lines per minute. Alternatively, a micro-computer can be transformed into a word processor via a pre-programmed word processor chip and a line/laser-printer. (This thesis was produced via a BBC Model B micro-computer/Wordwise word processor chip and an Epson FX-80 line-printer).

Conventional typing speeds, even on electronic or electric typewriters are dependent upon how many mistakes are made and how quickly they can be rectified. The word processor, as outlined earlier, introduces 'power typing' into the office where, if the secretary is not making mistakes she is not typing fast enough.

The usual worries about typing errors, line lengths and general lay-out disappear. 2 or 3 typists using word processors can now do the work of 10 typists using conventional machines.

Already in use are the 2nd and 3rd generations of word processors that can communicate with each other. The machines are linked to a central computer - the computer can either store the data the word processors feed into it or transmit it electronically via cable or telephone link to any other word processor in the same office, city, country or via satellite/telephone communication, to anywhere in the world. And the secretary can do all this from her own desk.

Where word processors have been introduced into British offices their effects have been immediate and substantial.

In 1977 Bradford Metropolitan District Council installed a Word-plex processing system that halved the number of staff required, from 44 to 22, and increased the Directorate's output by 40 per cent. The system, which became operational in July, 1978, can store 37,000 pages of A4 text in its central data base. Principal labour savings come from the use of standard letters which are stored within the system's memory, for example: a mortgage transaction would usually necessitate the typing of 25 different letters - a task that would normally take a typist about 2.5 hours, one girl with a word processor can produce 25 personal, accurately typed letters in 2 minutes. When the transaction is completed the word processor will print the final legal contract - obviating the need for paper files and filing clerks and saving one of the Council's 5 Directorates £60,000 a year. Brian Wormersly, Deputy Leader of Bradford Metropolitan District Council: "... we are in business to provide services ... we are not in business to type paper ..." (Womersly, 14th March, 1979, BBC1 TV, Tonight). (In 1977 an average Word-plex word processing system cost approximately £60,000, in 1984 the cost of a much more sophisticated system had fallen to about £35,000 and is still decreasing).

As a direct result of installing word processors throughout their organisation, a leading motor vehicle manufacturer (name not published) increased general correspondence productivity by

50 per cent, standard letter productivity by 450 per cent and overall productivity by 243 per cent. The Central Electricity Generating Board in Bristol reduced the number of girls in their typing pool from over 50 to 26. The National Coal Board Western Area cut their staff from 20 to 14. The introduction of word processors into the offices of the holiday company 'Horizon Midlands' reduced typing pool staff, including the supervisor, from 30 to 11; and by utilizing a direct link dictaphone system, achieved large productivity increases and saved £25,000 a year in direct costs - more than enough to re-pay all new equipment expenditure within 2 years. An unnamed Government Department has calculated projected job losses among the typing staff effective by 1990. Without word processors staffing levels are expected to increase from 490 to 662; but with word processors and further computerised automation, staffing levels are expected to decrease dramatically from 490 to just 20. And even these figures do not take into account the technology that will be available by 1990.

The most dramatic advance in office automation is, however, not the word processor alone, but the communicative electronic integrated multi-functional workstation. This is exemplified by the Xerox 8010 Star, (£7-8,000 - developed at the Xerox Corporation Palo Alto Research Centre, California), a personal electronic desktop workstation that has the capability of a micro-computer, word processor, a monitor for computer graphics - and, when linked to an internal office communications network, the Xerox Star becomes a total information system with instant access to company files via an external data base, a laser-printer and an 'intelligent copier (facsimile copying via the telephone system).

Traditional Office paraphernalia such as filing cabinets, box files, folders, documents and 'in' and 'out' trays are represented by graphic logos or icons at the right side of the workstation screen. The logos can then be moved around to form the required desktop lay-out as desired by the individual operator. By using the attached keyboard he/she can punch in his/her name and by moving the remote control unit (or 'mouse' as

Xerox call it) he/she can manipulate the small black arrow or cursor until it locates his/her in-tray - he/she then presses the 'select' and 'open' keys and all his/her on-going workload is immediately displayed on screen. The itemized list can now be dealt with in order of its urgency classification - the operator may decide to look first at a particular market survey; instead of asking a secretary or clerk to go and find it, he/she can simply call up the required document (or several documents at once via a split-screen facility), amend it if necessary, have it printed and sent, via a smart copier, anywhere in the world.

The Apple Lisa 1 and 2 (£4,500 and £3,500) and Macintosh (£1,795) computer systems, and VisiCorp's Visi On software package which facilitates personal computers (e.g. the IBM Personal Computer: total cost £3,000, ACT Sirius 1: total cost £3,000 and ACT Apricot: total cost £2,000) with the capabilities of an integrated multi-functional workstation, all have similar characteristics to the Xerox Star workstation incorporating 8 separate functions into one integrated system: conventional micro-computing; word processing, electronic messages and filing - including a flexible graphic documentation system via remote control unit or 'mouse', a split-screen facility allowing several documents to be displayed on the screen simultaneously, business graphics (high definition - for increased legibility, smooth graph curves and less eye strain), financial forecasting, network analysis and a sophisticated calculator. A conventional micro-computer would require 8 different programs. Apple maintain that it takes just 20 minutes to learn how to use their micro-computers.

As an alternative, or in addition to, the remote control unit or 'mouse' the Hewlett Packard's HP150 (£3,000) micro-computer touch-sensitive screen, for example, enables the user to simply touch the required option-box from the 'menu' that is displayed on the screen and the requested documents/papers appear instantaneously.

Workstations allow information to be continuously up-dated and thus by-pass the traditional pattern of incremental work

procedures and consequently all the staff that involves. This will ultimately lead to a much closer client-adviser professional relationship similar to the personalised service of the pre-industrial office. (See Figure 1).

It is already possible to program computers, workstations and word processors to perform various routines by means of voice recognition and even 'thought' recognition (via touch sensors). In May, 1982, the Japanese Government, in collaboration with 8 of Japan's largest electronics groups, established the Institute of New Generation Computer Technology with the specific intention of developing computers capable of 'intelligent concept thinking' in addition to character manipulation that could operate 1,000 times faster and store 10,000 times more information than any equivalent 1982 computer. By 1990 both Japan, and the United States (specifically the Massachusetts Institute of Technology) fully expect to have developed the 5th generation of computers (ultra sophisticated versions of the Xerox Star and the Apple Lisa 1 and 2 and Macintosh machines): super-computers, super-workstations, super-word processors and concomitant super-software that will accept spoken language programming, comprehend and converse in English, Japanese, French, German etc. from, and with humans and other machines. Verbal instruction commands, that could supercede or supplement conventional keyboard commands as a method of computer communication, will store and transmit electronic and/or human speech, and display complex colour graphics. Super-computers and super-workstations will accommodate a 100,000 word vocabulary, an instant multiple language translation capacity (90 per cent accurate), a simultaneous integrated multi-program capability and could theoretically incorporate an integrated interactive cable and satellite television , video phone and video/audio tape/disc drive facilities. These advanced systems would be linked to vast integrated international, national and local communication networks and data bases (or electronic libraries), they could provide instant access to specialist knowledge on almost any subject, e.g. medicine, education, finance, law, social welfare, leisure, sport etc., and consequently facilitate the progressive

and comprehensive automation of the service sector of the British economy.

By 1990-1995, in addition to conventional cable and satellite communication, super-computers, super-workstations and super-robotic systems will probably be talking to, understanding, interacting with, and even programming each other.

Arthur D. Little Inc., the United States international consultancy group (September, 1982, in Giuliano, September, 1982, Scientific American), have calculated that by 1990 40-50 per cent of all United States companies will be using computer terminal equipment on a daily basis. They expect (also by 1990) the installation of 38 million terminal based workstations, in diversifying but not necessarily incompatible formats, in offices, factories and schools ... 34 million personal home computers and terminals ... and at least 7 million computer terminals about the size of the present day calculator.

Today, the small portable terminal or micro-computer enables you to re-create the electronic integrated office within your own home - or even in a baseball stadium. (All the following examples have a conventional keyboard arrangement, integrated monitor-screen and full micro-computer/word processor capabilities).

The Portabubble 81, produced by the Teleram Communications Corporation, is used by New York Times sports journalist Malcolm Moran when reporting on out of town or home baseball games. For example - the New York Mets versus the Montreal Expos at the Shea Stadium: Moran can store his text-copy as the game progresses by utilizing the machine's magnetic bubble memory that can hold 9,000-20,000 characters, receive background material from the Times and finally, via an acoustic coupler, transmit the finished report at 300 words per minute back to the newspaper's central computer base.

Battery-powered totally portable micro-computers developed from the pocket calculator, will facilitate 320,000 characters of text. These machines measure about 15 by 12 inches to 8 by 5 inches, weigh 2-10 pounds, cost £500-£5,000, with RAM, ROM and

magnetic bubble memories, and brilliant, high definition liquid crystal display (LCD) or electroluminescent flat screens, a few millimetres thick, exemplified by the Hewlett Packard 75C and the Grid Compass micro (used on the 1984 Space Shuttle flights and by the US Army) and utilize 3 inch and 3.5 inch diameter micro-floppy discs (standard size 5.25 inch diameter).

Furthermore, it is probable that by 1988-1990 the 'Dynabook' - a portable battery-powered micro-computer the size and weight of a pocket calculator costing around £300-£500 - will have been developed. The 'Dynabook' pocket-office micro-computer could have a 1-3 inch micro-floppy disc storage capacity of 2-4 million characters, a bubble memory with a storage capacity of 4 million characters or a 3 inch Winchester micro-laser-hard disc with a storage capacity of 1-5 billion characters and facilitate the transmission and reception of electronic mail and publishing via a micro-waveguide antennae and Direct Broadcast Satellite (DBS) communication.

The following three diagrammatical plans represent the historical phases of a hypothetical ideal type information based office. Specifically, the illustrations depict a real-estate brokerage but it could easily be a civil service department, nationalised industry, bank, building society, insurance company etc. administrative/executive/clerical centre/complex.

The first plan portrays a pre-industrial office of the mid-19th century. Here, there is one to one personal contact with the client ... the grey lines show how members of staff work independently of one another, filing, retrieving files, up-dating records, showing customers prospective properties and attending meetings where the transactions are completed. The organisational structure is segregated into a series of small scale operations with the emphasis on close, friendly and efficient professional-customer relationships.

The second plan is easily recognisable as the present day industrial office or 'paper factory'. The majority of Britain's

administrative/executive/clerical centres can be fitted into this generalised representation.

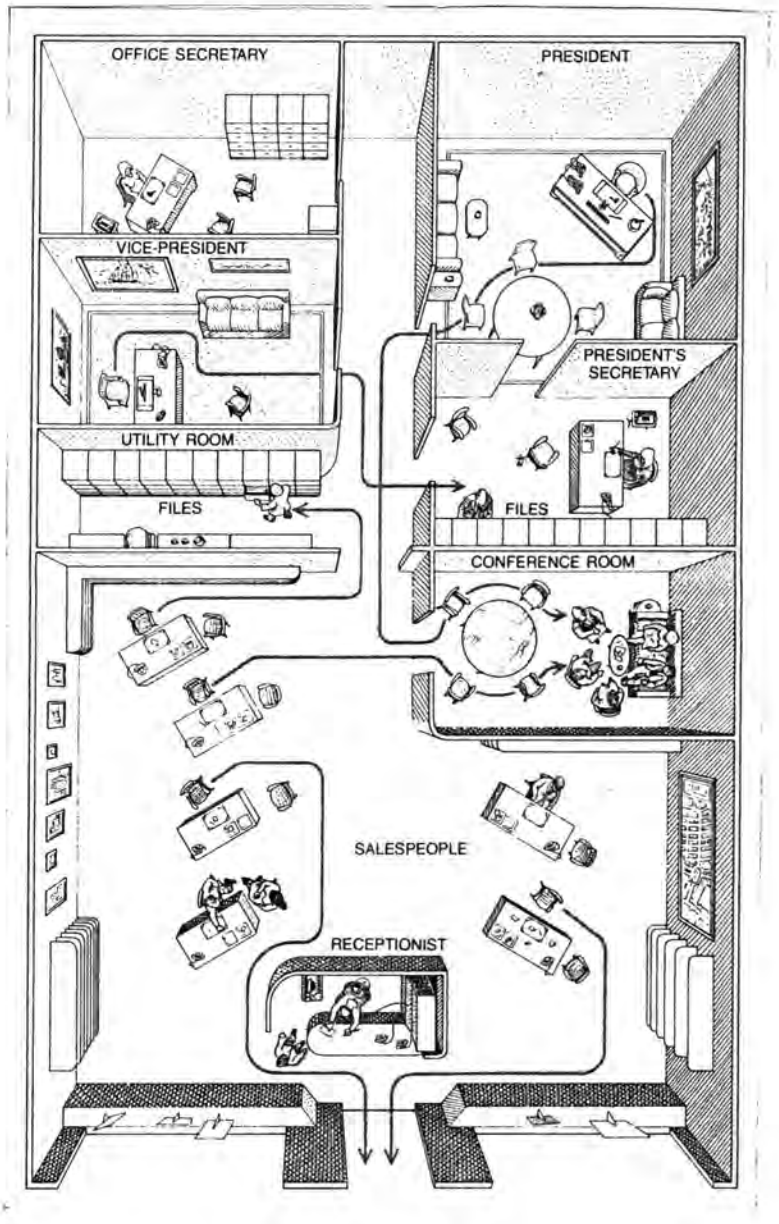
As the description 'paper factory' implies, the organisational structure is similar to that of the production line. Efficiency is not dependent upon one person, instead it is dependent on a clerical team executing a series of fragmented, monotonous tasks. The fine sharp angled lines/arrows and short arrows indicate the path of incoming documents from the mail room, the subsequent gradual incremental up-dating process, and their eventual outgoing journey back to the mail room. Intermittently the clerks may have to file or retrieve papers, examine computer print outs and arrange them in alphabetical or numerical order, answer telephone enquiries etc.

Personal enquiries at the front desk will probably mean the clerk will have to search out the information manually, ask someone who maybe is busy, or telephone another office - either way the clerk is usually unable to follow the problem through and avail the customer of a satisfactory solution. Consequently the work flow is extremely slow, individual tasks are boring and tedious, already inferior efficiency levels are susceptible to further deterioration and customer service ranges from poor to totally inadequate.

The final plan outlines the information-age or electronic integrated office. By fully implementing the most sophisticated microelectronic technology, it is possible to preserve the pre-industrial organisational lay-out and the professional-client relationships whilst storing an almost infinite volume of information. A series of workstations and computers controlled by managerial grades continuously monitor and up-date all client records. Individual controllers can therefore check on the required data, add, delete or edit as appropriate, write electronic letters/documents - complete an entire processing operation and consequently resolve all problems in one session whilst re-assured customers sit and watch.

Clients deal with one person all the time and not with a team of inefficient, faceless bureaucrats. Such communicative

FIGURE 1: THE PRE-INDUSTRIAL OFFICE



(Source: Giuliano, September, 1982, Scientific American, p.126).

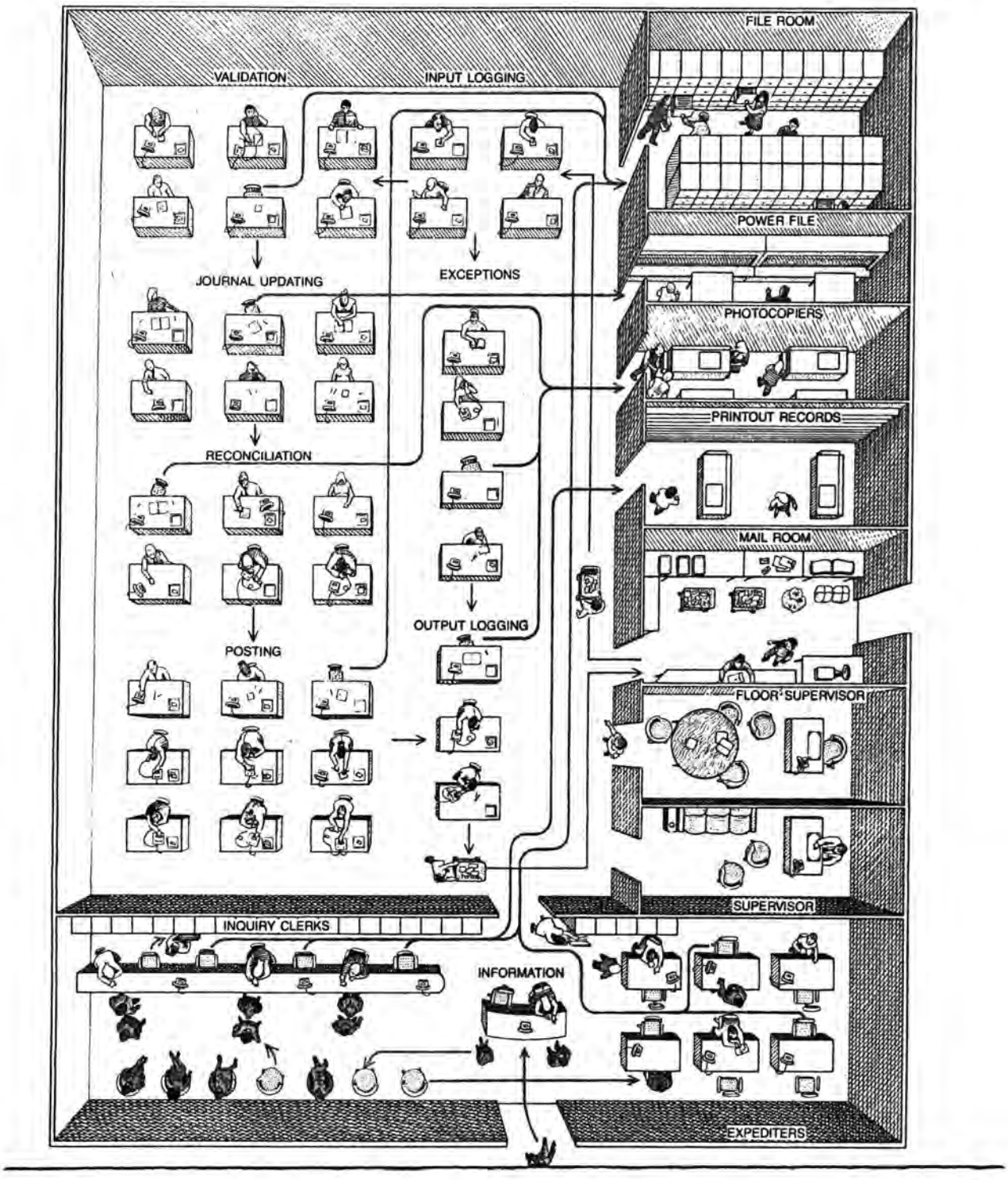
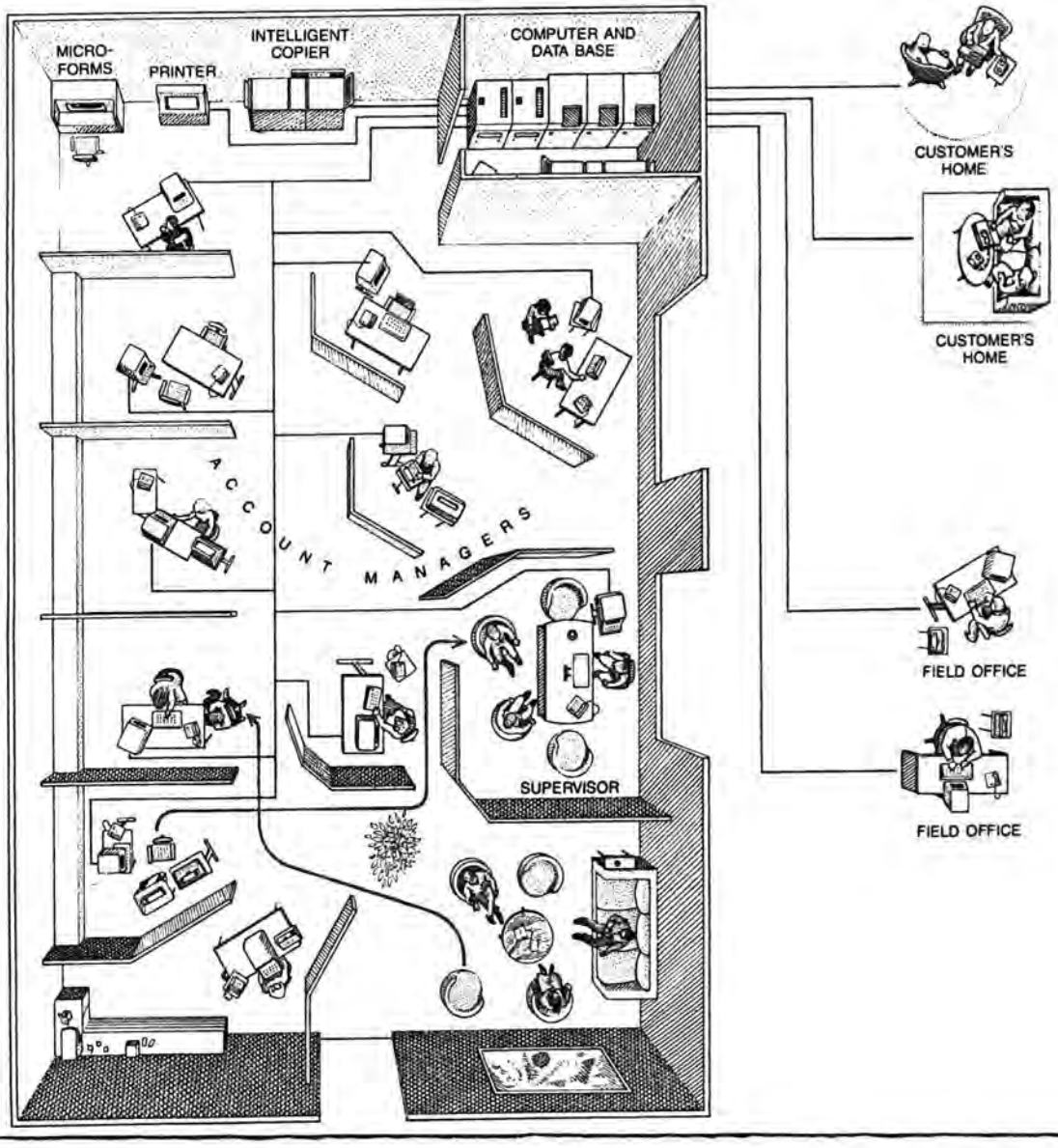


FIGURE 2: THE INDUSTRIAL OFFICE

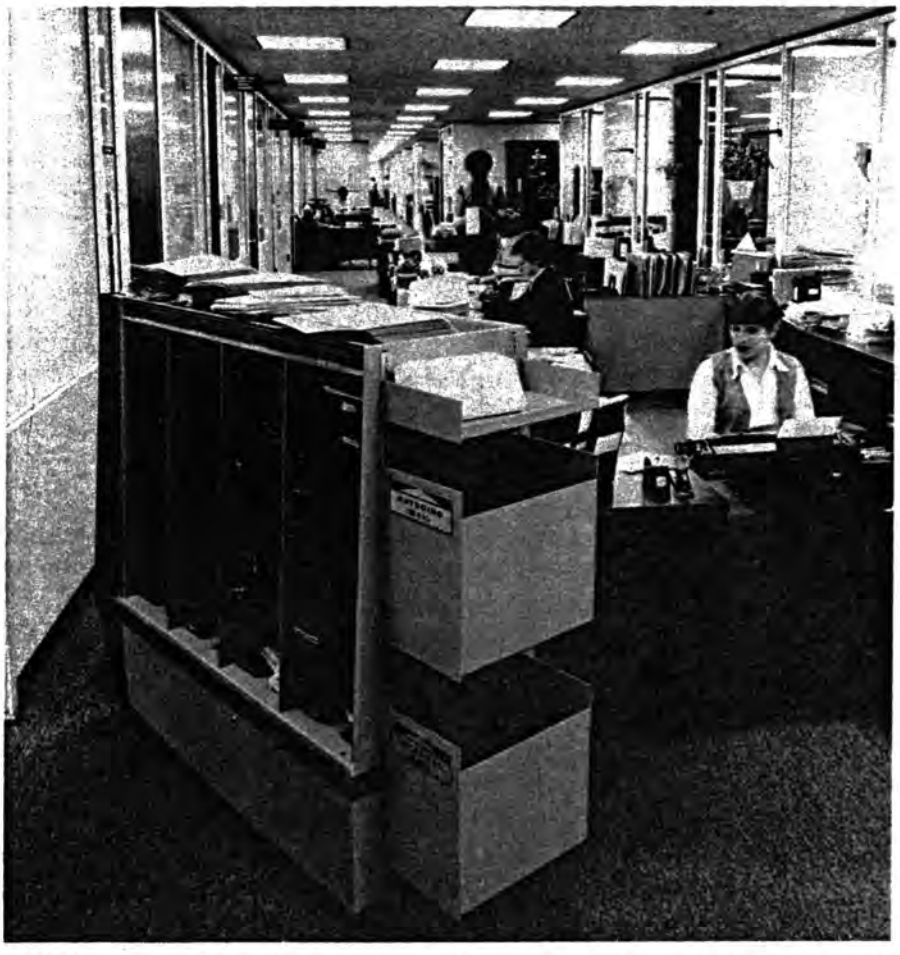
(Source: Giuliano, September, 1982, Scientific American, p.127).

FIGURE 3: THE INFORMATION-AGE OFFICE



(Source: Giuliano, September, 1982, Scientific American, p.128).

FIGURE 4: THE MAILMOBILE



MAILMOBILE, a driverless battery-powered delivery vehicle made by Bell & Howell, mechanizes intraoffice deliveries. Here it is negotiating a curve as it makes its way through the research department of Merrill Lynch and Company. The vehicle follows a chemical pathway, which is easily applied and modified to trace any route from the mail room through the office and back to the mail room. An emitter of ultraviolet radiation under the vehicle makes the chemical fluoresce; an optical sensor detects the fluorescent path. The Mailmobile moves at about one and a half feet per second (one mile per hour), beeping and flashing blue headlights. It stops at pickup and delivery sites designated by a coded pattern in the chemical pathway. Bumpers stop the vehicle on contact with a person or another obstacle. An "intelligent" version is being introduced that can be directed to choose among alternate paths or to board an elevator.

(Source: Giuliano, September, 1982, Scientific American, p.134).

capabilities enables the individual to work directly from the client's home or from a company field office via a portable micro-computer or terminal. In effect he/she is carrying around a complete electronic integrated office facilitating the writing and printing of information, editing, mailing - either to or from the customer or the office, storage/access - depending upon the size of the memory chip and retrieval from central or local data bases.

The senior Data Processing Manager of one of the country's largest nationalised industries told me that their IBM computer package costs were declining - taken separately the hardware section was undoubtedly falling whereas the software portion was either stable or rising slightly. However, with the rapidly growing proliferation of good software he was confident that these costs would also fall substantially.

The general financial trends of micro-technology projected to 1987-88 are as follows: computer memory chips - a decrease of 30-40 per cent per year, computer logic - a decrease of 25 per cent per year, communications - a decrease of 11 per cent per year, labour costs - an increase of 6 per cent per year. As the gap between the cost of high productivity - total automation, and low productivity - people, widens, the choices for individual organisations narrow considerably to the point where the justification for new technology hinges upon how much of the organisation can be automated and sheer economic survival.

The organisational characteristics of companies most susceptible to computerised office automation can be listed as follows:

(1) Overmanned and under capitalised.
(2) Labour intensive - with subsequent high labour costs.
(3) The handling of any kind of information.
(4) A paper filing index.
(5) Manual up-dating of records e.g. client, personnel, accounting records etc.

(6) Manual accountancy, actuarial, insurance calculations.
(7) Manual sorting, storing and retrieval of information.
(8) Storing and distributing payroll data.
(9) Processing/calculating claims, e.g.insurance, social benefit/pension etc.
(10) Issuing standard personalised letters or documents.
(11) Issuing money, cheques, cheque books, statements, etc. - monitoring bill payments.
(12) Stock control data.
(13) Traditional incremental clerical, typing, secretarial, executive, administrative work.
(14) Traditional mailing and photocopying.
(15) Messenger duties.

Any company with some or all of these components will, by implementing microelectronic systems, dramatically improve efficiency, productivity, work-flow, decision making, individual iniative, communications, diminish boring, mind deadening repetitive tasks, provide interesting work, a more efficient personalised service; and dramatically reduce and decrease labour costs and capital expenditure. The principal beneficiaries of office automation would appear to be clerical and administrative centres: the civil service, nationalised industries, banks, building societies, insurance companies, etc. (see Chapter 5). Office size is immaterial; a small firm, for example, can more than triple its output simply by installing 2 or 3 word processors, micro-computers or workstations and printers.

The productivity criteria within the information-age office is no longer solely pre-occupied with an increase in sheer volume output - other factors are now also taken into account: customer satisfaction, the sophistication and advantages of office automation, the clients' willingness to pay for an advanced, efficient and reliable service and the possibility of perpetuating and increasing traditional and new business transactions. The subsequent labour savings are enormous and are one of the principal and contract clinching constituents in any microelectronic technology/computerised automation package deal.

United States office complexes who have already implemented communicative multi-functional workstations report staff reductions of over 50 per cent (exemplified by the Prudential Insurance Company of America in Parsippany, New Jersey) - to an extent where the figure can now be regarded as a statistical norm, a norm which is likely to rise considerably.

Because of the increasing proliferation of personalised communicative, integrated, multi-functional workstations and pre-packaged specialised computer programs, the idea of a separate computer section or department could soon become obsolete. The physical hardware and software of the conventional computer department can now be accommodated within the management executive's or executive-secretary's personal office or home workstation. *The individual workstation will be the computer department.*

This trend towards computerised office automation is reflected in a survey conducted by Korn Ferry International for Beta Exhibitions, organisers of the 1983 International Business Show. 255 British companies with assets in excess of £1 million participated in the exercise. 95.2 per cent of the firms thought that computerised automation would increase efficiency; 97 per cent were confident that their staff would easily adapt to the new technology; and 49.2 per cent considered the nature of the hardware itself would provide offices with an agreeably pleasant working environment. Moreover, 68 per cent of the companies said that they intended to increase their capital expenditure on microelectronic technology, 27 per cent had had to delay their automation plans because of the economic recession and just 13.8 per cent believed that Britain is injecting sufficient investment into computerised office automation.

Currently, 78.9 per cent of the firms use word processors and 77.3 per cent micro-computers (with varying degrees of concentration). 46.6 per cent of the smaller companies predicted that computerised automation would decrease employment in the short term (2-5 years) and 53.4 per cent in the long term (5-15 years). Only 11 per cent forecast that employment would increase

in the short term and 26 per cent in the long term. Among the larger companies 53 per cent thought that computerised automation would reduce employment in the short term and 66 per cent predicted employment reductions in the long term. Just 7 and 10 per cent expected employment to increase in the short and long term respectively.

Furthermore, a 1984 survey by the Association of Professional, Executive, Clerical and Computer Staff (APEX), conducted in the Midlands area where the union has 25,000 members, concluded that for every job created by micro-technology, 50 are destroyed. 90 per cent of the companies surveyed had (in varying degrees) implemented computerised office automation. Gerry Veart, the APEX official who carried out the research, was not at all surprised by the survey's results:

"... over the past few years in the Midlands, we have found that the spread of new technology amounts to an office revolution. This report provides firm evidence for what we have been suspecting for some time. In our survey - which covers more than half of the APEX members in the Midlands - we found that in only 8 per cent of companies was there no form of office automation.

As only 4 per cent were shown to be fully computerised, it is fair to say that the office revolution has only just begun. Only time will tell what that means in terms of jobs, but the facts so far show that new technology destroys considerably more jobs than it creates.

According to our survey for every one job created by new technology, 50 others are destroyed by it." (Veart, 26th February, 1984, in May, 27th February, 1984, The Guardian, p.17).

Having established what is technically possible - will, as the conservative optimistic argument claims, microelectronic automation (at worst) adequately compensate for employment losses or (at best) create many more jobs than it destroys? This assertion is wholly dependent upon affirmative answers to 4 fundamental questions.

Will the manufacture of microprocessors, micro, mini and main-frame computers, word processors, multi-functional workstations etc. create more employment?

Texas Instruments of Dallas, Texas, who along with Nippon Electric of Japan and Motorola of Phoenix, Arizona, lead the world in microprocessor fabrication, predict that 1,000 workers will soon be able to produce the entire world supply of basic memory chips.

In a March, 1979, document, international consultants Arthur D. Little Inc., made the apparently optimistic forecast that by 1987 the United States and Western Europe could expect the creation of 800,000 jobs within the field of electronics. About 500,000 will go to the United States whilst the other 300,000 will probably be divided between Britain, France, West Germany and Italy. The British share is dependent upon the speed at which we adjust to, and accommodate the new technology. To attain maximum employment Britain must react at least as quickly as the aforementioned countries and quicker than the rest of Europe. Optimistically, Britain could get 90,000 which would mean 30,000 jobs a year - this figure, however, totally ignores automation within the microelectronics industry itself.

With regard to the manufacture of computers themselves Stonier points out that "... there will undoubtedly be new industries, but the hope that building computers will absorb a lot of labour is a nonsense. Most computers are so automated they practically make themselves" (via robotics/computers). "The UK might get 20-40,000 jobs out of computing - Britain has over 4 million unemployed ... so in terms of actually creating jobs in itself it will be trivial ... when coupled to other systems the computer's capacity for destroying jobs will be enormous ..." (Stonier, 16th March, 1982, BBC Radio 4, Study on 4).

The business of manufacturing office equipment in Europe is likely to reach £30 billion by 1990. Automated processes will keep employment, even in this expanding industry, to a minimum. But there are two other reasons why Britain will find jobs particularly hard to come by. The first is the intense

international competition:

Table 8: OFFICE AUTOMATION - WORLD LEADERS

	OVERALL WORLD SALES (APPROX.)
EXXON: United States Oil Company (largest company in the world - known as Esso in UK)	£65 billion
IBM: United States (have captured 60 per cent of the world computer market)	£26 billion
PHILIPS INTERNATIONAL: Holland	£14 billion
SIEMENS: West Germany	£10 billion
XEROX CORPORATION: United States	£5 billion
FUJITSU: Japan (largest computer manufacturer in Japan)	£4.75 billion
GEC-MARCONI: Great Britain (largest British electronics group)	£2.75 billion
LOGICA: Great Britain	£1.75 million

(Source: a compilation of BBC2 TV, 10th, 12th September, 1979, The Right To Work; Fujitsu advertisement, in Abegglen and Etori, October, 1982, Scientific American, p.J27; Marsh, 1981, p.147 and Logica Annual Review, 1981, p.10).

The second reason is exemplified by the British microprocessor manufacturer INMOS and the American owned

microchip manufacturer National Semiconductor. INMOS was established in 1978, has been state-financed by successive Labour and Conservative administrations and is now owned by Thorn EMI. The company employ 1,000 people world-wide, has a manufacturing plant at Colorado Springs, USA, a design team of 100 in Bristol and were expected to employ 4,000 people in Britain by 1984-85.

Of the 4,000, just under 2,000 were to be extremely well qualified and highly salaried software engineers (preferably, the majority would be university graduates or post-graduates). The remaining 2,000 jobs will offer little encouragement to unemployed unskilled, semi-skilled or skilled workers from the shipbuilding, steel or mining industries, because the vacancies call for the quick, agile, dexterous skills of young women. By 1986-87, the majority of the female employment will probably be eliminated by advanced computerised automated robotic systems.

"Microprocessors could automate my own job ... its already happening ... we used to have 1700 workers here (a Southampton microprocessor fabrication plant) we now have just 700 and can still produce the same amount of work ..." (Female microprocessor fabrication plant employee, paraphrased, 15th June, 1984, BBC2 TV, All Our Working Lives). Because a single particle of dust can destroy the efficiency of a microprocessor, fabrication plant staff wear special clothing in order to restrict the amount of dust carried by humans. The air is continuously filtered and re-circulated to a degree of 100 dust particles per cubic foot - modern hospital operating theatres contain 10,000 dust particles per cubic foot and are almost unhygenic by comparison. The fewer staff involved the less chance there is of dust contamination.

In order to attract and maintain personnel of the highest calibre, and because of the sensitivity of the product, factory locations were to be in pleasant, quiet, clean-air, vibration-free secluded countryside surroundings, yet within comfortable travelling distance of luxurious, exclusive, middle class housing, private schools, squash, golf and country clubs. What has happened is that of the two factories planned only one has actually been built.

The INMOS plant, which is situated on the outskirts of Newport, Gwent, South Wales, (and fabricates the 'transputer' - a 'listening', 'seeing' 5th generation computer-on-a-chip) cost £24 million (including equipment) to complete, yet still requires an additional £10-15 million to go into full volume production and employ a predicted 1,000 workers. Moreover, there has even been a reduction in the number of staff being recruited. The Newport factory currently employs just 180 people.

Similarly, on 5th March, 1984, National Semiconductor, one of the world's largest microprocessor manufacturers, announced a £100 million, 4 year expansion programme to increase the workforce at their Greenock, Clydeside, factory by 1,000. (The plant already employs 1,050). However, as with the INMOS example, 60 per cent of the jobs will go to dexterous young women, 30 per cent to graduate/post-graduate software engineers and 20 per cent to highly qualified software technicians.

Clearly, increased UK employment within microprocessing fabrication plants is somewhat paradoxical; it is confined exclusively to graduate/post-graduate software engineers and dexterous young female employees - who will soon probably be displaced by advanced computerised robotic systems.

I believe that by the early 1990's Britain's microelectronic employment share will be restricted to a few thousand white collared graduates and post-graduates software specialists and a few thousand steel collared robots. In 1984 Britain had 35 microprocessor manufacturing plants, only 1500 microprocessor fabrication specialist software engineers and a world market share of just 2 per cent.

GOVERNMENTAL FINANCE FOR BRITAIN'S MICROELECTRONICS INDUSTRY: MICROELECTRONICS INDUSTRY SUPPORT PROGRAMME:

July, 1978: Labour Government: £70 million; in 1979-80 cut to £55 million by former Secretary of State for Industry, Sir Keith Joseph.

March, 1984: Conservative Government: £120 million.

BRITISH AND EUROPEAN MICROELECTRONIC TECHNOLOGY RESEARCH PROGRAMMES:

Established

1983-1987: Conservative Government financed (350 million) British industry - British universities: several research collaborations - including (1) GEC: the total automation of manufacturing industry and (some) service sector industry via 'intelligent concept thinking' super-computers and advanced robotic systems; (2) Plessey/Imperial College, London: the development of voice recognition word processors facilitating letters via direct verbal dictation and ultra sophisticated 'intelligent concept thinking' 5th generation super-computers and (3) Racal: the development of 'intelligent' mobile computerised radio-office.

1983: ICL (Britain's largest computer company), Siemens (West Germany), Compagnie des Machines Bull (France) research collaboration. (Institute for microelectronic technology research estbalished in Bavaria, south east West Germany).

1983: Esprit (European Community research programme).

UNITED STATES MICROELECTRONIC TECHNOLOGY RESEARCH PROGRAMMES:

Established

1970 (Approx.): United States Defence Department (numerous research programmes)

1982/83 - 1990/93: Massachusetts Institute of Technology (5th generation computer programme).

1982/83: IBM, Apple, Xerox, ACT, Texas Instruments, Atari, etc. (numerous research collaborations).

JAPANESE MICROELECTRONIC TECHNOLOGY RESEARCH PROGRAMMES:

Established

May, 1982 - May, 1992: Institute of New Generation Computer Technology in collaboration with 8 of Japan's largest electronics groups.

April, 1983 - April, 1990: Electro-technical Laboratory of Japan's Ministry of International Trade and Industry's Agency of Industrial Sciences and Technology in association with 10 major robot and computer companies. (£45 million joint research programme).

(Source: a compilation of Large, 1984, p.195; Large, 20th March, 1984, The Guardian, p.23; Large, 6th June, 1984, The Guardian, p.21 and The Japan Economic Journal, 18th May, 1982, in Abegglen and Etori, October, 1982, Scientific American, p.J13).

Can the software business compensate for the jobs that are lost?

The Government's own Statistics Office reported that in 1981 there were fewer people employed by computing firms than at any time during the past 10 years. In 1972 the number was 50,400 whereas in 1981 the figure had fallen to 41,800. (Churchill and McKinnon, 5th March, 1982, Executive Post No.82).

The forecast from Ed Goldwyn (31st March, 1978), author of the BBC2 television Horizon programme 'Now the Chips are Down' is pessimistic; assuming Britain unreservedly adopts microelectronic technology and applies it to every possible section of society, we would still only need about 60,000 computer software engineers - this figure includes computer programmers, systems analysts and software consultants. Clearly, such numbers are not compensatory.

Will jobs be created by the manufacture of microprocessor based products?

Contrary to the conservative optimistic approach Professors Iann Barron and Ray Curnow (16th November, 1978) believe that employment reductions will easily outweigh any increases which may accrue. They point out that there are relatively few new products on the market: the negative impact on work "is much higher than the relatively trivial positive labour requirements for, say, video cassette recorders, home computers and electronic TV games". (Barron and Curnow, 16th November, 1978, in Forester, 16th November, 1978, New Society, p.388).

This theme is continued by Sherman who notes the lack of new products for the new market. There are however "plenty of opportunities to attack old markets ... new functions are being incorporated (often at no extra cost) into old products," (Sherman, 16th November, 1978, in Forester, 16th November, 1978, New Society, p.388) e.g. televisions, calculators, watches, clocks, cameras, washing machines, cookers, fridge-freezers, automatic dish-washers, hi-fi systems etc.

Even if there is a plethora of new microelectronically controlled unforeseen products, as suggested by the CPRS report (30th November, 1978) and Baker (10th May, 1982), then the products and production methods in these areas would themselves become primary targets for wholesale automation. For example; the Swiss watch industry now employs advanced robotic systems in the manufacture of microelectronic quartz digital watches. During the early to mid-1970's the established mechanical watch industry in Switzerland and southern West Germany was decimated by the development of the cheap, accurate, reliable and multi-functional microelectronic quartz digital watch - manufactured principally in Japan, Hong Kong and South Korea by low paid, manually dexterous young women. In 1947-48 Switzerland's share in the world watch industry was about 80 per cent, in 1983 it was less than 25 per cent. In 1970 employment in Swiss watch production was 89,448, in 1980 it was 47,200, a reduction of almost 50 per cent. 17 Swiss watch companies went

out of business.

Asuag, the largest Swiss watch group, had hoped that the microelectronic watch revolution was just a transient phenomena and thus delayed entry into the micro-technology world market. They were quickly overtaken by events and for sheer economic survival were compelled to totally re-organise their production techniques. As Asuag's Senior Executive, Marcel Rubin, points out "we have now gone through a complete technical revolution". (Rubin, 20th October, 1982, in Williams, 20th October, 1982, Financial Times, p.14). Robotic insertion machines have affected 2,000 workers at Asuag's latest microelectronic watch manufacturing plant and, despite natural wastage and voluntary redundancy schemes, 1,000 will lose their jobs. In 1974, a year before the microelectronic watch production explosion, Asuag had enjoyed a year of record output, employing 20,000 workers. In 1983, with the extensive implementation of advanced robotic insertion machine systems, they have easily matched the production levels of 1974, but with only 12,000 employees.

Table 9: LEADING WATCH MAKERS
(1981 TURNOVER)

	£ MILLION
1. K. HATTORI (JAPAN) (SEIKO GROUP)	2,150
2. ASUAG (SWITZERLAND)	423
3. CITIZEN (JAPAN)	388
4. TIMEX (USA)	N/A
5. CASIO (JAPAN)	341
6. SSIH (SWITZERLAND)	148

(Source: Seiko, 1982, in Williams, 20th October, 1982, Financial Times, p.14).

Table 10: 1981 WATCH PRODUCTION

	MILLION PIECES
1. JAPAN	107.7
2. HONG KONG	95
3. SWITZERLAND	77
4. USSR	39
5. CHINA	21
6. EUROPE (EXCLUDING SWITZERLAND)	19.9
7. USA	9
WORLD TOTAL	368.6

(Source: Seiko, 1982, in Williams, 20th October, 1982, Financial Times, p.14).

Moreover, Texas Instruments have automated 75 per cent of their pocket calculator production and Matsushita Electric, Japan's/world's largest electronics group, under the trademark of Panasonic, have automated most of their television, video, pocket calculator, hi-fi/audio and radio production via the sophisticated robotic Panasert automatic component insertion machine. In 60 minutes the Panasert machine can automatically insert 72,000 extremely complex and intricate microelectronic components (and wiring) onto a printed circuit board. Manually, the operation would require 240 workers, Panasonic's insertion machines require only 10 or 11. The technology, claim Matsushita Electric, "constantly ensures the highest standard of precision accuracy in assembly and consequently a high degree of quality control". (Panasonic Electronics: 1983, p.3). Matsushita currently employ about 7,000 insertion robots - by 1990 they intend to have 60,000 in operation; Matsushita also intend to develop substantially the 'intelligence' of their sophisticated integrated circuit assembly, screw fastening robots and combine the hardware/software with micro-computer/workstation, video cassette and disc technology. Increasingly, advanced

computerised robotic insertion machine systems and computer controlled testing equipment are proving to be much more efficient and cost effective than even the most manually dexterous, lowest paid, young female workers.

Furthermore, some of the new products will be sophisticated versions of the automated tools themselves, e.g. the Fujitsu Fanuc factory where robotic systems make advanced robotice systems (see Chapter 4). Therefore the figures estimating the number of jobs created by new unforeseen microelectronic products should tend to fall rather than rise because of the constant efficiency and cost effective improvements being made in automated flexible manufacturing techniques.

Michael Elliott of Electronics Weekly confirms this analysis: "... the difficulty in heralding electronics as a potential solution to unemployment is the technology itself. While new products arrive on the market so does new equipment to make them - and much of this equipment is automated. In April, 1983, a company which was talking about employing 500 people has now eliminated 150 from that figure, simply by finding more advanced automated production equipment ..." (Elliott, paraphrased, 20th April, 1983, Electronics Weekly, p.S1).

Will there be an increase in service sector jobs?

Barron and Curnow investigated this question in a 1978 report for the Computers, Systems and Electronic Requirement Board. Every area of employment will be enveloped by a "tidal wave of electronics. The use of information technology will directly influence the efficiency of 95 per cent of the economy, whereas support for the industry itself only affects 1-5 per cent of the economy ... the developments in the technology mean that electronics, computing and communications need to be seen as inter-related aspects of a more basic information technology. The reduction in cost of this technology means that it will be pervasive, extending throughout commerce and industry." (Barron and Curnow, 1978, in Forester, 9th November, 1978, New Society, p.332).

The optimism expressed by Carolyn Hayman in the CPRS report (30th November, 1978) of increasing service sector employment is regarded by Tom Forester (10th November, 1978, Labour Weekly) as being ludicrously naive. Forester's sentiments are echoed and amplified by Professor Chris Freeman (May, 1978, in Forester, 16th November, 1978, New Society) and Dr. Jonathan Gershuny (November, 1982, Social Innovation and the Division of Labour, unpublished 2nd draft, typescript) - researchers with the Science Policy Research Unit at the University of Sussex. It would be wrong to assume, argues Freeman, that the service sector could absorb all the unemployment from the manufacturing industries; indeed it is the information workers ... clerks, secretaries, typists, managers ... who are most at risk and they constitute over 50 per cent of the service sector.

Gershuny sees our dependence on, and consequently employment in the service sector as steadily decreasing "... the 1960's sociologists had a rather simple model with two elements: (1) as people get richer they want to consume more services, (2) services do not have the same potential for productivity growth as manufacturing industries do. More demand for services must mean more service employment. The argument said that there would be a satisfactory and fully straightforward transition from a society in which people were employed in the manufacturing industry, because people demanded manufactured products, to a similarly comfortable situation where people demanded mainly service products and therefore more and more people could be employed. Unfortunately there is a flaw in this idea.

Precisely because service industries have relatively low productivity growth their cost rises relative to other sorts of domestic products. And eventually those products that services are competing with will ultimately provide households with the same home information and entertainment facilities that were once the exclusive preserve of the external service. Consequently, over time you would expect increasing difficulties in increasing the number of services you are able to sell." (Gershuny, paraphrased, 26th September, 1982, BBC1 TV, Will Tomorrow Work?)

These in-home services: information, leisure, education etc.

will be facilitated by microelectronically controlled memory stores enabling extensive personal data libraries and by a new information transmission infrastructure of either current flexible telephone communication or the broad-band width necessitated by cable television or a combination of both.

In the following table Gershuny outlines the technological innovations that are gradually infiltrating households throughout the country:

MICROELECTRONICALLY BASED:

DOMESTIC: Centralised control and monitoring equipment (heating, lighting, safety). Automatic washing machines, spin dryers, replacing laundry services; fridge-freezers, cookers; do-it-yourself work, labour saving materials and technical advice packs replacing builders, painters and decorators.

ENTERTAINMENT: TV, Video Cassette Recorder, 'Home Box Office': cable, satellite TV, video tape and disc replacing cinema and theatre. (Subscription service helps promote new films, plays, ballets, operas, musicals, fringe theatre etc. that would not otherwise be shown).

TRANSPORT: Private cars, buses replacing public transport; electronic funds transfer; remote shopping and banking.

COMMUNICATION: Video telephone, video.

EDUCATION: Remote interactive learning packages.

MEDICINE: Remote counselling and diagnosis packs.

MICRO-COMPUTING: General purpose home computing, display and information storage equipment.

(All covered by a general purpose telecommunications infrastructure).

(Source: adapted from Gershuny, November, 1982, Social Innovation and the Division of Labour, unpublished 2nd draft,typescript, pp.10.7-10.8).

Although the cost of a series of isolated communication networks would be prohibitive, Gershuny believes that a shared communicative infrastructure would be a much more realistic and plausible option.

"Once the infrastructure is built, the marginal costs of most of the examples amount to little more than the software they require. It does appear that the same basic infrastructure could be designed to serve all the examples quoted. And of course there are probably many more sorts of services that could be provided in this way." (Gershuny, November, 1982, p.10.9).

One of the technological innovations outlined by Gershuny, the development of cable television, is regarded by Information Technology Minister, Kenneth Baker, as providing Britain with an enormous opportunity: "... cable television will involve a huge investment programme funded by the private sector, it will create wealth in our country and a lot of jobs. Cable television will create jobs in the cable companies actually making fibre optic cable ... jobs in the equipment companies making studio hardware, cable head-ends, television sets and in programme provision - television software. The electronic fibre optic cable network grid will create a whole new series of opportunities ..." (Baker, November, 1982, ITV, Cable TV).

According to the BBC1 television programme Panorama (10th October, 1983), the Government's own statistical forecasts estimate that 7,000 jobs (including 1,000 maintenance staff) will be created by the installation of a fibre optic cable grid. Moreover ITV's Cable TV programme (November, 1982) calculations indicate that the manufacture, installation and maintenance of fibre optic cable and hardware and software production will provide, in total, no more than about 10,000 jobs. Clearly, Baker would seem to have grossly over-estimated the potential for cable television induced employment creation.

The following tables attempt to illustrate the occupational scope and diversity of microelectronic technology by listing:

(a) the hardware/software itself

(b) the occupations affected by it

(c) the degree of occupational susceptibility to computerised automation/microelectronic technology by means of a personal value judgement rating based upon a comprehensive variety of source material and my own personal research

(d) the time-scale.

		Potential Staff Reductions	Potential Levels of Computerised Automation
Extremely High	* * * * *	In excess of 70 per cent	In excess of 75 per cent
High	* * * *	50-70 per cent	50-75 per cent
Average	* * *	25-50 per cent	25-50 per cent
Low	* *	10-25 per cent	10-25 per cent
Extremely Low	*	Less than 10 per cent	Less than 10 per cent

Table 11:

OCCUPATIONAL SUSCEPTIBILITY TO COMPUTERISED AUTOMATION/MICROELECTRONIC TECHNOLOGY

HARDWARE/SOFTWARE

(1) SOPHISTICATED COMPUTERISED FLEXIBLE MANUFACTURING SYSTEMS.
(2) ADVANCED COMPUTERISED ROBOTIC SYSTEMS.
(3) COMPUTERISED MACHINE TOOLS.
(4) COMPUTER AIDED DESIGN (CAD).
(5) COMPUTERISED CONTROL, MONITORING AND TESTING SYSTEMS.
(6) SENSOR AND/OR CAMERA REGULATED COMPUTERISED DRIVERLESS VEHICLES/TRAINS/LOADING, UNLOADING, STACKING ETC. DRIVERLESS, ROBOTIC VEHICLES VIA ELECTRIC CURRENT PATH IMPRINT ON ROAD OR TRACK OR MACHINE'S OWN POWER (HOVER-POWER).
(7) COMPUTERISED AUTOMATED TICKET AND CHANGE GIVING MACHINES.
(8) AUTOMATED COMPUTER CONTROLLED CRANES.
(9) COAL-CUTTING ROBOTIC SYSTEMS, ROBOTIC MINING DRUM CUTTING TUNNELLING - SUPPORT SHIELD/BEAM CONSTRUCTION SYSTEMS, KOMATSU ETC. SEA-BED EXPLORATION, MINING AND CONSTRUCTION ROBOTIC SYSTEMS.
(10) MICRO-COMPUTERS.
(11) SPECIALISED SOFTWARE: CASSETTE/DISC.
(12) LINE/LASER-PRINTERS, INTELLIGENT COPIERS (FACSIMILE COPYING VIA THE TELEPHONE SYSTEM).
(13) INTERACTIVE CABLE AND SATELLITE TELEVISION.
(14) CONVENTIONAL TELEVISION, TELETEXT, PRESTEL.

(ALL HARDWARE/SOFTWARE LINKED VIA FIBRE OPTIC AND SATELLITE COMMUNICATION).

OCCUPATIONS AFFECTED	DEGREE OF SUSCEPTIBILITY: A PERSONAL VALUE JUDGEMENT BASED ON SOURCE MATERIAL AND PERSONAL RESEARCH. TIME-SCALE: 1984-1994
AGRICULTURE	* * * * (See Chapter 4)
CAR MANUFACTURE	* * * * * (See Chapter 4)
CHEMICALS	* * * * *
CLOTHING	* * * * *
COMPUTER/ROBOTIC SYSTEMS MANUFACTURE	* * * * * (See Chapter 4)
CONSTRUCTION	* *
CONTAINERISED PORTS	* * *
FOOD, DRINK AND TOBACCO	* * * * * (Cadbury-Schwepps have eliminated 3,400 staff from their workforce of 7,000. See Chapter 4)
GAS (MANUAL)	* * * *
ELECTRONICS/ELECTRICAL/ MECHANICAL MANUFACTURE	* * * * *
ELECTRICITY (MANUAL)	* * * *
LOCAL GOVERNMENT (MANUAL)	* * *
MICROPROCESSOR FABRICATION	* * * * * (See Chapter 4)
MINING	* * * *
NUCLEAR POWER PLANTS	* * * *
PHARMACEUTICALS	* * * * *
PLASTICS AND RUBBER	* * * * * (The plastics industry are to cut at least 50,000 jobs (out of a total workforce of 250,000) by 1988-1989).

RAILWAYS	* * *	(The Tyneside Metro has unmanned stations and one-driver trains. The Lille Metro System has driverless trains, 8 software engineers and 4 roving ticket inspectors. Birmingham Airport utilizes the Maglev hover-train (the people-mover) a totally automated driverless hover-train, capable theoretically of speeds in excess of 200 miles per hour.
SHIPBUILDING AND MARINE	* *	
TV, VIDEO, CALCULATOR, HI-FI/AUDIO MANUFACTURE	* * * * *	(See Chapter 4)
TEXTILES	* * * * *	
WAREHOUSES	* * * * *	
WATER (MANUAL)	* * * * *	

Table 12:

OCCUPATIONAL SUSCEPTIBILITY TO COMPUTERISED AUTOMATION/MICROELECTRONIC TECHNOLOGY

HARDWARE/SOFTWARE

(1) COMMUNICATIVE ELECTRONIC INTEGRATED MULTI-FUNCTIONAL WORKSTATIONS.
(2) MICRO, MINI AND MAIN-FRAME COMPUTERS.
(3) PORTABLE MICRO-COMPUTERS.
(4) WORD PROCESSORS.
(5) SPECIALISED SOFTWARE: CASSETTE/DISC.
(6) LINE/LASER-PRINTERS, INTELLIGENT COPIERS (FACSIMILE COPYING VIA THE TELEPHONE SYSTEM).

(7) COMPUTER AIDED LEARNING (CAL).

(8) INTERACTIVE CABLE AND SATELLITE TELEVISION (EDUCATION, INTERACTIVE SERVICES, E.G. TELE-BANKING, HOLIDAY AND TRAVEL BOOKING/ARRANGING ETC., INFORMATION, ENTERTAINMENT).

(9) CONVENTIONAL TELEVISION, TELETEXT, PRESTEL (FACILITIES AS ABOVE).

(10) VIDEO CASSETTE RECORDERS, VIDEO DISC MACHINES.

(11) SPECIALISED SOFTWARE: VIDEO CASSETTE/DISC.

(12) HI-FI/AUDIO.

(13) SPECIALISED SOFTWARE: AUDIO CASSETTE/DISC.

(14) CASH SHOPS.

(15) AUTOMATED CASH DISPENSER/TELLER MACHINES.

(16) SPECIALISED SOFTWARE: CREDIT CARDS.

(17) EXPERT SYSTEM/KNOWLEDGE REFINING: an encyclopaedic data base of jargon-free composite knowledge, information and experience gleaned from medical, educational, social welfare, financial, legal, marriage, sports specialists etc.) accessed via computer, interactive cable and satellite television, Teletext, Prestel, video/audio cassette/disc etc.

(ALL HARDWARE/SOFTWARE LINKED VIA FIBRE OPTIC AND SATELLITE COMMUNICATION).

OCCUPATIONS AFFECTED	DEGREE OF SUSCEPTIBILITY: A PERSONAL VALUE JUDGEMENT BASED ON SOURCE MATERIAL AND PERSONAL RESEARCH. TIME-SCALE: 1984-1994
ACCOUNTANCY	* * * *
BANKS	* * * * * (See Chapter 5)
BUILDING SOCIETIES	* * * * * (See Chapter 5)
CIVIL SERVICE	* * * * * (DHSS and DE to cut 25,000 jobs by 1995. Inland Revenue to cut 7,000 jobs by 1987. See Chapter 5).

EDUCATION	* * *	(Staff should be increased. See Chapters 6, 7, 8 and 9).
ELECTRICITY (CLERICAL, EXECUTIVE ADMINISTRATION)	* * * * *	
GAS (CLERICAL, EXECUTIVE, ADMINISTRATION)	* * * * *	
HOTEL MANAGEMENT	* *	
INSURANCE	* * * * *	(US insurance office complexes have cut staff by 50 per cent. See Chapter 5).
LAW	* *	
LEISURE	* * *	(Staff should be increased. See Chapters 8 and 9).
LOCAL GOVERNMENT (CLERCIAL, EXECUTIVE ADMINISTRATION)	* * * * *	
MEDICINE/HEALTH CARE	* *	(Staff should be increased).
POSTAL SERVICES	* * * * *	(Electronic mail see Conclusion).
PRINTING AND PUBLISHING	* * * * *	(Electronic publishing see Conclusion).
SOCIAL SERVICES	* * *	(Staff should be increased).
SOFTWARE PRODUCTION	*	(Computer, Television, Video, Film etc.)
TELECOMMUNICATIONS	* * * * *	(System X fibre optic communications will require only 4 per cent of the current labour force of about 50,000).
TELEVISION AND RADIO	* *	
WATER (CLERICAL, EXECUTIVE ADMINISTRATION)	* * * * *	

Table 13:

OCCUPATIONAL SUSCEPTIBILITY TO COMPUTERISED AUTOMATION/MICROELECTRONIC TECHNOLOGY

HARDWARE/SOFTWARE

(1) POINT OF SALE COMPUTER TERMINALS - OPTICAL LASER SCAN, OPTICAL LASER-PEN, BAR-CODE SYSTEM.

(2) SPECIALISED SOFTWARE: STOCK CONTROL PROGRAMS (MONITORING GOODS/BOOKS IN STOCK, RE-ORDERING GOODS/BOOKS, ISSUING REMINDERS WHEN REQUIRED AUTOMATICALLY; INDEXING).

(3) ELECTRONIC FUNDS TRANSFER: THE AUTOMATIC TRANSFER OF CREDIT CARD PAYMENTS TO SUPERMARKET/DEPARTMENT STORE COMPUTER VIA CUSTOMER'S OWN BANK COMPUTER.

(4) SOPHISTICATED COMPUTERISED ROBOTIC SYSTEMS, CHECK-OUT ROBOTS, ETC.

(5) SENSOR AND/OR CAMERA REGULATED COMPUTERISED DRIVERLESS TROLLEYS; LOADING, UNLOADING, SHELF-STACKING ETC. DRIVERLESS ROBOTIC VEHICLES.

(6) AUTOMATED CUSTOMER-CONTROLLED ROBOTIC CUTTING, SLICING, WEIGHING, WRAPPING, PACKING MACHINES.

(7) INTERACTIVE CABLE AND SATELLITE TELEVISION (INTERACTIVE SERVICES, E.G. TELE-SHOPPING, BOOK/PERIODICAL/NEWSPAPER SEARCHING, INFORMATION, EDUCATION, ENTERTAINMENT).

(8) CONVENTIONAL TELEVISION, TELETEXT, PRESTEL (FACILITIES AS ABOVE).

(9) VIDEO CASSETTE RECORDERS, VIDEO DISC MACHINES.

(10) SPECIALISED SOFTWARE: VIDEO CASSETTE/DISC (ADVERTISING GOODS, BOOKS, VIDEO/AUDIO SERVICES, GENERAL SERVICES ETC.).

(ALL HARDWARE/SOFTWARE LINKED VIA FIBRE OPTIC AND SATELLITE COMMUNICATION).

OCCUPATIONS AFFECTED	DEGREE OF SUSCEPTIBILITY: A PERSONAL VALUE JUDGEMENT BASED ON SOURCE MATERIAL AND PERSONAL RESEARCH. TIME-SCALE 1984-1994
DEPARTMENT STORES	* * *
LIBRARIES	* * *
SUPERMARKETS	* * *

From 1994 onwards I could envisage a 5 star susceptibility rating for all the aforementioned occupations except education, health, social, leisure and sports services where activity-employment should be increased.

My analytical research into the effects of microelectronic technology on employment, the conflicting opinion and evidence, the latest international research and development and the actual and potential effects of computerised automation upon a comprehensive range of numerous occupations, has led me to the conclusion that the radical pessimistic argument overwhelmingly outweighs that of the conservative optimists both in terms of persuasive argument and evidential illustration.

Clearly, the opinions regarding the rate of technological change vary, but what is critical is that it is not studied in isolation and disassociated from attitudinal change. The conservative optimists appear to believe that microelectronic technology can develop and accelerate in a vacuum; they believe that direct and related new technology employment and service sector employment will adequately compensate for those jobs lost in the manufacturing sector. They do not seem to appreciate that direct and related new technology employment and service sector employment are themselves primary targets for wholesale computerised automation.

Nevertheless, although the radical pessimist argument and evidence appears to be conclusive, to complete the analysis I felt some first hand research and personal impressions were an absolute necessity. (See Chapter 5).

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CHAPTER 5: EMPLOYMENT CASE STUDIES*

At a more local level (the north east region of England) I wanted to ascertain the levels of automation present among labour intensive office complexes, their potential susceptibility to computerisation, office staff attitudes towards the new technology and their general views on its implications for work and leisure.

The reason for investigating these organisations at first hand was because of the rapidly accelerating developmental nature and almost infinite potential of microelectronic technology. To establish current and potential levels of computerised automation some 'on the ground' research was absolutely essential. It was important to carry out these studies as a check on the diverse claims and forecasts of the respective conservative optimistic and radical pessimistic approaches. I also thought that current levels of computerised automation should not be analysed in static isolation, but linked to personal unofficial theories and official/unofficial microelectronic programmes and plans, and assimilated into one total package in order to realistically assess the true potential of microelectronic technology within individual organisations.

The criteria for inclusion was that the organisations should be, as far as possible, representative of large labour intensive office complexes both locally and nationally. Specifically, I wanted to find out the current and potential effects of microelectronic technology on staff, productivity and efficiency levels. I also wanted to elicit the personal views of senior and middle management executives, computer specialists, clerical, secretarial, typing and union staff - did they favour the conservative optimistic or the radical pressimistic approach?

Without exeception, however, my initial contact with the organisations prompted a hesitatingly cautious response. The sensitivity of the subject tended to produce an almost MI6 level of secrecy. For example, senior executives at the Department of Health and Social Security, Central Office, Newcastle upon Tyne,

refused to allow any clerical, secretarial or typing staff interview or questionnaire contact, and my letters to the Civil and Public Servants Association at both local and national level did not evoke any response. However, an article in the local evening paper (Evening Chronicle, 16th September, 1982) did outline the union's basic position (see Employment Case Study 1).

The subsequent Social Security Operational Strategy document (15th September, 1982) published less than a month after my interview with three DHSS senior executives totally discredits their naive view that the implementation of micro-technology would be evolutionary, taking about 20 years, that word processors would not make a significant difference to productivity and the almost unbelievable view that the computerised automation of the DHSS would probably increase rather than decrease the staff workload.

The second major Civil Service Department in the study kept no copies or notes on the nature of their response and one of the insurance companies even went so far as to tear off the top third of their first reply sheet - the section that had presumably contained their name and address. Furthermore, when I inquired about circulating my questionnaire among members of a local building society's head office managerial staff, having first assured total anonimity, their Data Processing Controller rejected the idea saying that the questions were too sensitive and controversial. He suggested that as an alternative a short, generalised questionnaire could be distributed among some of their senior managers. Similarly all the other organisations made it a pre-condition of co-operation that there could be no interview and/or questionnaire contact with any clerical, secretarial, typing or union staff.

The very fact that there was so much reticence and secrecy is in itself a blatant indication and an unspoken admission of the unparalleled potential of microelectronic technology. Nevertheless, on a strictly unofficial basis some senior/middle management executives and computer specialists were prepared to disclose their personal views and unofficial and official forecasts and policy decisions.

With regard to the free-answer questionnaire itself, it was designed to be as specific yet as comprehensive as possible. The most crucial and therefore the most controversial questions concerned the effects of microelectronic technology on the organisations over the next ten years, the potential for a decrease in staffing levels, what jobs or sections have or could become obsolete because of the technology and how much of the organisation could become automated. The intention was to establish, in view of rapidly advancing computerised automation, what was actually possible. Could staff levels decrease by 25, 50 or 75 per cent? Would it be possible to automate over 50 per cent of each individual organisation? Is it time to re-define what we mean by work, leisure and activity?

Specifically, and with particular reference to communicative, integrated, multi-functional workstations (described earlier) that have reduced staff numbers within US office complexes by 50 per cent, I wanted to determine potential staff reduction and organisational automation levels within British (north east of England) labour intensive office complexes. The information-age office diagram (see Figure 3, Chapter 4) illustrates how sophisticated workstations could almost totally automate conventional office procedures and reduce staff by at least 50-75 per cent.

Therefore, between August, 1982, and September, 1983, I conducted a series of case studies involving senior and middle management executives from two major Civil Service Departments, two nationalised industries, two national banks, a northern building society and two leading insurance companies. It must be stressed that these studies are illustrative examples only and not random samples, nevertheless I have no reason to believe that they are in any way atypical of current and potential levels of computerised automation, and of the views of senior executives within large labour intensive office complexes.

My research took the form of either direct interviews using a questionnaire as a guiding framework, or a free-answer postal questionnaire or a combination of both. All the respondents

emphasised the 'extreme sensitivity' of the subject and therefore requested total anonymity both individually and as an organisation. The responses, depending upon the nature and volume of the material, take the form of either an account adapted, paraphrased or gleaned from and based upon the questionnaire and/or interview, a series of alternate questions and answers or a combination of both. The full questionnaire is set out in case studies 8 and 9.

Employment Case Study 1:

On 27th August, 1982, I visited the Department of Health and Social Security, Central Office, at Longbenton, Newcastle upon Tyne and spoke to three high ranking senior executives about the feasibility of conducting some research into the possible effects of microelectronic technology on the Central Office workforce.

(DHSS Central Office employs about 11,000 executive, clerical, secretarial, typing, union and messenger staff and it is the repository for the entire country's (Britain's) National Insurance and Pension records. The administration complex is one of the largest in Western Europe.)

I showed them my proposed questionnaire which I had hope to circulate among various sections of staff (executive, clerical and union) - although they expressed interest they considered my research project to be inadvisable and did not think it prudent for such questions to be asked. As they represented a Government Department this reaction was wholly understandable but nevertheless disappointing - I felt that research of this kind at local level into the employment effects on clerical and executive staff within an office complex accommodating some 11,000, could have proved invaluable. However it was apparent that the sensitivity of the subject - which they told me was an 'industrial minefield' - made further progress impossible. Yet from my talk I did gain some valuable impressions as to the genral attitudes of senior management regarding micro-technology.

The senior executives told me that although they thought microelectronics was a revolutionary technology they considered

the argument advanced by the pessimists predicting massive unemployment to be totally unrealistic. They said the enormous valve computers of the 1950's had had a greater effect on jobs than microelectronics - indeed if anything, they new technology had increased employment rather than decreased it.

Word processing had not made a significant difference to productivity - where advantages may occur in the form of standard letters, it was claimed to be quicker to have such letters printed and the names and addresses written in. They asserted that the benefits of word processing were well below those claimed by the manufacturers and in any case the costs of such processes were prohibitive, for example the utilization of telephone lines for word processor communication.

The linking of DHSS local offices with central computer configurations, such as those at Longbenton, by computer terminals could well increase the workload of the staff as records may run to several pages. They claimed the paperless office was a long way away and that there would always be a need for actual documentary evidence: written requests and enquiries from the public and written evidence in the case of computer fraud. Neither were they impressed with the Prestel Viewdata service, arguing that only 16,000 British companies out of a possible million commercial enterprises had subscribed to the system. They did not think the notion of electronic newspapers would catch on.

Most of the computers at the DHSS Longbenton site are ICL main-frames - they have not yet become involved to any large extent with micro-computers. The cost of hardware, they admitted, was declining but they maintained software costs were in fact rising. It was thought the full implementation of micro-technology will be a gradual process taking about 20 years.

The overall impression I gleaned from the discussion was that the general attitude of the senior executives towards microelectronic technology was one of defensive caution, distrust, suspicion and unspoken fear and antagonism. The DHSS senior executives concluded the talk by affirming their agreement

with the general principles of the CPRS report (30th November, 1978) in their conservative optimistic outlook.

In a Government Green Paper, published on 15th September, 1982, the Social Security Operational Strategy team announced a £700 million programme to fully computerise all of Britain's social security operations.

The Department of Health and Social Security and the Department of Employment have 117,000 staff, the majority of whom are clerical, working outside London, administering 30 different types of benefit (10 have been introduced since 1970) worth £25 billion to 24 million beneficiaries at an annual running cost of £1.4 billion.

Anthony Newton (16th September, 1982, in Williams, 16th September, 1982, Financial Times) Under-Secretary of State for Health and Social Security, stated that during the next 20 years there will be a saving of £1.9 billion in adminstrative costs and a displacement of between 20-25,000 staff.

Clearly there is a discrepancy here. Although the senior civil servants at Newcastle Central Office advised me of the impending Government consultative document, their opinions would appear to have little in common with any of the Green Paper proposals. Even after the report was published John Garfit, Public Relations Officer at Newcastle Central Office re-affirmed the senior civil servants' views:

"The effects are long term. We are taking advantage of technology to give our staff more satisfying jobs and a better service to claimants. To talk in terms of possible redundancies is very short-sighted." (Garfit, 30th September, 1982, Evening Chronicle, p.9).

David Ward, Under-Secretary in charge of computer systems at the DHSS: "We are engaged in a mammoth paper chase. We estimate that 5,000 local office staff are needed simply to locate and move bits of paper around offices." (Ward, 16th September, 1982, in Williams, 16th September, 1982, Financial Times, p.1). The system will form a 3 tiered communications network consisting of 70 main-frame computers, 30,000 computer terminals and 3,000

micro-computers.

Level 3: the Newcastle computerised central index - an extensive ICL main-frame computer configuration that will store all social security records, the equivalent of 115,000 copies of the Financial Times. (Virtually all National Insurance Contributions data is already stored on existing computer files).

Level 2: area or regional compters, with built in security checks, will duplicate the principal index store at Newcastle thus allowing the terminals and micro-computers regional access to all the necessary information.

Level 1: the installation of 3,000 micro-computers in local offices throughout the country will greatly enhance the speed and efficiency of assessments and payments - because of the direct area computer link claimants will be able to obtain all the relevant information at one office rather than 3 or 4 as is the case today.

At present however, "DHSS local offices are purely clerical with millions of paper records held in rows of filing cabinets. These offices are the initial contact point for the public. Half the staff work on calculating and paying Supplementary Benefit, while the rest are concerned with Sickness, Invalidity and other benefits and other local work ...

... As computers shoulder more of the burden of calculations and ensure that all the right questions are asked, errors should be reduced and calculations speeded up. As staff would be less burdened by procedural and arithmetical work, each of them would be able to handle a wider range of social security business, instead of requiring claimants to contact different counters at different offices. It would then be possible for them to treat customers as 'whole persons'." (DHSS, 1982, Social Security Operational Strategy: A brief guide, pp.4,15).

Currently, DHSS and DE staff, by referral to over 100 different sets of bulky, closely printed instruction manuals,

frequently amended and riddled with cross references, laboriously calculate the 30 differing types of benefit. Not surprisingly many sections have been and are completely overwhelmed by the sheer volume of necessarily painstaking clerical work. Yet, once programmed into the system, many of these time consuming procedures will become totally automated.

The computerised National Insurance Records, Retirement and Widows Pensions and Child Benefits at the DHSS Newcastle Central Office, the DE Reading and Livingstone computers that administer Unemployment Benefit to all Unemployment Benefit Offices via a separate network, the DHSS North Fylde Central Office that pays War Pensions and various disablement benefits, plus all the local offices, will all be integrated into the proposed communications network.

"Most of the long-term savings would come from a need for fewer staff in DHSS and DE, particularly in local offices. The savings would build up, project by project, and would depend on the way the strategy progressed. If the full programme of projects were carried through on the timetable envisaged, *staff savings would start in 1984 and would build up, gradually at first but more sharply from 1990, and could reach a level of 20-25,000 by 1995*. Other factors, including the extent to which savings were ploughed back into improvements in the quality of service would affect the exact level achieved. There would be discussions with the trades unions about the staffing consequences of each individual project. The aim would be to achieve savings gradually through natural wastage." (DHSS, 1982, Social Security Operational Strategy: A brief guide, p.17, italics added).

The DHSS admit that because of the programme's graduated implementation over a 15 year period, technological advances could well force changes on the original DHSS recommendations. With regard to Newcastle Central Office, Garfit sees this as a virtue: "The beauty of this programme is that it is not a rigid blueprint, but able to assess new directions and accommodate new proposals." (Garfit, 30th September, 1982, Evening Chronicle, p.9).

I would suggest that the 10-20 year time-scale will necessitate a radical re-assessment of the proposals with an inevitable increase in the projected 20-25,000 staff displacement.

The DHSS reasoning contradicts itself. They maintain that the system will probably have to be altered in order to accommodate technological advance, if this is so then why should the number of job losses remain static? Surely it is likely that job losses will increase correspondingly as microelectronic technology improves. The DHSS should therefore at least admit the possibility of alterations to the number of staff savings by widening their statistical forecast band instead of making fixed, narrow predictions based on current technological development.

The author was employed at Newcastle Central Office for 8 years, spending most of his time in the Post Receipt Centre in Establishments and Organisation Branch. The Post Receipt room accommodated about 100 people sorting, opening letters and parcels, shuttling paper and files around the room, filing, internal and external posting, checking and validating documents, order books, cheques, postal orders, etc., and typing; the introduction of automated sorting machines, electronic mailing, interactive cable television, electronic messengers (see the Mailmobile, Figure 4, Chapter 4) and about 10-15 multi-functional workstations could probably reduce staff numbers by 80-90 per cent.

My overall pessimistic hypothesis is endorsed by a well informed Newcastle Central Office senior executive. On 20th September, 1982, via a free-answer questionnaire, he told me that he fully expected a dramatic decrease in Newcastle Central Office staffing levels during the next 10 years of at least 25 per cent but which could be as high as 35-40 per cent. He anticipates that the large Central Pensions Branch could disappear completely and thinks that Child Benefit operations are particularly vulnerable. The huge General Index department, which once formed a major part of Records Branch, the largest branch at Central Office, is now obsolete. The entire country's

National Insurance and Pension records contained within the numerous rows of heavy cumbersome binders (similar to telephone directories) have now been transferred onto a new ICL main-frame computer at Washington. "This provides instant access to all National Insurance and Pensions data for index traces. Records Branch, Central Pensions Branch and Overseas Branch have access via visual display units - no specialist training is required. In the near future we could lose most of, if not all, Central Pensions Branch, Contributions Branch, Records Branch (already dramatically run down), Finance Division (now concentrating on computer audit), Establishments and Organisation Branch - primarily concerned with internal staff records, and possibly Overseas Branch."

The largest union at the Newcastle complex is the Civil and Public Servants Association with a membership of some 7,500 clerical staff. Branch Secretary Barry Fuge is in no doubt about the possible consequences of the new technology:

"We are in the firing line for large scale redundancies under this plan for computerisation. Our union is not opposed to the introduction of new technology as long as it benefits the claimants and protects staff jobs. We would rather see the introduction of a shorter working week than see thousands of our staff on the dole. Negotiations with the DHSS on this issue are being handled by our national officers. But it will be the civil servants in the north east who will bear the brunt of any job losses." (Fuge, 16th September, 1982, Evening Chronicle, p.11).

The senior executive was emphatic about the need to embrace microelectronic technology as quickly as possible but was extremely pessimistic about the social consequences "... we are fully aware that talk of more leisure time is nothing more than a series of meaningless platitudes and as such, totally unrealistic. There is no way that under the current Government we will become other than unemployed. There is a big opportunity within the Civil Service to introduce job sharing resulting in even a three day week with minimal loss of salary. Not enough attention is given to the problem because *there is no intention to use the technology other than to cut back on staff.*

We cannot just be satisfied with half a computerised system and attempt to run an ancient clerical system as well. To be 'competitive', i.e. to run the Civil Service in a correct and solvent manner which is acceptable to the public, we must introduce new technology but *not* at any cost."

The senior executive was certain that multi-functional workstations, word processors, micro-computers (portable and desktop), interactive cable television, would change the role of the traditional Civil Service executive (and indeed the traditional duties of the clerical staff). "Every new development within the DHSS seems to be inextricably linked to, and dependent upon, microelectronic technology. It is realistic to assume that eventually we must all be replaced. This is inevitable and has to be accepted. If we could foresee a time when micro-technology will be a social asset then undoubtedly we would accept it. Unfortunately no one has yet set out a plan for the Civil Service that could in any sense be described as 'in the employees' interests'.

The Civil Service has of course always been behind the times - probably mainly due to lack of co-operation from the unions. This lack of co-operation is in turn caused by lack of union involvement in decision making. It is now normal for future planning to be decided upon without any union involvement until after the decision to implement has been taken."

The executive said that new technology educational awareness programmes involving Civil Service staff centred exclusively upon the specific mechanics of an individual's duties and how new technology may directly affect their job in the future. As Civil Service new technology educational awareness programmes did not extend beyond these very narrow parameters they were, admitted the official, particularly ineffective. The exception to this unsatisfactory trend is in the area of Automatic Data Processing (ADP), where it is accepted that because of the nature of the work and the inside knowledge obtained, staff within this section are fully aware of the unlimited potential of microelectronic technology.

"At present, Government cut backs have reduced the number of

home visits made by local office staff and I would imagine that the public will have more direct contact with Civil Service machines such as the 'hole in the wall' type of system used by banks. Unfortunately however, judging by current Government thinking, I doubt very much if there will be a general change in working patterns, i.e. shorter working day, week, month or year, job sharing, extra holiday, sabbaticals, flexible retirements and financial security in the form of a leisure income. The criteria governing the introduction of new technology is simply to establish a minimum number of jobs but not necessarily at a maximum level of efficiency.

I believe that many of the job losses will be in Central Office. This is the main administrative area and if local offices have direct computer access, and there is a revision in benefit conditions, I would expect at least a 35-40 per cent reduction in staffing levels at Newcastle upon Tyne Central Office. The Child Benefit section at Washington is extremely vulnerable as the payment of benefit would be carried out simply by computer with minimal changes in benefit conditions. Within the Civil Service, the Department of Health and Social Security in particular, microelectronic technology is used now, and I suspect always will be used, *as a means of cutting staff costs.*"

Employment Case Study 2:

This unofficial pessimism is confirmed by middle management executives within another major north eastern Civil Service Department. Because the reply to the free-answer questionnaire was necessarily obtained in a clandestine manner, I will not disclose the name of the Department concerned. The Department's answers (30th March, 1983) are preceded by their accompanying letter.

"I have finally completed your questionnaire. The views expressed in it are mainly personal views from various members of staff. Our ability to move forward with micro-technology is dependent on Government to a large extent.

The replies are handwritten because of the sensitivity of

some of the points raised. I hope you find the information useful."

Concerning the impact of microelectronic technology on the Department over the next 10 years "... certain support areas will have their records converted to a microelectronic system. Paper files will no longer become working files but merely archive material retained under law. Referencing will become much easier and hopefully purchase and repayment procedures will be speeded up. Business forecasting, staffing forecasting, and efficiency scrutinies will become less onerous manual tasks and will be easy to update and amend.

There will be an overall decrease in staffing levels if business trends remain constant. The actual scale is very difficult to forecast. We are at the mercy of the financial market and Government policies. One of our other offices reduced its staffing by 25 per cent over a 3 year period whilst converting to a main-frame computer system. It is generally accepted that a similar decrease would occur in this office as technology progresses."

What sort of micro-technology is currently used within the Department?

"Very little - 2 micro-computers and 2 word processors."

Are there jobs or sections which have, or could become obsolete through the implementation of computerised automation?

"No jobs have gone yet. But it is envisaged that some areas of the office (mainly specific work procedures) will become part of history."

How much of the Department could become automated?

"All filing areas and record keeping areas could become automated. 50 per cent of correspondence areas could become so."

New technology - no redundancy agreements: would you expect such agreements to result in shorter working hours?

"Eventually, yes - but the no redundancy agreements are becoming harder to negotiate. Staff will accept a shorter working week but will still expect the same money with the usual yearly rises. We would still find many staff willing to take voluntary redundancy/early retirement providing that such terms

were made attractive enough. With the Civil Service this is negotiated virtually by Government. The Civil Service has a set of guidelines agreed by the Trade Union side for the introduction of new technology and this is devolved to local level. There are unfortunately many snags yet to iron out."

Do you think the Department should implement microelectronic technology as quickly as possible?

"The answer has to be yes - but we may be doing ourselves out of a job."

Do you believe the Department is fully aware of the potential benefits of micro-technology?

"Yes - but funding/labour relations/education are stumbling blocks."

How do you view the possible introduction of new technology?

"The common view in the office is one of great interest - certainly from the management side - staff may view new technology with some suspicion."

Do you think there are enough new technology educational awareness programmes involving Departmental staff?

"This being the Civil Service all changes are gradual. The Automatic Data Processing personnel attend courses on the development of new technology but clerical staff are not involved in any great detail."

Do you believe the Department want to implement the new technology?

"Hard to say because we are subject to Governmental control and many levels of management. If the Government has a positive policy on new technology it has not filtered down to my level."

Would you welcome working with micro-technology?

"Most answers I received would welcome the opportunity."

What plans are there for the introduction of microelectronic based technology?

"Stationery Stores/Office Services have a micro-computer. Management Information Unit has one for estimating and statistics. Personnel group are currently under scrutiny."

The middle management executives told me that technological change had been slow during their time with the Department and

(from the following ascending scale: evolutionary, slow, average, fast or revolutionary), judged the general rate of Civil Service technological change to be similarly slow. They did however expect workstations to become commonplace within the Department and in other similar administrative/executive/clerical complexes by around 1990, thus allowing information to be up-dated continuously rather than via a pattern of incremental work procedures.

What levels do you think unemployment will have reached by 1990-1995? (A rough estimate).

"Unless Government provides the education/stimulus for alternative employment and there is a social attitudinal change to the type of jobs done - around 5 million."

As yet, the executives did not believe there was a shift away from the traditional work ethic to some form of leisure or activity orientated ethos. They agreed with my suggestion that we could be heading for serious industrial/social disruption if there continues to be virtually no political, TUC, CBI dialogue about the social consequences of microelectronic technology.

The Departmental middle managment executives concluded the questionnaire with the following statement:

"This was a difficult questionnaire to complete, partly in view of the heavy workload we have been subjected to and partly because of the level at which it was completed (middle management). Senior management would not have had time to complete it and would perhaps have been more restricted in the information/policy matters they were able to discuss.

You have mainly been presented with personal views admittedly some based on experience. Because of the sensitive nature of the questionnaire I will not be keeping copies of this reply."

(The Inland Revenue, in a massive computerised automation programme involving 17,717 computer terminals linked to 44 ICL main-frame computers, intend to reduce their clerical staff by 7,000 by 1987. Future Civil Service office automation projects will include the comprehensive computerisation of the Driver and Vehicle Licencing Centre at Swansea and the production of

specialised software that can quickly and accurately calculate the various rates of Unemployment Benefit, Supplementary and Pension Allowances, Family Income Supplements (FIS), Invalidity Benefits, Industrial Death Benefits etc.).

Employment Case Study 3:

On 26th October, 1982, a senior manager and chairman of the local trade union branch from one of the principal nationalised industries discussed with me the effects of micro-technology based upon my free-answer questionnaire.

"The impact of microelectronics on the organisation over the next decade will result in increasing automation, organisational re-structuring and staff reductions." At present they run a Honeywell main-frame computer dealing specifically with payrolls and credits etc. During the past 4 years, under the guidelines of a new technology - no redundancy agreement, they have introduced word processors and Commodore PET micro-computers.

Within the Newcastle office, word processing has reduced the typing pool by about a third from 16 to 11 girls. The pool was then split into mini pools consisting of 3 or 4 girls with direct contact with an organisation manager. Rather than flooding the pool with every form of copy, the manager could reduce the total ongoing workload by putting a 'hold' on some or all non-essential typing.

From various experimental exercises it was found that modest staff savings could be made at the clerical level - difficulties arose however with the reluctance of senior management to change the organisational structure of their work procedures, otherwise labour savings could have been increased substantially.

All the industry's existing technology should be seen as just the initial stages of a gradual building process. On the basis of a series of recommendations by internal capital and labour saving studies the organisation is now embarking upon a comprehensive 5 year office automation programme. Their intention is to install about 200 workstations into the Newcastle office by 1985-86, all of which would be linked to a central main-frame computer.

The 200 workstations will be divided among the 1200 non-manual staff. The 6-1 ratio in Newcastle is not necessarily representative throughout the country - levels could range from 3-1 to 8-1. By 1986 there will be one word processor for every 2-3 members of staff. (The organisation expects the cost of word processors to fall by more than 50 per cent - a further decrease may mean a 1-1 ratio. In 1984 word processors ranged from approximately £1,000 - £3,000). Overall staff reductions are dependent upon the amount of executive and clerical organisational change, improvements or lack of them in customer service, new technology productivity increases in direct billing, general office procedures and in managerial and professional output - a 15-20 per cent increase would result in considerably more job losses. Current projections calculate a modest - average staff displacement. However, it was pointed out that the trend was towards a steady decrease in numbers within the organisation and although the changing technology made employment levels difficult to predict, the situation would undoubtedly get worse.

Micro-technology will significantly reduce staff numbers in the data preparation, computer, clerical and typing/secretarial sectors of the organisation. The least affected area will be that of managerial and professional staff. With regard to the number of jobs gained the percentages ranged from nil to very small. (Although precise percentages were given to me, their sensitivity was such, the manager did not want them included in the thesis.)

If there was provision for a leisure income or social wage the senior manager was confident most opposition to micro-technology would disappear. He agreed that new technology - no redundancy agreements should include discussions on a shorter working week but at the moment this was not happening. The concept of working from home was not considered applicable to their particular industry.

The organisation should, and is embracing the technology as quickly as possible - indeed their Senior Executive was said to be keenly aware of all the technological potential

microelectronics provided. Office automation invariably means an enormous re-training programme. Nonetheless, I was particularly impressed with their current educational awareness schemes. They run a large course teaching computer programming and have various self-programming schemes whereby two Commodore 'PETS' are passed around the staff and anyone who is interested can take the machine home and either learn the BASIC programming language or simply play with it - it becomes almost like a new toy. The computer, by its very nature, attracts 'user participation'.

Approximately a third of all staff within the organisation will be involved in the following learning programmes: awareness training regarding automated office systems and their potential, designing and writing programs, specialised training in communicating and editing data input for use on a private viewdata system and information retrieval from external databases.

The rate of technological change within the industry has in the past been evolutionary but now it could definitely be described as being fast. The organisation is more centralised than before and this will probably result in a reduction in the number of individual organisation branches. Being chairman of the local trade union branch, the senior manager stressed he was well aware of the desperate need for shorter hours, work sharing, extra holiday, sabbaticals, flexible retirements and financial security via a leisure income but did not expect a general change in working patterns for at least 5 years, and indeed, could envisage continuing rising unemployment reaching 7-8 million by 1990.

He agreed that if the present situation continues, of virtually no political dialogue about the potentially explosive social problems then Britain could well face serious industrial/social disruption - thus encouraging a Luddite reaction towards the technology. The organisation has a new techology - no redundancy agreement currently in operation but this expires in 1984 and "renewing such agreements is becoming increasingly difficult".

On the subject of leisure and education - those who retire

from the organisation do receive guidance on how best to enjoy their free time through an 'education for leisure' course. However no scheme existed for those, usually in their early 50's, who left via a voluntary severance programme.

The senior manager did not see any signs of a shift away from the deeply engrained work ethic to a more leisured society which, he said, was regrettable. The interview concluded with him expressing total agreement with my proposals advocating a massive increase in the volume and content of our educational, health, social, leisure and sports services.

Employment Case Study 4:

On 13th October, 1982, I visited one of the country's major nationalised industries and talked to two senior managers about the potential impact of micro-technology. (They did not wish to answer the questionnaire but agreed to discuss the topic in general).

"Over the next 2 years staffing levels will probably be maintained, however, in the longer term over a 10 year period there will be a *significant reduction in the number of staff required.*

Most of the organisation will become fully computerised - currently, we are using word processors, micro-computers and main-frame computers and have recently been discussing a long term plan for a fully integrated computerised system with IBM which would include the introduction of multi-functional workstations. The system would enable the integration of all the organisational divisions: finance, personnel, planning etc., which at present operate independently. There would be a substantial improvement in efficiency and an inevitable decrease in staff. The organisation is being squeezed by political constraints that will have a larger impact on employment than micro-technology. However the number of redundancies will depend upon the nature of future governmental policies and the development and implementation of computerised automation.

The electronic office is already here, indeed all the

technology necessary is readily available for implementation - the difficulties are predominantly social. Any talk of new technology is immediately viewed as meaning redundancies. The issues are extremely sensitive. There seems to be a desperate need for a change in attitude towards unemployment. The introduction of cable television and the establishment of a national communications grid network will revolutionise the service the industry provides to the public. Organisation executives working at home is a distinct possibility probably as a form of networking where employees can also take on contract work - this is already being done at Rank Xerox." (Paraphrased extensively).

They told me that they were extremely impressed by the capabilities of their current software ... although they were fully aware that well before these horizons were reached their software/hardware would probably be completely obsolete. The planning department which involves the processing of data will probably become totally automated. But in general the automation of the organisation would move very slowly. One of the senior managers said that he did not think unemployment would ever fall below 3 million and agreed that patterns of work will have to change.

Employment Case Study 5:

On 6th October, 1982, an executive official from one of the leading banks in the country completed my free-answer questionnaire with the following results:

The executive told me that microelectronic technology was liable to have a considerable impact within their organisation. "In the short term the labour force will probably decrease by about 10 per cent - by means of natural wastage, for example: early retirement, vacancies not filled after pregnancies etc. In the mid-term there may well be a reduction in the working week although companies are likely to see this as increasing costs and so little attention is being given to the problem; for example: bank staff working on Saturdays simply means extra hours - no

time off is given in lieu, and no new staff recruited. However, given the widespread adoption of cash dispensers and home banking, by 1990-1995 the total computerisation of individual branches could lead to a 75 per cent reduction in present staffing levels.

Counter service, the processing of cheques, credits, and secretarial work will all be speeded up by microelectronic technology, for example: automatic cash dispensers - more are constantly being fitted; microprocessor controlled machines for the weighing of bank notes - giving an instant read out as soon as money is paid in; point of sale terminals in shops will be linked directly to bank computers; the use of plastic cards eliminating vouchers (cheques, credits, debits, transfers from accounts, deposits etc.) and the utilization of word processing.

The secretarial side and posssibly the machine room staff who process all the vouchers, could find their jobs made obsolete through automation ... many people are still paid in cash but this is unlikely to continue indefinitely, instead it is likely that direct crediting will become commonplace.

A possible compensatory factor is that banking is becoming more personalised - both the receptionist and the personal banker sit outside the 'branch secure area' and deal with customer enquiries, complaints and try to market the bank's services. Receptionists do this for any customer whereas personal bankers are allocated a number of accounts to look after, for example: A-E and deal with them specifically.

It is in this area that jobs will probably increase. Marketing is a necessary feature of banking and people are better at it than machines. More staff are likely to be freed by technology from mundane jobs to market the bank's services and answer customer queries. The personal touch is very important in banking and staff will be needed to compensate for all the machines.

If there was provision for a leisure income giving people financial security, work would decrease in importance and to a great extent opposition to new technology would disappear.

However people need some goal to achieve and work gives them this in the form of promotion or increased knowledge ... it gives a feeling of purpose to life, a direction, satisfies the need of ambition and enables the individual to appreciate and enjoy his/her leisure time.

The bank must embrace microelectronic technology as quickly as possible ... it is the only way to remain competitive - but a parallel increase in customer relationships is also required. The bank is fully aware of all the potential benefits - especially with regard to labour saving and efficiency.

The introduction of the technology is inevitable and desirable if personal customer contact could be increased and enhanced by freeing staff from monotonous, uninteresting duties ... it would be undesirable to just simply cut employment.

There is a need for more new technology educational awareness programmes involving company staff ... knowing how to operate portable micro-computers ... this will allow greater flexibility with the possibility of working from home. The portable micro-computer will mean the bank executive will have more information readily at hand when making decisions but will probably suffer from greater control from head office."

The actual rate of technological change within the organisation was estimated as being 'fast' (from the following ascending scale: evolutionary, slow, average, fast or revolutionary). "The introduction of workstations is likely to become commonplace by around 1990 both in this organisation and in other similar administrative/executive/clerically based offices.

There will eventually be a general change in the patterns of work but it will be very much in the long term. But when it does happen it will be a good thing since there will be less work to do and what there is will probably be shared. In the future we will probably need to educate people to enjoy their leisure time since without work people become bored and restless.

There will have to be a move towards a leisure ethic ... and a large-scale expansion of educational, health and leisure services would be desirable and may happen eventually but it is

doubtful whether it can occur when the monetary system is in its present state."

Employment Case Study 6:

On 14th November, 1982, I visited the Regional Headquarters of one of the 4 major banks and spoke to their Regional Manager. Although he did not have the time to complete the questionaire and did not wish to go through specific questions, he agreed to an informal interview.

The Regional Manager did not envisage microelectronic technology having any noticeable effect upon their, or indeed on any other banking establishment. "In 1961 the company installed their first computer system into one of their London branches, at that time the organisation employed 24,000 - we now employ some 45,000. During this period there was a vast increase in the amount of work handled by the bank. Business has been rising by 8 per cent each year and over the past 15 years the bank doubled its number of accounts, procuring 8 million contracts representing more than 800 million annual transactions requiring 61 million bank statements. Furthermore, with about 50 per cent of the population not having a bank account there is the distinct possibility of substantial business expansion."

(But rather than create more employment I would argue that this untapped business resource merely heightens the incentive to become even more highly automated).

Nevertheless, due to the new technology staffing levels had actually increased. "What the technology does do, is reduce the rate of increase. Consequently there will probably be no further growth in staff numbers over the next 5 years." Bank-front and off-bank location automatic cash dispensers, the introduction of interactive cable television by 1986 and subsequent tele-banking would, thought the manager, have little impact. What might affect the labour force would be industry-bank computer links - but otherwise he was extremely sceptical of the predicted change. "People do not like change", he told me, "they immediately feel threatened. No doubt banking will develop along with the

technology but it will be a very slow process."

I put it to him that surely a massive increase in cheap, computing power would inevitably improve productivity and reduce labour costs. But again, he considered this would make little difference. "The trend is towards ensuring a better customer service - many people, especially the elderly, dislike dealing with automatic cash dispensers, they would much prefer to maintain personal contact with banking officials. All cash dispensers have done is take away the single transaction from the counter clerk, shortened queues and hopefully improved the service. The bank has recently installed an automated teller machine into a factory run by a large electrical firm and as a direct result the controlling local branch has doubled its staff from 6 to 12." (Most of the extra work is involved in maintenance).

The Manager agreed with the general outline of the ideal type pre-industrial, industrial and information-age office plans and thought it was just possible that they could be applied to banking. Moreover, I pressed him to try to consider and envisage what could happen given a sudden technological explosion whereby financial and international imperatives compel British manufacturing and service sector industry to adopt unreservedly all the available developments in microelectronic technology. He conceded that such a technological explosion was indeed quite possible.

The large scale automation of banking could lead to what he described as 'cash' or 'money' shops where every form of business transaction, including loans, would be conducted through a series of sophisticated, totally automated machines. "These 'shops' would be responsible for credit storing and administering cash, cheque books, cheques, statements, personal loans etc. Although", he added "the customer may omit some vital information which could mean a machine might not be able to deal effectively with the required transaction."

(But surely, tele-banking via cable television could obviate all such problems by advising the customer of all the necessary data before, for example, a loan could be secured).

"All management and corporate expertise could be pooled into a regional or national centralised caucus - these offices would form the nucleus of a computerised communications network linking all the 'cash shops' country-wide. The 'cash shop' however, may provoke public opposition to the machines themselves." (3 or 4 financial advisors in each shop could quickly alleviate any initial problems. And in any case the bank is already positioning staff in 'public space' in order to deal with people's queries). "Undoubtedly there will be an increase in leisure time but whether or not people will like it is very much dependent upon individual temperament and the bank's initative in taking responsibility to teach people to enjoy longer periods of free time. It is a marvellous thing to be perfectly happy doing absolutely nothing." (Employment Case Study 6 was paraphrased extensively).

Employment Case Study 7:

This particular case study of a leading northern building society takes the form of 2 separate questionnaires. The Data Processing Controller was willing to complete the principal free-answer questionnaire and after some discussion it was agreed that a much shorter, less controversial free-answer questionnaire could be distributed among a selection of managers within head office. I duly received the replies on 16th May, 1983.

First, an account by the Data Processing Controller adapted from the conventional, extensive free-answer questionnaire.

"The effects of microelectronic technology will be evolutionary. The computer has already extended itself to the workplace via visual display unit terminals and the next 10 years will see more sophisticated terminals with multi-function use, self-operated terminals for customers and terminals for executive use. Building societies are a growth industry. We would do well to maintain existing staff levels. There will be a swing towards technical and research staff away from administrative staff .

Our current hardware includes an ICL main-frame computer, several v.d.u. workstations and one Apple micro-computer. Over

the past 10 years various jobs and sections have become obsolete because of the adoption of new technology - this will continue. Building societies are purely 'offices' and the degree of automation will depend on the office technology available. There remains a high number of administrative tasks despite computer systems.

The working week is now 37 hours. This has steadily decreased over the years and will decrease further with automation. Again I see it as an evolutionary process. Perhaps new technology - no redundancy agreements will result in fewer working hours; there is a lot of talk but it is all too theoretical. When real situations draw near then real decisions will follow.

Undoubtedly we want to implement microelectronic technology as quickly as possible but with commercial reality in mind. We realise the potential benefits of computerised automation (labour savings, increased productivity and higher efficiency levels) but we need the right equipment at the right price. I view the introduction of micro-technology with guarded enthusiasm.

Most of the new technology educational awareness programmes border on science fiction and tend to be more opinion than fact. The fundamental role of the executive will not change with micro-technology but the resources he is planning and the means of obtaining corporate objectives will change. We will implement the new technology as it becomes commercially available. Our immediate plans in this area will be a move towards counter top terminals and self-service banking. We already have conventional workstations. The next move is toward communicative, integrated multi-functional workstations.

A general change in working patterns (i.e. increasingly more free time) will evolve. I believe the pace of change will not be forced by technology but by social patterns which will take place in a natural way and not be held back by lack of means, e.g. Prestel has not made an impact because the public were not ready for it.

The main problem in educating people to enjoy their leisure time is the work ethic instilled in us all. Most people could enjoy themselves if they did not feel guilty about not working."

At the request of the Data Processing Controller the following questionnaire, completed by 4 head office managers, necessarily excluded any controversial references to the actual organisation conerned; therefore all the questions were couched in general rather than specific terms. For convenience and simplicity each question will be followed in turn by a compilation of the responses given.

(1) How aware are you of the new developments taking place within the field of office technology? (i.e. communicative integrated multi-functional workstations).

"I am aware of the technology mentioned."

"I am aware that numerous and far-reaching developments in office technology are taking place but have a limited knowledge of specific developments. My main sources of information on innovations of this type come from either television, the press or circulars on specific types of new technology."

"I feel reasonably aware of the type and capability of machines on the market although not in terms of specific models."

"I am fully aware of the sort of things that are available."

(2) What are your views on such innovations?

"I think they have made a significant contribution to (a) efficiency, (b) cessation of drudgery and (c) unemployment."

"There are obvious advantages and disadvantages although I don't believe in the concept of men being replaced by machine. Office technology which makes an organisation more efficient, effective and competitive is a good thing but not to the detriment of the employees."

"Such innovations are obviously desirable provided the machine meets the problem rather than finding a problem to meet the machine."

"My views are somewhat mixed. On the one hand, I am very much in favour of making full use of work-saving devices if they can be cost justified. On the other hand, there are significant

control problems associated with the concept of the 'paper-less' office which can not always be easily overcome. The introduction of such innovations must take into consideration the job satisfaction of the clerical or even managerial employees who would operate them, as well as saving costs (if this is actually the case) and improving the quality of output from the system and its reliability. It is not sufficient to look only at the benefits if there are significant disadvantages in other areas."

(3) Do you believe that the comprehensive implementation of microelectronic technology is desirable?

"Yes, but those who may have been forced to join the dole queue because of it would not agree."

"Yes, provided the technology is being used for beneficial purposes. This however, is not necessarily the case and in areas such as defence both East and West can be accused of using new technology for detrimental purposes."

"No. In a lot of cases it may theoretically increase efficiency but in practice make jobs less interesting."

"Almost invariably, yes."

(4) Do you expect a dramatic increase in microelectronically based consumer hardware/software? (i.e. home micro-computers, video cassette recorders, video disc machines, televisions with cable and satellite facilities, hi-fi/audio stereo systems, cassettes, discs and programmes etc.).

"Probably not dramatically. Cost must be an inhibiting factor. E.g. I do not envisage everyone rushing out to buy new digital audio systems to replace their existing stereo. The younger generation are more aware of the world of micro-electronic based consumer goods but their enthusiasm will be balanced by the lack of interest of an ageing population."

"As society becomes more accustomed to microelectronic based consumer goods demand will undoubtedly increase and I think by the end of this century we will be a more electronic based society in UK."

"Yes."

"Yes, especially if prices continue to fall."

(5) With actual unemployment at around 4.5 - 5 million, and given a rapid acceleration in the implementation of microelectronic technology - do you think there should be a reduction in the number of working hours, extra holiday, sabbaticals, flexible retirements and possibly a leisure income providing financial security and a general attitudinal shift away from the Protestant/Puritan work ethic to an activity or leisure orientated ethos?

"I think the situation has already been forced upon us by a world-wide recession. How we cope depends on our ability to compete with other highly industrialised nations i.e. can the producers earn enough to provide the necessary "transfer of payments" to the non-producers. Changes in attitudes are necessary but I find the concept of a change to a leisure ethic rather difficult to grasp. It may well come in some future Utopia. In the present real world, however, we either produce and earn or we go under."

"Innovations in technology should create new jobs in new industries to replace the older decaying industries. A move towards shorter working hours etc. is desirable provided the country's economy, the organisation and the individual do not suffer. I would imagine a stable mix of the work and leisure ethic would prove to be suitable."

"To an extent yes. I certainly feel that unemployment will not be solved by job creation and we must change society's attitude towards duration of working life. I feel early retirement and overtime restrictions as law would be a first step."

"I think that there must be a significant move in this direction before the end of the century, however it will be difficult to persuade those who *have* paid, full-time employment that they can not expect to be paid the same amount for working shorter hours. This could well be a significant political problem in the future. It is not generally possible to make full

use of increased leisure time without having some money to spend, on hobbies and other leisure activities, therefore it is likely that only those in better-paid jobs will be able to regard such an arrangement as a good thing. There must be many among those currently unemployed who would be able to make excellent use of, say, a home computer to occupy a large part of their leisure time, but have no way of affording such a 'toy' out of their very low incomes. (Perhaps they should be available on the National Health!)"

The answers given by the Data Processing Controller in particular are somewhat paradoxical. Whilst acknowledging the need to implement new technology as quickly as possible, he sees the proliferation of computerised automation as being an evolutionary process. Yet, when these views are set within the context of current developments, they do not appear to appreciate the potential speed of building society technological change.

A prime example of this is the Homelink home banking and tele-shopping service developed by the Nottingham Building Society in association with British Telecom and the Bank of Scotland. It is, as the sales literature points out, "Britain's first home banking and tele-shopping service. Imagine a building society, bank, department store and a massive information service in your living room." (Nottingham Building Society, 1983, Homelink Publicity Literature).

The system operates via a domestic computer terminal - television receiver link and external communication is via the conventional telephone network. Homelink enables the individual to call up his/her current and up-dated bank and/or building society statement/account, issue cheques, pay in or withdraw cash, order goods and services, arrange holidays and send electronic letters or messages. In addition, the system also patches into the vast Prestel network which provides access to information and entertainment services, i.e. news, weather, sport, traffic information, cinema and theatre guides, travel data, restaurant menus, recipes etc. All this information can be accessed 24 hours a day, 7 days a week, 365 days a year, at a cost of a few pence per week. But the exclusivity of the

Homelink system is that unlike Prestel or Teletext, the Nottingham Building Society's service is interactive thus facilitating instant retrieval and access to personal financial information and to general information and entertainment services.

By keying in the appropriate codes the individual can order, authorise payment and arrange for delivery of goods from an increasing number of department stores, i.e. Comet, W.H.Smith, Trident, Telefusion etc., and from a variety of supermarkets.

John Webster, the General Manager of the Nottingham Building Society, is confident that their company has taken the correct innovatory and positive initiative in partially developing the unlimited potential of microelectronic technology.

"This system has the same potential to revolutionise your life that Henry Ford had in the transport business. No more queues, no more problems, just do everything you want, when you want. We already have girls working from home, typing onto a television screen instead of paper - they call up the computer and get their workload flashed onto the screen.

If this takes off as we think it will in the future, you could live and work in the South of France or anywhere else for that matter. There is genuine envy from our competitors, and the more we get the results of this early use the more I realise what dynamite this is in changing people's lives. What we have done so far is like a dream come true for me ... but it is the future that is so exciting." (Webster, 16th September, 1983, in Richardson, 16th September, 1983, Daily Express, p.10).

The Nottingham Building Society and the Bank of Scotland could expand their number of branch offices electronically throughout the country without ever having to acquire any expensive High Street premises. Clearly, these 'electronic branches' would be considerably more cost effective, efficient and flexible than staffing hundreds of high-cost, only moderately

efficient, inflexible High Street banks, building societies and post offices etc. The Homelink system has put the Nottingham Building Society 5 years ahead of its nearest competitors and will almost inevitably ensure a dramatic acceleration in the rate of building society and bank technological change.

Employment Case Studies 8 and 9:

Two of Britain's leading insurance companies complete the employment case study research. Employment Case Study 8 was answered by a senior computer specialist and Employment Case Study 9 by ... "four specialist research staff on behalf of the organisation whose view is reflected in the responses provided." A number of their answers are perhaps some of the most remarkable of the entire survey. In order to illustrate the complete free-answer questionnaire I will reproduce these particular case studies (31st March, 1983, and 15th September, 1983, respectively) in their original alternate question and answer form. (Again, for conveniece and simplicity each question will be followed in turn by the two case study responses).

(1) During the next 10 years what sort of effect do you expect microelectronic technology to have on the organisation?

"If our current Data Processing expansion plans are implemented then a significant impact should be made on our company by the introduction of micro-technology. We are planning to install a branch terminal network which should speed up our rate of processing transactions etc. but we will also be faced with the problem of training staff to use the computer terminals."

"It was generally felt that new technology would have a large impact on the organisation with the 'Home' playing an important part in business activities. Our membership could have the facility to call upon our services by subscribing to cable television, for instance, while many of our staff will work from home with the electronic office becoming a reality. Our Patrol Force will be affected by new technology as electronics become

increasingly important to the working of the car. Both the training and type of employee would have to change as a result."

(2) Do you expect an increase or decrease in staffing levels during the next 10 years? (Given rapid technological advances).

"I personally would expect a decrease in staffing levels as computerisation is phased in, but if present trends are to be taken as typical, then it appears that as we computerise a given department, that department acquires more staff."

"A gradual decline in staffing levels was foreseen, due to the effects of changes in working practices, e.g. less hours, more holidays, earlier retirement, later school/college leaving ages, etc."

(3) Approximately on what scale? What is the highest number of job losses you could envisage?

"10-15 per cent but this may be offset by transferring the affected staff to other departments to cover the increased volume of manual operations, and organisation growth could lead to a general rise in head office staff anyway. At branch level then it must be assumed that staffing levels will be increased as more branches are opened."

"Impossible to tell as experience has shown that a decrease in staff from an operational area due to the introduction of new technology can lead to an increase in support functions."

(4) What sort of micro-technology is currently in use within the organisation?

"IBM SYSTEM - 34: which forms the basis of our Data Processing including terminal/printer network throughout head office. 2 WORD PROCESSORS: used for processing mortgage applications. 1 MICRO-COMPUTER: used for personnel records."

(No response).

(5) Are there jobs or sections which have, or could become

obsolete through the implemention of computerised automation?

"Yes, but I dare not mention them."
(No response).

(6) How much of the organisation could become automated?

"90 per cent."
"Because of the nature of the organisation's business and its large labour force, most departments and sections could become more automated."

(7) Economists say that when financial reward reaches a certain level, workers are willing to trade off work for more leisure time. If there was provision for a leisure income facilitating financial security, do you believe most opposition to micro-technology would disappear?

"I can only speak personally on this and my answer is that I would take a reduction in pay for more leisure time. Being involved directly in Data Processing it would be foolish of me to accept that because of my skills I must work full time 'ad infinitum' while other people have an easy time of it, provided for by the state (i.e. those left in work). The workload should be distributed to those who are capable of doing it so that everyone gets a fair slice of the cake."
"Any introduction of 'leisure income' with a trend towards an older population is going to lead to two distinct population groups, those in work and those without work. Personal wealth is bound to fall as those working would be supporting a larger non-working population and, therefore, most opposition to new technology would not immediately disappear."

(8) New technology - no redundancy agreements: would you expect such agreements to result in shorter working hours and a shorter working week? Is enough attention being given to the problem?

"Such agreements must lead to a shorter working week. Enough

attention is not being given to this problem."

"The introduction of new technology will come about anyway and changes will be gradual. Recent events in industry have shown that 'no redundancy' agreements and 'new technology' agreements have been meaningless."

(9) Do you think the organisation should embrace microelectronic technology as quickly as possible?

"Yes, but with an increase in qualified staff."

"Only as part of a carefully planned development that is in line with improving efficiency/effectiveness. Companies have gone out of business by introducing new technology which is either *too new or untried*. New technology should be shown as being reliable."

(10) Do you believe the organisation is fully aware of the potential benefits (increased productivity, efficiency and cost effectiveness) of micro-technology?

"Hard to say! Sometimes yes, sometimes no."

"We have personnel whose job it is to be aware of the potential benefits, but we also have people who are not."

(11) How do you view the possible introduction of new technology?

"I am extremely keen for the expansion of our Data Processing system, but I feel that if I have to wait much longer I may have to change jobs to satisfy my job requirements. This is because as a Data Processing professional you can quickly become out of touch with new developments in the whole field of micro-technology and as a result you can lose your edge on the job market in general."

"There were mixed feelings to this question from suspicion to enthusiasm. However, with planned introduction, new technology should enhance (a) the organisation, (b) the individual's job, (c) the state and (d) the facilities for leisure and the attitude

to unemployment."

(12) Do you think there are enough new technology educational awareness programmes involving organisation staff? (e.g. proposed new developments: programming 5th generation 'intelligent' super-computers in spoken English by 1990 and multi-functional workstations already in operation in US insurance companies/office complexes facilitating 50 per cent staff reductions).

"There are none at all."

"There are courses available, however, places are limited and so the answer must be a qualified no."

(13) Do you believe the role of the executive within the organisation will have to change? i.e. because of portable micro-computers and workstations, interactive cable and satellite television etc.

"I should think so. Not because of novelties such as Prestel and Teletext but because of portable micro-computer terminals and accoustic couplers, plus tele-processing in general."

"Company executives would be the first group to benefit from new technology which is bound to aid the 'decision making process'."

(14) Do you believe the organisation want to implement the new technology?

"I have my doubts at this moment in time. There seems to be a fair bit of interest at higher management levels but no-one seems prepared or confident enough to opt for one particular system/manufacturer for the 'expansion programme'."

"Yes, our organisation has been fairly progressive in this area."

(15) Would you welcome working with micro-technology?

"It is my job."

"Each of the specialists questioned felt that new technology offered a great challenge/opportunity and would welcome working with it."

(16) What plans are there for the introduction of more microelectronic based technology?

"Answered above."

(No response).

(17) How quickly has the technology changed during your time with the organisation?

"Very little in 2.5 years."

"In recent years it was felt that new technology had been introduced more quickly."

(18) Would you say the rate of technological change within the organisation is evolutionary, slow, average, fast or revolutionary?

"Slow."

"Average."

(19) Do you think the organisation is one of Europe's leaders in adapting to technological change?

"No."

"No."

(20) Is the organisation going to reduce its number of branches?

"No. I anticipate an expansion of our branch network as we are a 'service industry'." (This could perhaps indicate an introduction/expansion of an 'electronic' branch network similar to that of the Nottingham Building Society).

(No response).

(21) Would you expect multi-functional workstations to become commonplace in your organisation and in other similar administrative/executive/clerical complexes (by around 1990)? Thus allowing information to be continuously up-dated rather than via a pattern of incremental work procedures.

"They are at present and I expect a greater distribution in the future."

"Yes."

(22) Do you expect a general change in working patterns, e.g. work sharing, a reduction in the number of working hours, extra holiday, sabbaticals, flexible retirements and financial security via an activity/leisure income? Is this a good thing?

"Yes. Work sharing. Longer holidays and more leisure time. And reduction in retirement age to 50 by the 1990's. It is ridiculous at the present time why anyone should work for the best part of his life, then be given the remaining years to try and enjoy oneself."

"This is already being introduced in some areas and is a good thing."

(23) What levels do you think unemployment will have reached by 1990-1995?

"Around 10 million if work patterns do not change. Most of this could be absorbed by work distribution leaving a hard core of unemployed who really have nothing to offer society in general and will probably never work again though this is most likely a fault in the educational system rather than their own."

"The general view was that attitudes to unemployment will have to change by the 1990's and therefore any calculation or prediction would be meaningless as the basis for calculation will have changed."

(24) Do you believe we should educate people to enjoy their

leisure time or is enough being done already?

"We should be making arrangemnts now to condition people that unemployment is not a disease. It is merely an alternative to the working system. Possibly in the future people may take years off work at a time, working on a contract basis. Unemployment is here to stay and we must accept it."

"School leavers today expect to have difficulty in finding employment but still have difficulty in coming to terms with it. However, there is only so much that the State can do in preparing for increases in leisure time without spending vast amounts on providing the facilities."

(25) Do you believe there is/or should be a shift away from the traditional work ethic to an activity/leisure ethos?

"Yes. Sports and leisure services should be made more self-financing and not so heavily subsidised by taxation and rates. This would give people the opportunity to invest in their particular pleasure with no penalty to others who may fancy something completely different. The difference between work and leisure must be maintained and rewarded differentially to balance the distribution. Micro-technology has been with us in volume for around a decade now. The lowering of prices has made people more aware of it because now they can generally afford it."

"The shift towards a leisure ethic is inevitable."

My overall impression of the employment case studies was that the majority view one of radical pessimism. Whilst the current levels of micro-technological development within the labour intensive office complexes researched were moderate, the majority of unofficial personal theories and the official and unofficial microelectronic implementation programmes and plans appeared to be suggesting that their individual organisations were extremely labour intensive, unproductive and inefficient and are, therefore, particularly susceptible to the comprehensive implementation of computerised automation.

The Department of Health and Social Security study was

particularly interesting because it was conducted on three levels:

(1) the unofficial ultra conservative optimistic and somewhat naive approach of the three Newcastle Central Office senior executives,

(2) the official DHSS and DE intentions which are surprisingly innovative,

(3) the unofficial views of the senior executive which, whilst in alignment with DHSS and DE decisions to develop computerised automation extensively throughout their respective departments, were even more refreshingly radical and honest.

The Data Processing Controller from the northern building society may need to revise his rather neutral stance on the potential of micro-technology particularly in view of the innovative developments in home banking and tele-shopping introduced by the Nottingham Building Society and the Bank of Scotland. And the Regional Bank Manager, whilst at first proposing a conservative optimistic orientated forecast, when pressed, did concede that radical innovations such as 'cash' or 'money' shops were indeed feasible banking developments.

The vacillating reluctance of the respondents, whether verbal or written, to move away from the unrealistic or semi-realistic official work orientated view and to actually set out unofficial, radical yet realistic theories and forecasts, was a feature of the employment case study research. Once the respondents had agreed to temporarily suspend the official conservative optimistic organisational line and the indoctrinating effects of the work ethic, the majority of their statements proved to be in direct alignment with those of the radical pessimistic school of thought.

On the crucial question of potential staff reductions and levels of organisational computerised automation the responses tended to confirm the radical pessimistic hypothesis of:

(a) a dramatic decrease in staffing levels,

(b) a dramatic increase in organisational computerised automation.

Although there were considerable variations in the figures produced it would seem that staff reductions and computerised automation of approximately:

20 - 40 per cent are inevitable
40 - 60 per cent highly probable
60 - 75 per cent probable
75 -100 per cent possible.

Table 14:

STATISTICS GLEANED FROM THE EMPLOYMENT CASE STUDIES

	POTENTIAL STAFF REDUCTIONS	POTENTIAL LEVELS OF COMPUTERISED AUTOMATION
DHSS and DE official estimate: (20-25,000 job losses out of 117,000 DHSS and DE staff over a 10-11 year period).	21 per cent	unavailable
DHSS Senior Executive:	35-40 per cent	50-75 per cent (Estimation based on the information gleaned).
North East Civil Service Department:	25 per cent plus	100 per cent of traditional filing, 50 per cent plus in correspondence section.
Nationalised Industry 1:	Significant reductions	Very high
Nationalised Industry 2:	Significant reductions	Very high
Leading National Bank 1:	75 per cent within individual branches.	90-100 per cent (Estimation based on the information gleaned).

	POTENTIAL STAFF REDUCTIONS	POTENTIAL LEVELS OF COMPUTERISED AUTOMATION
Leading National Bank 2:	95 per cent (Estimation based on the information gleaned).	90-100 per cent (Estimation based on the information gleaned).
Northern Building Society:	Moderate. (This figure would appear to be an extreme under-estimation in view of the Nottingham Building Society's technological innovations).	70-90 per cent (Estimation based on the Nottingham Building Society experience).
Leading Insurance Company 1:	10-15 per cent. This figure would appear to be an extreme under-estimation in view of the potential 90 per cent level of organisational automation.	90 per cent
Leading Insurance Company 2:	Gradual decline	70-90 per cent (Estimate based on the information gleaned).

"Automation? Depends how it's applied. It frightens me if it puts me out on the street. It doesn't frighten me if it shortens my work week. You read that little thing: what are you going to do when this computer replaces you? Blow up computers. (Laughs). Really. Blow up computers. I'll be goddammed if a computer is gonna eat before I do! I want milk for my kids and beer for me. Machines can either liberate man or enslave him, because they're pretty neutral. It's a man who has the bias to put the thing one place or another." (Chicago steel worker, in Terkel, 1973, p.23, in Jones, ed., 1980, p.168).

The previous two chapters have, I believe, illustrated the potential of microelectronic technology at international, national and local level. And although the conservative optimists acknowledge, in varying degrees, the effectiveness of the technology they all tend to ignore the social consequences. The radical pessimists, however, fully appreciate that this scale of technological change and development cannot possibly progress in total isolation: there must inevitably be a parallel and concomitant degree of *social* change and development.

If we do nothing the social consequences could be disastrous, i.e. a divided society of a minority of wealthy contented executive technocrats and a majority of financially insecure, frustrated, discontented and miserable unemployed. It is crucial therefore, argue the radical pessimists, that we change our fundamental attitudes to work itself and channel our efforts into creating a new activity or leisure based ethos. The urgent necessity for attitudinal change is reflected in the latest developments in sophisticated, advanced computerised robotic and automated office systems, the list of occupations affected by micro-technology and the author's local case study research.

But clearly, if the most desirable option is to develop an activity or leisure ethic we would need some form of mechanism or industry that could satisfactorily 'employ' the majority of the British population. Education could provide the ready made solution. I would envisage the massive expansion of our current educational system to the extent that it would encompass academic, vocational, leisure and sports subjects/activities -

indeed almost every activity it is possible to teach, learn, participate in and enjoy. In effect the educational system would be transformed into an educational industry. An industry based principally within the individual's home and/or within education-activity-sports centres (schools, colleges, universities, polytechnics and new purpose built complexes) but which could theoretically function in any geographical location, e.g. hospitals, health and social welfare centres, libraries, supermarkets, offices and factories etc. New patterns of employment could be re-defined as activity-employment in order to include the participants as well as the communicators. The term activity-employment is used because I feel it probably encompasses the majority of subjective definitions of work, leisure and play and therefore satisfies the twin pre-requisites inherent in the ethos of work and leisure.

To facilitate such a radical change we would require a neutral catalyst, i.e. microelectronic technology, that could provide the necessary flexibility to make such a revolutionary expansion possible. It is entirely our own choice whether or not we actually decide to use the technology to transform and, I believe, stbstantially improve our archaic and restrictive educational system. The Open University does go some way towards a form of total education-activity concept, but although it waives academic and age qualifications, the OU curriculum is too academically orientated and student intake is too small.

As indicated earlier, I believe that education should become Britain's largest source of activity-employment. Students and participants, as well as teachers and specialist communicators, should receive a substantial activity or leisure income ensuring personal financial security.

The transformation of our present out-moded educational system into an all-encompassing education industry would require the political (specifically governmental), CBI and TUC recognition and appreciation of eight crucial factors:

(1) The necessity and desirabvility to encourage enthusiastically the simultaneous development of technological and attitudinal change before technological change is imposed in

isolation leaving only the retention of the Protestant/Puritan work ethic and unprecendented levels of mass unemployment.

(2) The opportunity to allow microelctronic technology to create wealth in (a) traditional employment sectors via extremely efficient, productive and cost effective computerised automation and in (b) education via the production and sale of specialised knowledge, information, skill and advice. Throughout conventional employment areas it is irrelevant who actually creates the wealth, man/woman or machine. If it was the machine, the individual could do exactly whatever he/she wanted to do, e.g. creating knowledge industries within education or simply teaching, learning and/or enjoying themselves.

(3) The necessity for individual and family security in the form of an activity-employment leisure income.

(4) The idea that although microelectronic technology destroys conventional employment, it can provide the necessary flexibility to facilitate a comprehensive educational industry and thus create the kind of activity-employment we can enjoy.

(5) The advantages of immense flexibility and versatility a microelectronically orientated education industry could provide. (See Chapter 8).

(6) The necessity for a massive horizontal and vertical extention of Britain's traditional education curricula, i.e. a large increase in subject range and content.

(7) The need to build multi-purpose educational-activity-sports centres and to utilize effectively schools, colleges, universities and polytechnics all year round.

(8) The requirement of a 'total education activity' concept similar to the Open University but considerably more radical and comprehensive in its approach, i.e. an infinite variety of subjects and activities and an unlimited student intake

irrespective of age or qualifications.

Unfortunately, however, there is probably only a remote possibility that any of these criteria will be met satisfactorily. Nevertheless, I strongly believe that this is the kind of future we should aim for. It is up to us whether or not we allow the technology to free us from the monotonous drudgery and tedium of traditional work and facilitate a comprehensive activity-employment education industry.

If these recommendations were accepted, then this new industry could employ the majority of the population, i.e. tens of millions of participants and students partaking in the activities of their choice in addition to the several million in the conventional but highly enjoyable and fulfilling role of the specialist communicator, teacher and lecturer. Teacher-student staffing ratios could be reduced to the much more effective levels of 1-5, 1-3, 1-1 or perhaps even 2-1 or 3-1. (See Chapter 8).

Within this education industry I would advocate massive staff increases in health and social services with staffing ratios of 3 or 4 nurses for every patient and 2 or 3 social workers for every client. Such quantitative increases in staffing ratios would, I believe, enhance significantly the qualitative level of health care and enable all health care staff to work, for example, 3-4 hours per day, 2 or 3 days per week or more if they so wished.

(Currently, rather than expanding, Government policy has resulted in the disastrous contraction of our education, health and social services - the most critical areas of society, e.g. in 1982, 1500 doctors of medicine were unemployed and in 1983-84 numerous thousands of teachers, lecturers, doctors, nurses and social workers were either unemployed or being trained for unemployment).

Clearly, these crucially important areas of society should be expanded dramatically in the form of, I would suggest, an enormous labour and capital intensive all-encompassing education industry. It is with this ultimate goal in mind that the next

section reviews the current state of school computerisation, looks at some personal views on microelectronically orientated education from a selection of north east headmasters, principals and teachers, examines the potential of a totally flexible, integrated, multi-media education industry and, continuing this theme of educational activity-employment for all, the final chapter discusses the possible development of an activity/leisure orientated ethos.

EMPLOYMENT CASE STUDIES*:

In addition to the source references already quoted the previous account was based upon information gleaned from:

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SECTION 3:

A CONTEMPORARY-FUTURISTIC PERSPECTIVE

CHAPTER 6: EDUCATION: A CONTEMPORARY PERSPECTIVE*

"The Conservative Government's programme for educational computerisation is cosmetic, inadequate and adds up to something like a half-hour's experience per child per year in secondary schools." (Kinnock, Spring, 1983, in Large, 1984, p.111).

In the summer of 1981 the Prime Minister, Margaret Thatcher, announced the Department of Trade and Industry's Micros in Schools Scheme, first proposed by Kenneth Baker, Minister of State for Information Technology, with the apparently coherent strategy of installing one micro-computer into every school in the country. (A robot in every school could be the next Department of Trade and Industry project).

The Micros in Schools Scheme is, however, totally inadequate - there *is no* planned, coherent strategy for the computerisation of Britain's schools. No decisions have been made as to what school computers should be used for. It is critically important that computers are integrated into, and form an integral part of, the entire curriculum and not simply concentrated on, and confined to, computer science. This kind of restriction where 'computer literacy' and 'computerised education' are limited to writing programs and straightforward operational instruction within the context of computer science itself, can isolate and alienate micro-technology from the majority of other school subjects.

The Head of the Computing Department at a North Tyneside High School told me that in his experience the older the teacher, the less likely they were to connect the relevance and advantages of computing with their particular subject. His school's 1 stand alone Research Machine (RML) 380Z and their 4 Research Machines Link (RML) 480Z (connected to a Network 380Z Server) were currently designated specifically to Computer Studies, Mathematics and Science. "This is due to software availability limitations but it is hoped that we will very quickly be able to expand the use of micro-computers across the High School curriculum."

The School Broadcasting Council (advisors to BBC Schools programmes) found in a summer 1982 survey that micro-computers were used almost exclusively within the field of science and mathematics. 94 per cent of computer science and mathematics departments accommodated only one teacher capable of programming and/or operating a micro-computer, 23 per cent of geography departments included one micro-computer-user-teacher and 10 per cent within economics departments (the other subject percentages were negligible).

There was a universal lack of good software in virtually every school subject. The majority of programs were gleaned from the numerous computer periodicals rather than software developed by the local education authority. For a basic introduction to micro-computers most teachers and examination groups had watched and relied almost totally upon the BBC Computer Programme 1 - which is an indication of the ridiculously naive and incompetent approach to computer science taken by the Department of Trade and Industry and the Department of Education and Science.

It appears that the development of good academic computer software is entirely dependent upon the initiative and enthusiasm of the individual teacher.

Duncan Sledge, supervisor of a Durham micro-computer schools project, argues that if we do not establish national software standards "... teachers, and especially non-experts, may well become confused and disillusioned. A further danger is that without national co-ordination of effort and dissemination of information, schools and colleges in every part of the country may be re-inventing the wheel." (Sledge, 23rd March, 1983, in Hodges, 23rd March, 1983, The Times, p.8).

This situation is indicative of the lack of Governmental guidance and thought as to whether school computers should be utilized for computer literacy alone, as a comprehensive teaching aid/tutor throughout the curriculum, or a combination of both.

Kenneth Baker apparently favours a vague, diluted form of computer literacy, i.e. 'electronic keyboard techniques' - the 'QWERTY' keyboard layout skills could be acquired on a conventional typewriter or home computer.

"All children as they leave school should have skills in

electronic keyboard techniques so that they can operate the electronic gadgetry of this revolution, since it is going to have such a dominating effect upon their lives." (Baker, 21st March, 1983, in Hodges, 21st March, 1983, The Times, p.8).

Straightforward operational control specifically for technological employment (if available) negates all the potential educational benefits that could be derived from total computerisation and, by implication, channels the student into and restricts the parameters of computer based learning to computer science itself.

Surely micro-technology in education does not exist for the primary purpose of providing pupils with electronic keyboard techniques for new technology employment. Baker fails to see that the traditional learning process and school curriculum could be radically and dramatically enhanced by availing schools of the necessary finances and by allowing the proliferation of micro-computers, terminals, word-processors etc. Baker must first critically examine new technology education before he turns all too quickly to new technology employment (if indeed much of it exists).

And as Lucy Hodges (21st March, 1983) Education Correspondent of The Times has pointed out, the majority of computer educationalists would prefer to see microelectronics play a much more expansive educational role than the one Baker suggests.

They believe that the subject of computer science should:

(1) enable pupils to become familiarised with, and feel comfortable alongside, micro-technology,
(2) teach students to operate, program and appreciate the potential of the new technology,
(3) instruct pupils how to use computers as educational aids.

For example: mathematics and physics programs illustrating geometric diagrams, graphs, solids, molecular structures, gas flows, etc., geography graphics depicting rock formations, glaciation, wind direction, the principal industries of various countries, ordinance survey, country and world maps etc. 4th year pupils at Swayne School, Rayleigh, Essex, are able to study

a software package on the Russian Revolution that delineates all the complex and critical decisions facing the main protagonists in 1917.

These proposals, although an improvement on the vague generalisations of Kenneth Baker, are, as we shall see, still nowhere near as radical, comprehensive and progressive as I believe they should be.

Since 1980, the Department of Education and Science have been running their Microelectronics Education Programme (MEP) with a budget of £9.5 million covering the period 1980-84; its brief was to train teachers (presumably to some standard of computer literacy), encourage the writing and development of software and generally co-ordinate and publicise the whole enterprise. There is a possibility of further supplements of approximately £5 million for 1985 and 1986 respectively.

In addition, the summer 1981 - December, 1982, secondary school equipment scheme resulted in an order of some 6,400 micro-computers at a cost to the Department of Trade and Industry of £3.5 million. And in May, 1983, DTI extended this financial backing to £8 million to enable secondary schools to up-date the few micro-computers they have and to expand their equipment range to colour monitors and line-printers. In the autumn of 1982 the scheme was expanded to encompass primary schools and - although the hardware/software will differ - if all the primaries accept the new technology the DTI could spend a total of £7-10 million on the computerisation (or rather the inadequate attempt at computerisation) of British secondary and primary schools.

Not only are Government Departments unclear about the direction computerised education should be taking, their unsatisfactory and naive approach extends to the finances of the operation in general and to the Department of Trade and Industry's Micros in Schools scheme, mentioned earlier, in particular.

In order to qualify at all the school itself must:

(a) pay 50 per cent of the hardware costs, which necessarily involves internal and external school fund raising by teachers, pupils and parents, and

(b) guarantee, dependent upon their particular Local Education

Authority, to send two non-computer specialist teachers on either a 4 day training course (secondary schools) or a 2 day training course (primary schools).

Providing schools can meet these conditions, teachers can at last begin their basic computer education. But training courses of 4 and 2 days are at best ineffectual and at worst ridiculously futile. For schools with only 1 or 2 computer specialists and perhaps 2 or 3 teachers with minimal elementary computer instruction, the hope of a computerised curriculum is virtually non-existent. Indeed there is the distinct possibility that pupils with home computers will be writing, or will have already written, considerably more advanced and sophisticated programs than their teachers and be generally much more technologically aware of the potential computer orientated educational applications within their particular subject.

Maurice Savory, Chairman of the Association for Science Education and advisor to Gloucestershire's schools/colleges on computer education, has serious reservations concerning not only the unsatisfactorily short duration of the microelectronics teacher training, but the actual course content ...

"... if the two days are used to train teachers how to type into a keyboard, its a waste of time. They must know how the micro can be used in the classroom and how to assess software." (Savory, 23rd March, 1983, in Hodges, 23rd March, 1983, The Times, p.8).

The French, however, began their school computer programme 9 years earlier in 1971. From 1971-76 the French had already spent £10 million on a scheme to benefit High School pupils aged 15-18. 58 French Lycees (High Schools) were given a time-sharing facility on a French made mini-computer - 600 teachers received a year's full time computer literacy education and a further 5,000 computer training via correspondence course.

In 1978 the French launched their 'Operation 10,000 micros' programme with the intention of, by 1984, installing 8 micro-computers into every secondary school in the country. Currently, French teachers have the opportunity to take a one year full time computer education course - the subsequent

knowledge and enthusiasm gleaned is almost inevitably passed on to the teachers interested, or even moderately interested colleagues. Another option available to French teachers involves a series of 3 day computer literacy courses. French microelectronics in schools expenditure in 1982 alone totalled £9 million on hardware and computer-teacher-training; an additional £1.5 million was spent on the development of educational software.

Clearly, by concentrating their outlay into one specific sector, i.e. secondary schools, French computer literacy/education is proving, and I believe will continue to prove, to be much more effective than the ineffective, dissipated methods employed by the Department of Trade and Industry and the Department of Education and Science. Even Richard Fothergill, Director of the Microelectronics Education Programme, concedes that 4 and 2 day training courses are inadequate ...

"The MEP and the Department of Trade and Industry's Micros in Schools scheme is only a nibble, a flag being raised. Behind the 4 day secondary course we had one aim - that teachers would ask intelligent questions afterwards. They would know how to switch the micro on, how to unpack it, put it together, run it and put a few programs in. There must be supplementary courses. We train the trainees and then the local education authority puts on the courses." (Fothergill, 23rd March, 1983, in Hodges, 23rd March, 1983, The Times, p.8).

Gloucestershire, for example, use the 2 day training courses purely as an introduction to the inherent educational advantages of micro-computers, which is at least an improvement on the indeterminate Government/LEA thinking - simply because Gloucestershire have decided upon an explicit computer education policy.

Derek Esterson, who resigned from the Microelectronics Education Programme advisory panel (dissatisfied with the progress being made) and currently computer advisor for inner London, feels that a 4 day maximum computer education is grossly inadequate - teachers will only reach any degree of competence and therefore enable the creative use of micro-computers, if they receive a minimum of 14 days computer instruction.

"We're putting the cart before the horse. If we don't have adequately trained teachers and a sensible appreciation of the potential of the equipment, it could just become a toy for playing Space Invaders on a wet Friday afternoon." (Esterson 21st March, 1983, in Hodges, 21st March, 1983, The Times, p.8). (London have extended the computer training of 1600 primary school teachers from 2 days to 4).

I would suggest that the principal shortcomings in our approach to educational computerisation are that:

(1) Department of Trade and Industry and Department of Education and Science financial input and guidance concerning school computerisation is totally inadequate and unsatisfactory.

(2) There is a universal lack of consultation between the DTI, DES, LEAs, teachers, specialist computer programmers and consultants, systems analysts, hardware and software manufacturers, pupils/students and parents.

(3) There is an unnecessary, educationally restrictive, almost total bias towards the subject of computer science itself.

(4) Although the Prime Minister, Margaret Thatcher, stated in July, 1982, that "schools and authorities can choose from three packages of equipment" (Thatcher, July, 1982, in Deeson, March, 1983, Sinclair User, p.55), ostensibly the local authorities *alone* are adjudicating as to what kind of micro-computers schools should be adopting. This has resulted in, for example, the partial exclusion of the Sinclair ZX81 and the ZX Spectrum. Sir Clive Sinclair therefore, independently sold the ZX81 at £25 each to 2,300 secondary schools. (I believe that school/college staff, in association with computer specialists, should be permitted to select the educational hardware/software package *they believe* most appropriate for their pupils/students educational requirements).

(5) There would appear to be virtually no discussion (from any sector of British education) regarding the immense potential of

linking micro-computers with interactive cable and satellite television, conventional television and video/audio cassette/disc into one flexible integrated system: total educational computerisation. (See Chapter 8).

Tony Wilshaw, a principal lecturer at Ilkley College, Yorkshire, has pointed out that "one micro shared between 1500 pupils in a comprehensive school is spreading the jam a bit thin and averages about three-quarters of an hour per year for each pupil". (Wilshaw, 21st March, 1983, in Hodges, 21st March, 1983, The Times, p.8). My case study research, as we shall see, reveals similar problems of resource dispersal until the resource itself becomes virtually useless.

Table 15:

MICROS IN SECONDARY SCHOOLS SCHEME (Established in 1980)

Supplier	Model	Price with Monochrome Display	External Memory	Number Sold
Research Machines	RML 380Z	£1,680	Floppy Disc	3,600
Acorn	BBC A	£260	Audio Tape Cassette	2,800

(Source: Cookson, 22nd March, 1983, The Times, p.8).

Table 16:

MICROS IN PRIMARY SCHOOLS SCHEME (Established in Autumn 1982)

Supplier	Model	Price with Colour Monitor and Cassette Recorder	Basic price	Number ordered so far
Research Machines	RML 480Z	£922	£700	1,350
Acorn	BBC B	£649	£399	7,200
Sinclair	ZX Spectrum (48K)	£365	£125	450

(Source: Cookson, 22nd March, 1983, The Times, p.8).

Potential additions to this limited selection are: Acorn Electron (£200), Sinclair Quantum Leap, QL, (£399), Atari 600 XL (£149), Commodore Vic-20 (£140) and Commodore 64 (£200).

Within the next 10 years I would expect the personal home micro-computer to become as commonplace as the pocket calculator and increasingly intense pressure from parents, pupils/students and educationalists will, I believe, compel schools and colleges to expand dramatically their technological hardware and software.

The Lamp-lighter (private) Elementary School, Dallas, USA, enjoys the highest concentration of, and ratio of, micro-computers per pupil of any school anywhere in the world - 60 micro-computers for its 300 pupils or 1 micro for every 5 pupils.

There are approximately 1.35 million micro-computers in Britain, distributed among 7.2 million families or one micro for every 6th British home. The number of micro-computers in Britain has tripled since 1982.

("Work will largely disappear, leisure will gape, and education's aim will change from 'inculcating knowledge' to 'inculcating desires'... civilised life will then resemble Periclean Athens with the slaves replaced by machines.") (Sinclair, paraphrased, 30th June, 1984, in Levin, 30th June, 1984, BBC2 TV, The Levin Interviews, in Barnes, 1st July, 1984, The Observer, p.22).

Table 17:

TOTAL NUMBERS OF MICRO-COMPUTERS SOLD BY 28TH FEBRUARY, 1983

MANUFACTURER	UNITS SOLD
Sinclair	560,000
Commodore	120,000
Acorn (BBC)	103,000
Dragon	55,000
Apple	54,000
Texas Instruments	50,000
Tandy	46,000
Sharp	41,000
Lowe (Genie)	35,000
Atari	30,000

(Survey based on sales figures supplied by computer retailers, confirmed by distributors and certain manufacturers, and conducted by Allason Associates. Source: Allason, 27th March, 1983, The Observer, p.20).

EDUCATION: A CONTEMPORARY PERSPECTIVE*:

In addition to the source references already quoted the previous account was based upon information gleaned from:

Campbell-Jones, S. (14th February, 1983), BBC2 Television, Horizon, 'Talking Turtle'.

Large, P. (1984), The Micro Revolution Revisited, Frances Pinter (Publishers) Limited, London.

Pawson, R. (15th April, 1984), 'Of Mice and Menus', Micro-computers, Technology Extra: Lowdown on the Latest Hi-tech, Observer Magazine, The Observer, (15th April, 1984).

CHAPTER 7: EDUCATION CASE STUDIES

Having established the current national state of school computerisation, at a more local level (as with the employment case studies) I wanted to ascertain the views of educationalists from leading north east schools and colleges on educational computerisation. (Although one of the case studies focuses upon a south west of England Comprehensive High School, the teacher concerned hails from the north east of England). Specifically, I wanted to find out the potential effects of micro-computers on the school curriculum and the overall potential of a microelectronically orientated education system or industry. Did their opinions tend towards a sceptical, traditionalist approach or a radical, innovative, expansionist, futuristic approach to computerised education?

Therefore between March, 1983, and May, 1983, I conducted a series of case studies involving headmasters, principals and teachers from a Newcastle upon Tyne Junior School, a north east 6th Form College, a leading north east Comprehensive High School, one of the most highly rated and respected northern Independent Grammar Schools and a leading south west Comprehensive High School. The case studies are illustrative, and are as far as possible representative, examples only; they are not random samples, yet I would be surprised if the general impressions gleaned from the studies were not repeated in many other schools and colleges throughout the country.

My research took the form of a series of postal free-answer questionnaires and although the educationalists did not specifically request anonymity, I decided that the best chance of ensuring a response was to assure the respondents of total anonymity both individually and as an educational institution. As with the employment case studies, the responses, depending upon their substance and length, take the form of an account adapted from and based upon the questionnaire, a series of alternate questions and answers, or a combination of both. The full questionnaire is set out in the compilation of case studies

3, 4 and 5.

Education Case Study 1:

On 7th March, 1983, the Headmaster of a centrally located Newcastle upon Tyne Junior School completed my free-answer questionnaire concerning the effects of microelectronics on education.

By the early 1990's he expected to see substantial changes in the traditional school curriculum:

"Inevitably the impact will be considerable especially as the rate of techological innovation escalates, but it is difficult to envisage the scene in 10 years time when all the hardware we are tentatively using today will be entirely obsolete. Undoubtedly the traditional school curriculum will be radically affected. As a relevant curriculum should be capable of changing to meet changing needs and circumstances, it would obviously be non-functioning if it failed to adapt."

The Headmaster could envisage a situation where the majority of pupils learn via a home and/or school micro-computer with the teacher developing the pupil's particular interest by advising on how and when to advance and diversify their studies, discussing options etc. - a 'professional enthusiast' or 'knowledge counsellor' and 'colleague' as Professor Tom Stonier puts it, rather than a 'chalk and talk' lecturer. (Stonier, 2nd March, 1982, The End of the Culture Dinosaurs? Some Technological Aspects and Their Implications, p.4).

"... whether this situation would be desirable is debatable. After all, good teachers are more than 'knowledge counsellors' - especially in primary education where relationships are vitally important. It could possibly work that way in secondary education, but even then aspects such as imagination, critical awareness, life skills and philosophies and attitudes, e.g. towards race or stereo-typing or disarmament, require much more than a 'knowledge counsellor' and what about counselling which is an important part of secondary education? I think that Professor Stonier may be overlooking the importance of the teacher-pupil relationship."

I believe Stonier is particularly conscious of the importance of the teacher-pupil relationship and the opportunities for self-development the educational system should and could afford. Indeed he favours, as I do, extremely low or equal teacher-pupil ratios. His point is that at the moment these opportunities are being squandered because of the inflexibility of a rigid school curriculum, particularly in the area of secondary education:

"It has always been the dream of educators to develop critical faculties so that students are able to understand concepts and develop them on their own. This should be expanded, however, not only to foster more creative imagination, but also artistic, physical and social skills. Particularly important among the latter are communicative and organisational skills. It is one of the sad features of the present education system that it gives the students very little chance to organise things themselves or to prepare for real-life situations. In the real world it is not only what you know that counts, but also how fast you can find out new things. Furthermore, the major activities of the real world involve interacting with *people*. Social development, by contrast with intellectual development, has always been part of the hidden curriculum. Such skills need to be fostered in a more conscious and systematic fashion." (Stonier, 1979, from Schuller and Megerry, eds., 1979, pp.31-44 in Richards, ed., 1982, p.291)

The Headmaster felt that the use of micro-computers across the curriculum would undoubedly "help the learning processes, but it is important to remember that the creative process, which is different and equally if not more important, is unlikely to be enhanced by micro-computers. Can micro-computers create or help create Art, Poetry, etc. - I think not."

Should the school curriculum itself be changed in order to offer and accommodate a much more comprehensive, multi-disciplinary approach to education? (Including leisure subjects/activities).

"In primary education many subjects already overlap and to a degree this happens in secondary education now, but I would be wary of interrelation simply for its own sake. Obviously there are areas where it would be desirable and advantageous and would

be part of a current trend. As to the widening of the curriculum to include leisure subjects, I think this is inevitable because of the changing socio-economic factors of society."

The Headmaster was enthusiastic about the idea put forward by Alfred Bork, (6th September, 1982, BBC2 TV/Open University, E200 Contemporary Issues in Education) Professor of Physics at the University of California, of linking the micro-computer with the video disc and tape. Bork believes this would be of immense educational value - the facility to illustrate points with film/television extracts and stills rather than just computer graphics. The Headmaster concurred with Bork's estimation of the potential educational merit and importance of a computer-video link.

Should we aim for a much higher standard of education for everyone (not just for pupils/students aged 5-21) with further and higher education becoming the norm rather than the exception? Can computers help improve standards?

"I don't think computers will improve standards though they may broaden them - they will certainly improve range and experience and would obviously be useful in further and higher education. How you get higher education to become the norm, I really don't know ... the North East has the lowest take-up of higher education places in the country. This is historical as well as socially and economically based and it will take more than computers to change it."

The Headmaster believed the writing of computer programs by specialist subject teachers to be "... incredibly time consuming and increasingly complex. Maybe centres with software specialists working in conjunction with teachers would be more time and cost effective."

Given the rapid development and the comprehensive implementation of microelectronics and unprecedented levels of unemployment, could you foresee some form of massive microelectronically orientated education industry encompassing virtually all subjects and activities? (An education industry for anyone to learn about and/or participate in anything)

"Unless there is a radical change in present economic policies, it would seem that this is not only a possible part

solution but a necessity. However, it requires an imaginative leap on the part of someone and I can't see the Department of Education and Science giving that sort of lead."

Is this the sort of future we should be aiming for?

"... this is the sort of future we are being forced towards but not necessarily the desirable one. Why should education pick up the pieces after Governmental failure. Wider based education yes, but not as a substitute to basic human rights."

Is there enough educational awareness with regard to microelectronic technology throughout the educational system? (i.e. teaching staff, pupils/students, parents, local authorities, Department of Educatiion and Science and the Department of Trade and Industry).

"No, although it is obviously increasing and certain Local Education Authorities are making determined and effective efforts in this area. Parental awareness however is sadly, totally neglected."

Are you enthusiastic about the increasingly important role of the computer as as educational aid and/or tutor within the home and school?

"Yes. The micro-computer is a welcome addition to school resources and thoughtfully handled should be invaluable. It is not the answer to all educational problems. It will undoubtedly radically alter traditional educational values and practices but experience has shown that education changes which survive and develop for the benefit of the pupil are those which are handled thoughtfully, carefully planned and continuously assessed. The changes which fail are those where everything is jettisoned in favour of the new and this is usually disastrous."

Education Case Study 2:

The second study, (16th May, 1983) which is of one of the top 6th Form Colleges in the north east of England, was unforunately necessarily abbreviated because of the Principal's heavy workload.

"In my view," the College Principal told me, "the impact on the curriculum will remain limited so long as the present examination system is retained, with its emphasis at both 'O' and

'A' level on the level of knowledge shown by candidates. In view of the problems involved in changing this system change is likely to be extremely slow.

In such circumstances I anticipate:

(1) an increased, but far from universal, knowledge of computer usage being acquired in schools on the basis of CSE/O/A level work.

(2) a limited usage of simulation exercises to reinforce class learning, usually on an individual basis in the 16-19 age group. This is likely to be most apparent in the sciences and in those social sciences with a quantative approach to some of their work e.g. Economics and Geography.

(3) an occasional use of computers for teaching purposes. This will depend on the provision of an adequate number of terminals more than appropriate software.

(4) computers will also be used for administrative purposes, particularly in large institutions.

I do not think that the English education system is geared either by its organisation nor in terms of finance to rapid change and am therefore cautious about predicting more than this in the next decade."

Education Case Studies 3, 4 and 5:

Education case studies 3, 4 and 5 represent the personal views of (3) the Headmaster of one of the leading Comprehensive High Schools in the north east of England, (24th May, 1983), (4) the Headmaster of one of the most highly rated, prestigious and respected Independent Grammar Schools in the north of England, (16th March, 1983) and (5) the physics and computing teacher of a leading Comprehensive High School in the south west of England (May, 1983). In order to reproduce the questionnaire in its entirity and for convenience and simplicity, each question will be followed in turn by each individual response designated thus -

3: North East High School, 4: Northern Independent Grammar School and 5: South West High School.

(1) During the next 10 years what effect would you expect micro-computers to have on the traditional school curriculum?

North East High School:

"I hope to have a proper computer laboratory as a central facility, wired in to separate subject Departments around the school. I expect Typing to disappear from the curriculum and be replaced by word processors etc.

I envisage growth in those areas to which the new technology is particularly relevant (e.g. Design Technology, Physics, Biology - no doubt others) and some retrenchment in areas less concerned with it."

Northern Independent Grammar School:

"Probably very little effect in that time-span."

South West High School:

"The impact of micro-computers in schools within the next decade will depend on how quickly education authorities are prepared to react to new innovations, and how often they will be willing to sink cash into renewing and improving present hardware.

There are two effects which micro-computers ('MCs') should have on the curriculum

(i) Education about computers, not necessarily how to program them but what they do, how they work (i.e. the fact that they cannot 'think' or 'reason') should increase vastly so that all people leaving school should be familiar with computers and what they are capable of.

(ii) The use of computers in the classroom will increase and within the next decade a computer will be as familiar a teaching aid as a video recorder or film projector is today."

(2) Could you envisage a situation where the majority of the pupils/students learn via a home and/or school micro-computer with the teacher developing the pupil's particular interest by

advising them on how and when to advance and diversify their studies, discussing options etc. - a 'professional enthusiast' or 'knowledge counsellor' and 'colleague', as Professor Tom Stonier puts it, rather than a 'chalk and talk' lecturer? (Stonier, 2nd March, 1982, The End of the Culture Dinosaurs? Some Technological Aspects and Their Implications, p.4).

North East High School:

"Not so completely for a considerable time ahead; in the next century I would expect schools as we now know them to be different beyond rational projection."

Northern Independent Grammar School:

"Frankly no! Professor Stonier deals in an amusing and enlightening kind of science fiction, which like all good SF is based on what is plausible and possible, but as a *prediction* of what will happen it falls short, through underestimating (a) the conservative force of the inherited educational process (investment in systems, staff and facilities) and (b) the social psychology of school education i.e. the human context of learning (pupil-pupil and pupil-teacher). A particular point under (b) is that traditional class-teaching leaves room for individual 'switching off' (intellectual rest-periods?!) thus making the burden of schoolwork bearable without intellectual or emotional collapse: computers require a constant input of logic from their users, which is beyond human capacity if it were the only diet."

South West High School:

"Following on from (ii) above ... With MC's at their current stage of development the idea of computer tutors which actually teach is right at the limit of the imagination. I would agree that an able child, who requires little praise for good work and only needs one explanation of a set of ideas to gain understanding, could cope with such a system. But the majority of pupils need things explained in several different ways and are often externally motivated. What I am trying to say is that (as yet) a computer does not have the sensitivity and adaptability of a teacher to tailor the presentation of a set of facts to a particular pupil or group of pupils.

I can see that the MC alternative may be preferable to a 'chalk and talk' teacher but I haven't met one of this outdated breed since I was at school. There is a wealth of learning aids now available (especially in science), including using a MC and a Database."

(3) Do you think the extensive utilization of micro-computers across the entire curriculum will enhance the quality and fascination of the subjects themselves? Do they help the pupils/students in the learning process?

North East High School:

"Almost certainly so for many pupils. It looks a bleak future for the technologically illiterate, however. Our micros are currently used for a computing 'O'/CSE course, for electronics systems at 'A' level, for administrative data storage, and as a facility where staff/pupils perceive a one-off use that they want to put them to."

Northern Independent Grammar School:

"They could no doubt help in the efficient transmission of fact and of logical insight in the case of committed learners, but for engendering enthusiasm they would be no better and probably much worse than even the average classroom teacher. Enthusiasm is transmitted from human to human, not via machines."

South West High School:

"There are 3 points to discuss here. So one by one ...

(a) 'ENHANCE THE QUALITY'

Speaking from personal experience as a science teacher there are several distinct ways in which a MC is of use to me in a classroom -

(i) AS A CONTROLLABLE, MOVING ELECTRONIC BLACKBOARD. I am a member of a group which voluntarily writes computer programs for use in science lessons. Both of my major works fall into this

category of 'electronic blackboard'. They help the teacher to discuss some ideas which are difficult to visualise or calculate quickly, e.g. one is a model of radioactive decay which makes an area of the screen decay, a lot of atoms decay at the beginning and few at the end. The teacher can vary the number of atoms, the half life of substance *and* what is displayed on the screen - graphs can be drawn and compared etc. The program was designed to do something which was very difficult to understand without it. There are many other programmes, in the field of science, which do exactly the same *type* of thing - to try and show a diffult concept and to allow the teacher to discuss alternative solutions to a problem. This type of program allows questions of the *'what if'* type to be answered quickly and visually. (E.g. what happens if we half the halflife?)

(ii) EXPERIMENTS - There are many scientific experiments that can be done using the computer that could not be done without it, and an even greater number which can be vastly improved because the computer can take the readings and then display the results in various forms.

(iii) PROGRAMMED LEARNING - Where the pupil sits in front of a MC and runs through a series of steps designed to teach a specific point. In the 1960's programmed learning done with workcards, informational cards, (tests and answers) were used and tested and proved to be largely ineffective. I have written a programme which was a *slight* improvement on the primitive idea by giving the user an initial series of tests then depending on his/her answers took them through one of three explanations of how to manipulate equations. My program was a crude attempt to teach something and it took up most of the computers available memory. Given a few more years I'm sure there will be better algorithms and more sensitive programs to diagnose a pupil's problems.

(iv) PUPIL'S USE AS A PIECE OF SCIENCE EQUIPMENT - E.g. as a data recording device which will graph their results quickly for them and alter the data to get a straight line. E.g. it could plot power output of a bulb against voltage and find a curve, then the pupil could ask it to try the square root of the voltage - finding an even bigger curve he/she might try the final

solution of plotting P against V^2. In this case the pupil would have worked out the answer for themselves which will stick with them a lot longer than if I was to tell them. It is true to say that all this plotting could be done by hand and calculator but it would require a great deal of time and determination. The computer opens up things that they can try which before only the teacher could do.

(b) FASCINATION

Mainly the fact that the computer opens up new fields of possibility and new approaches will lead to a greater fascination; because topics that were dry before (because audio visual aids could do little to demonstrate some dry topics such as radioactivity, astronomy which are dynamic and require an understanding of how planets, atoms change) can now be made more interesting and easier to understand.

There is also a novelty value at the moment of using a computer in a classroom, which will wear off when it becomes an everyday piece of classroom furniture. (This does not mean that I will not capitalise on it while it lasts).

(c) HELP IN THE LEARNING PROCESS?

As you will have read above I do think they will help in the learning process (or else I wouldn't be wasting about 7 hours a week writing programmes for them). The reasons why are contained above."

(4) Should the school curriculum itself be changed in order to facilitate a much more comprehensive, multi-disciplinary approach to education, for example, subject overlaps - the history of computing, mathematics, physics or chemistry within the specific history subject; and the development of historical analysis within the context of the natural and social sciences, humanities and the arts; and the introduction of leisure subjects/activities into the curriculum; or is the current subject content and range satisfactory?

North East High School:

"I feel that school curricula have continuously adapted to change and will continue to do so, but I doubt the value of the

examples of multi-disciplinary approaches given."

Northern Independent Grammar School:

"A big question - ranging far beyond the mere impact of computers! I would be content with the present evolutionary approach, whereby the traditional subjects are (rightly) expected to include new elements, some of them interdisciplinary. This raises the question whether Computing should count as a 'subject' at all. It is best seen as another 'language' and likely to claim a similar status within the curriculum as English or Mathematics, i.e. (a) taught in its own right, but (b) as essential tool for so many other subjects (cf. the Bullock Report 'English across the Curriculum' etc.)."

South West High School:

"The course taken by society whether to accept vast unemployment, *or* to remove its stigma by the way it pays everybody *or* by job sharing is yet to be determined. No matter what course is taken we must begin to educate people more on how to cope with/enjoy/develop leisure time.

I cannot see a time where a multi-disciplinary approach will be adopted. Partially because of the fact that I do not see the need for it, nor can I envisage the need. But also because the teachers themselves would not be able to teach such a wide range of information and techniques.

'The subject content and range' is not satisfactory, it never has been to teachers. Education in general should be a way of training people to live in society as it is. Giving them the information and techniques that they need. Society is always changing but what is taught in schools is largely determined by society's needs for qualifications and the examination boards move very, very slowly. The physics syllabi that I teach to 4th, 5th, 6th and 7th years may have been good 10 years ago (I doubt this) but are now fairly inappropriate and very dated. The examination boards have enormous power and have a monopoly on the examination system therefore determining what is taught in schools."

(5) Alfred Bork, (6th September, 1982, BBC2 TV/Open University, E200, Contemporary Issues in Education) Professor of Physics at the University of California, has suggested that the linking of the micro-computer with the video disc/tape would be of immense educational value - the facility to illustrate points with film extracts and stills rather than just computer graphics - do you agree?

North East High School:

"Yes. The micro needs linking to a wide range of information-providing sources."

Northern Independent Grammar School:

"Surely he is right in this and is it not an imminent general development? Bits of film on the computer screen would make a pleasant change from an undiluted diet of computer graphics. By this circuitous route we can perhaps expect the visual-aid element in education to take a leap forward: indeed will the 'computer in every classroom' be *more* used for film-extracts etc. than for distinctive computer-usage?"

South West High School:

"I absolutely agree."

(6) Should we aim for a much higher standard of education for everyone (not just for pupils/students aged 5-21) with further and higher education becoming the norm rather than the exception? In 1980 39 per cent of Japanese students entering the workforce were from some form of higher education, compared with about 13 per cent of UK students. (Source: Appendix 132, Waga Kuni no. Kyoiku Suijun (The Educational Level of Our Country), 1980 Edition, Ministry of Education, 1981, Tokyo, in Abegglen and Etori, October, 1982, Scientific American, p.J13). Can computers help improve standards?

North East High School:

"I think continuing education throughout adult life will become increasingly normal."

Northern Independent Grammar School:

"Yes, why not? But is it realistic? I don't see that computers much affect this question."

South West High School:

"As a teacher I think that everybody should be able to gain more education and all pupils could be better educated. I know I could teach better given more time and more money for equipment and resources.

Computers can help in this goal of a higher standard of education in two ways.

Firstly as I have outlined above, they can help with learning in the classroom by making it more interesting - easier to understand etc. etc. *but much more importantly* they can create the money necessary to put into the service industries such as education and also create the time for people to carry on with their education after the age of 16. This effect of money and time is, in my opinion, what has lead to those remarkable statistics of higher education in Japan.

I am convinced that the technology if used properly can benefit all of mankind and not just the profit margins of the multi-national companies."

(7) Is enough being done to enable the specialist subject teacher to write his/her own specialist software?

North East High School:

"The creation of software by teachers is heavily dependent on proper technician assistance, and there isn't enough of it yet."

Northern Independent Grammar School:

"Probably not. See (4) above (computing as a language): we have at present a teaching force which is reasonably literate and numerate but not yet computer-literate (or whatever the word should be). The Cockcroft Report highlights a widespread feeling of inadequacy about Maths: there is surely going to be an even greater problem of 'embarrassing ignorance' about

computer-language - especially amongst teachers, whose pupils will be streets ahead of them in this respect. So, inservice training in computing for the various subject-specialists - yes, it *should* be offered, as computers become increasingly part of the school scene."

South West High School:

"Definitely not. Programming is a skill which is not easy for all people to learn. Intelligence and/or a degree is not a guarantee of programming skill. I know many teachers who cannot handle the specific skills needed to programme. However this is not a major drawback if the county councils are prepared to spend a little on a programmer.

All that teachers need to know is what a computer is capable of. They can then imagine or be educated into thinking how a computer could be of use to them. They can then communicate to a programmer who can convert their ideas into software. Some enlightened education authorities (e.g. Rotherham) are training teachers to know what computers can do, then these teachers consult with the educatiional programmer and together with each other's expertise they work towards a 'useful' programme.

Many education authorities do nothing to educate teachers even in computer awareness. Thankfully such an authority is becoming extinct. However the majority of authorities (like Avon County) expect individual teachers who can programme (like me) to write programmes for use throughout the county. There is no payment for this service only 'the satisfaction of helping people'; it would be much more productive if for example we were released from teaching one afternoon per week or if one teacher was allowed a term's leave of absence, but no money is spent in this way."

(8) Given the rapid development and comprehensive implementation of microelectronics and unprecedented levels of unemployment, could you foresee some form of massive microelectronically orientated (micro-computers, interactive cable and satellite television, video cassette recorders, video disc machines, hi-fi/audio etc.) education industry encompassing virtually all

subjects and activities including education, health, social, leisure and sports services? (A radical re-definition of what we mean by traditional education - an education industry for anyone to learn about and/or participate in anything).

NORTH EAST HIGH SCHOOL:

"This seems a perfectly likely development - it would be a welcome alternative to soft-porn videos as the universal occupier of spare time."

NORTHERN INDEPENDENT GRAMMAR SCHOOL:
"Not really. See 2 above."

SOUTH WEST HIGH SCHOOL:

"As I have said before I cannot see that the technology and software necessary to 'teach' people (with all that the word 'teach' implies), will be in existence for several decades even at our advanced rate of technological development.

We cannot predict what route society will take in the next few years. I would guess that the examination dictatorship will not be overthrown by the ideals of multi-disciplinary education. Therefore the syllabus as a concept will not disappear and therefore pupils' learning will be along similar structured lines.

However general education - containing such ideas as Leisure, How to Educate Yourself (where to find facts via computer) etc., must increase, this area already exists in one form or another and is usually outside the constraints of the examination system and so can react quickly to changes in society.

I also regard education as a service industry which trains people for society (or rather should train people for society). A very important part of this is how to work with people, school plays a large part in the social development of pupils, how to get on, work together etc., things which are sometimes referred to as the 'hidden curriculum'. If the microelectronics revolution does pay off for society in general then I would like to see more teachers and smaller classes with increased resources at their disposal as the aim in the next few decades. In my

opinion this would serve society the best."

(9) Do you agree that this is the sort of future we should be aiming for?

NORTH EAST HIGH SCHOOL:

"Possibly. Events tend to overtake our forecasts."

NORTHERN INDEPENDENT GRAMMAR SCHOOL:

"Not really. See especially 2(b) and 3 above."

SOUTH WEST HIGH SCHOOL:

See answer to question 8 above.

(10) Is there enough educational awareness with regard to microelectronic technology throughout the educational system? (i.e. teaching staff, pupils/students, parents, local authorities, Department of Education and Science, Department of Trade and Industry etc., concerned with primary, junior, middle, secondary schools, colleges, polytechnics and universities).

NORTH EAST HIGH SCHOOL:

"There is insufficient awareness in all categories listed."

NORTHERN INDEPENDENT GRAMMAR SCHOOL:

"Not yet. There are various ad hoc initiatives - DES competing with DTI, HMC 'going it alone' and LEAs doing their best - but does it all add up? There is a great weight of inertia to contend with, not to mention the reasonable suspicions of those who feel that the humane and human aspects of education are threatened (e.g. 'will computers + TV be the death of *reading*')."

SOUTH WEST HIGH SCHOOL:

"Simple answer No. A lot of the teachers are unaware of microelectronics and its capability and so the people they teach are also uneducated about the appropriate facts in that subject area.

The reason is simple, the Government will not give the local authorities the necessary cash to educate the educators. There is plenty of cash for hardware around but in my area (Avon) little is being done to the 'teacher at the chalkface' to bring them gently into the microelectronics revolution.

I have also encountered opposition within my school from those who understand MC's when I stress what I see as important, i.e. the teaching of computer awareness now. I am told that we do not as yet have the resources to do so. I protest that something is better than nothing and every year we delay, another 270 pupils leave without knowing about computers. Again this is caused by a lack of instant cash + expertise on the part of the Local Authority."

(11) Are you enthusiastic about the increasingly important role of the computer as an educational aid and/or tutor within the home and school?

NORTH EAST HIGH SCHOOL:

"Not enthusiastic. Resigned to it."

NORTHERN INDEPENDENT GRAMMAR SCHOOL:

"Mixed feelings. For the moment I don't doubt that Computing needs to be helped rapidly forward into its proper niche in education: we have to assist this remarkable revolution. But soon important questions will arise about balance in what we offer - what ideals we project - to the younger generation through education. In particular, if we now have a third language of equivalent importance to English and Maths (see 4 above) and if Computing and Maths are natural allies on the 'technical' side, we can expect to find literacy and the traditional concepts of 'humane culture' under threat and pressure will develop to under-pin this aspect of education. So why should one not be wholly ambivalent and be aware of *both* the above points?"

SOUTH WEST HIGH SCHOOL:

"Yes. See 1-10 above."

(12) Please add any further comments.

NORTH EAST HIGH SCHOOL:

"I believe that in many areas of life we are mistaken in shedding human skills for machiner - I'd rather have a fully-employed, if necessary less efficient, world.

(We have two PETS and an RML)."

NORTHERN INDEPENDENT GRAMMAR SCHOOL:

"Enough said, I think. Many of my own comments and thoughts arise from awareness of what others are saying and thinking and doing about Computing within the School at present. I assume that the staff consensus would be that their Headmaster should assist the rapid introduction of Computing (as recently by the creation of a separate Department with its own Head) while at the same time not encouraging fanaticism about it. We need a balance.

(We have the following computing facilities: 9 32K PETS, 2 8K PETS, 2 56K RML 380Z, 7 BBC Micros in various states of upgrade, 2 4040 Disc drives, 4 Printers, various Interfaces, Monitors /TVs etc)."

SOUTH WEST HIGH SCHOOL:

"I would like to point out that a good education system should be tailored to the society that it serves. It is no good teaching Africans how to speak French if what they need to know is Agriculture and how to keep healthy.

There are many alternatives for society in the next few years. I still believe that the present possibilities range from almost full (if part-time) employment to massive unemployment with all the current stigmas attached. As society changes so will the education system.

I used to believe that the possible problem of unemployment (long or short term) would be taken care of as in Japan by an expansion of service industries soaking up those made redundant from the traditional industries. But with the current Conservative Government not creating jobs (as I believe the

Japanese did when a similar situation occurred) mass unemployment has resulted. They have not done anything to aid the unemployed - changing the social system radically - by regarding those whose jobs were lost as a valuable part of society and paying them a decent wage.

Surely people should not be just there for industry fodder? Or be useless. Surely everybody has a value in society.

(We have 6 BBC Model B micro-computers and 1 Disc drive)."

As with the employment case studies, the majority view appeared to favour a radical, innovative, expansionist, futuristic approach, but restricted by current reductionist Governmental educational policy, were forced to take a more sceptical, traditionalist approach to computerised education.

If schools and colleges were given the prospect of a massive increase in their financial budget, encouraged to innovate and expand their curriculum and employ as many additional specialist teaching/lecturing staff as they wished, then the views of those educationalists questioned (verbal and written), freed from the reality of educational contraction would, I believe, become increasingly enthusiastic about the development, proliferation and implementation of an innovative multi-media technology-teacher/advisor mix.

CHAPTER 8: AN EDUCATION INDUSTRY?

"The new electronic information/communication devices will usher in the first genuine revolution in education in a hundred years. A century ago, our Victorian forbears created *mass* education. That *was* revolutionary. However, the classroom of today is merely an extension of that Victorian classroom. During the remainder of this century, computer-based learning will increasingly shift the formal learning process out of the classroom back into the home (where it belongs).

As the microprocessor becomes as integral a part of our lives as the light switch, home computers will become as commonplace as television sets. Before the end of the decade there will have appeared a flood of sophisticated education software to go with these computers. The education software will range from teaching young children to read and write, introduction to numbers, science, history, etc., to advanced university subjects." (Stonier, 2nd March, 1982. The End of the Culture Dinosaurs? Some Technical Aspects and Their Implications, p.2).

(Within this chapter the terms teacher and lecturer should be regarded as encompassing all forms of specialist communicating).

The development of our educational, health, social, leisure and sports services into one large 'education industry' which 'employs' all those involved in it (as in any other traditional industry) could, I believe, initiate the complete revision of the Protestant/Puritan work ethic, the development of a radical activity or leisure orientated ethos, and raise substantially the pleasure threshold and content of all paid activities to a level comparable to the paid activities that already enjoy (albeit varying degrees of) work-leisure synonymity.

As indicated earlier an education or self-actualisation industry is, I believe, the perfect mechanism through which to pull in and encompass all the crucial personal services: education, health, social welfare, leisure and sport, requiring teachers, lecturers, doctors, nurses, social workers, specialist

communicators etc., and accommodating anyone who wanted to participate, study or teach. The industry could be financed by the wealth created by advanced computerised automation; as argued earlier, it does not matter *how* the wealth is created whether it be by people or by advanced automated microelectronic systems. Microelectronic technology can provide us with the *opportunity to choose* in which areas of wealth creation we may, or may not, wish to participate: conventional factory and office work etc., or the knowledge, skill and information industry of education, e.g. software production: relaying specialist knowledge and skills via computer program and/or video tape or disc. This could afford personal financial security, via a substantial leisure income, for the tens of millions 'employed' in the industry. Clearly though, the government, CBI and TUC would need to play an active role in channelling the finances created by the technology into what Stonier calls the 'infinite employment sink of education'. (Stonier, 19th October, 1979, The Third Industrial Revolution: Microprocessors and Robots, p.19). I would extend this infinite sink of education orientated employment to include the recipients as well as the communicators of knowledge, information, skill and advice.

But before I develop what is a purely personal concept of our educational future, it is important to establish exactly what is technologically possible. Can microelectronic technology become, as suggested earlier, the neutral catalyst that could provide a totally flexible and comprehensive education industry?

I believe that within the next 10 years teaching, learning and enjoying an almost infinite variety of subjects and activities could be facilitated via a comprehensive electronic communications network and the integration of:

(1) HOME, SCHOOL AND UNIVERSITY MICRO-COMPUTERS, (CASSETTES/DISCS) linked to massive local, national and international data bases (via fibre optic communication) allowing instant access to an infinite amount of information on any conceivable subject. Every school, college, university, polytechnic and public library could have their own large electronic data base or library. With extensive computer

programming training and expert software advice, teachers and lecturers could develop their own specialist software specifically designed to meet their own students' educational requirements. Specialist subject interactive computer programs could link the student at home to his/her teacher and/or personal tutor at school, college, university or polytechnic at local, national or international level, and/or the teacher's/tutor's own home. (Interactive cable and satellite television could provide an identical facility, see next paragraph).

(2) INTERACTIVE CABLE AND SATELLITE TELEVISION linked via a fibre optic cable and/or satellite communications network to the student's own home, to schools and universities at local, national and international level and to his/her teacher's and/or personal tutor's own home. Subject teaching need therefore not be restricted to the local school or university. It may soon be possible to patch into classes or lectures anywhere in Britain or indeed, the world. It may soon be easier for the student to participate in a sociology or physics seminar at the University of California than physically to travel to his/her own local university or college.

(3) VIDEO CASSETTE RECORDERS AND VIDEO CASSETTES, VIDEO DISC MACHINES AND VIDEO DISCS, HI-FI/AUDIO SYSTEMS, AUDIO CASSETTES AND COMPACT DISCS facilitating specialist video and audio academic and leisure classes and lectures; general and specialist science, social science, medicine, law, humanities, arts, leisure and sports tapes/discs; specialist medical, financial, legal, holiday etc. advice tapes/discs; classical and contemporary plays, films, ballet and opera tapes/discs etc.

(98 per cent of UK homes rent/own televisions. 40 per cent of UK homes are expected to rent/own video recorders by December, 1985, and 70 per cent by December, 1990.

Only Denmark: TV's: 90 per cent, video recorders: 42 per cent: December, 1985, 70 per cent: December, 1990;

Norway: TV's: 93 per cent, video recorders: 16 per cent: December, 1985, 32 per cent: December, 1990;

West Germany: TV's: 98 per cent , video recorders: 15 per cent: December, 1985, 30 per cent: December, 1990;

Sweden: TV's: 97 per cent, video recorders: 21 per cent: December, 1985, 27 per cent: December, 1990;

and the Netherlands: TV's: 97 per cent, video recorders: 15 per cent: December, 1985, 25 per cent: December, 1990,

are expected to challenge the UK's concentration of TV's and video recorders in Europe and probably only Japan and the United States (statistics unavailable) in the world).

(Source: Thompson, 1983, in Cookson, 21st March, 1983, The Times, p.15).

(4) CONVENTIONAL BROADCAST TELEVISION offering a variety of specialist and non-specialist educational programmes, for example:

Open University	BBC2
Horizon	BBC2
Panorama	BBC1
World in Action	ITV
TV Eye	ITV
The Living Planet	BBC1
The Amateur Naturalist	Channel 4
The World About Us	BBC2
Chronicle	BBC2
Timewatch	BBC2
Forty Minutes	BBC2
Weekend World	ITV
Channel 4 News	Channel 4
Daytime on Two	BBC2 Schools
For Schools	ITV Schools programmes

I believe that they key to a totally flexible computerised education industry is the complete integration of these 4 mediums inextricably associated with specialist subject/activity teachers, lecturers, specialist knowledge communicators etc: a multi-media technology-teacher/advisor mix. Such flexible integration overcomes the individual short-comings inherent within conventional mass teaching, computer programs and interactive cable/satellite television, and can utilize the most effective elements of all traditional and microelectronic based communication. As Stonier has said, "coupling computer based learning with educational TV in the home means that tailor-made, individually orientated education will be able to replace the much less adaptable mass classroom-based education currently imposed on children in western countries". (Stonier, 1983, p.173).

Critics of this idea tend to regard computerised education as consisting exclusively of home and school/university micro-computers and by implication preclude all other forms of microelectronic based media. They believe that microelectronic orientated software is limited to boring, repetitive number crunching arithmetic exercises and consequently feel that all the limitations of micro-computer educational software are blatant reflections on the effectiveness of computerised education as a whole. As we shall see this is arrant nonsense.

I believe that the principal advantages of a fully integrated home-education-entertainment-information communications system are:

(1) Individualised tutoring and advising to a degree that is impossible with 1-25 teacher-student ratio, mass educational instruction.

(2) A world-wide choice of international specialist teaching via interactive cable and satellite television, computer programs; and video/audio tape/disc.

(3) Local, national and international data bases (electronic

libraries) storing information on almost any conceivable subject.

(4) Television and video film, programme, computer graphic and photographic slide images that heighten subject/activity fascination and comprehension.

(5) An interactive learning process (in the case of computer programs and interactive cable and satellite television). It is the students themselves who decide whether to go forward to a more advanced stage or to return/rewind to, or seek advice from another specialist about, something they have not fully understood.

(6) Infinite patience. Computer programs, video/audio tapes/discs will repeat general and specific points and items ad infinitum.

One of the first instances of computer-assisted learning was at Seneca College, Toronto, northern Ontario, in a mathematics project developed and sponsored by the Ontario Institute for Studies in Education and conducted during the late 1960's. The results were that:

(a) Students completed the programme in one-third of the time required for a standard non-computer course.
(b) Teacher intervention was less than 10 per cent of the total study time.
(c) Cost per student was one-third of those on similar non-computer courses.
(d) Student drop-out rate from remedial mathematics was reduced by 80 per cent.

The majority of students enjoyed the course. The immense educational value of the Toronto project, and indeed, all other forms of computer-assisted learning was concisely articulated by one of the girl students: "the computer is the first maths teacher that never yelled at me".

(7) A personalised learning speed irrespective of the student's

ability. He/she need never feel they are being left behind.

(8) Compatibility with any student's individualised mode of studying. (For example: foreign language or language translation soundtrack).

(9) Privacy. Only the computer, personal tutor or the individual student in the case of video/audio tape/disc need know about any mistakes. Computer programs enable the student to simply 'wipe'/erase everything and start afresh. The computer, video/audio tape/disc does not mind how many errors are made or how slow or fast, moderate or able the student is.

(10) Well written, produced and presented specialised or generalised computer/video/audio software never becomes irritated or patronising. "Good software provides effective positive re-inforcement." (Stonier paraphrased, 1983, p.172).

(11) Computer programs and video, cable, satellite and conventional television could facilitate thousands, possibly millions, of question permutations for science, social science, humanities, arts, medicine, law, leisure and sports subjects.

(12) Communications system software encourages "... a more positive attitude towards mistakes", as pointed out by mathematician Seymour Papert (1980, p.114, inventor of Logo: a high, medium or low level computer language designed for learning or programming irrespective of age and intellectual skill). "Users devising new programs are not 'right' or 'wrong'. Rather they need to discover the 'bugs'. Mistakes are not something to be ashamed of, but to fix." (Papert, 1980, p.114, in Stonier, 2nd March, 1982, The End of the Culture Dinosaurs? Some Technological Aspects and Their Implications, p.3). The student can enjoy the computer's confidential facility to 'fix' mistakes in subject exercises and projects, personal or even professional educational programs without any failure, pressure or anxiety complexes.

(13) A comprehensive range of sophisticated software: computer, video, audio, cable, satellite and conventional television on virtually any academic, leisure and sports subject/activity.

(14) Continuous monitoring of academic/activity enjoyment and achievement.

(15) A remarkably flexible, efficient, pleasant, entertaining and cost effective educational assistant, tutor, advisor, colleague and friend.

(16) The capability to facilitate "students with the skill of analysis by reducing problems to 'mind-sized bites'. It is possible to build a large intellectual system without ever making a step that cannot be comprehended." (Papert, 1980, p.103, in Stonier, 2nd March, 1982, p.3).

(All 16 points are an adaptation and extension of Stonier, 2nd March, 1982, The End of the Culture Dinosaurs? Some Technological Aspects and Their Implications, p.3 and Stonier, 1983, p.172).

Adapting and extending Stonier's original analysis of educational software enhances, I feel, rather than detracts from the radical pessimistic approach. And simply by substituting the words 'integrated communications system' and 'microelectronically orientated' for computer, the following advocation becomes even more persuasive:

"... an integrated communications system could provide opportunities for several users to work together, including pupils and teachers. The learning experiences provide new situations not only for the students, but for the teachers as well. Increasingly, the role of the pupils will become that of 'junior colleagues', while teachers become guides and 'knowledge counsellors'.

The opportunities for improving education are enormous. Microelectronically orientated education will be cost effective and fun. The process will begin with middle-class and skilled

working-class parents buying education software for their children to help them with their school work. The present rate of development is such that the teaching profession will feel its impact in the late 1980's. In due course, an increasing percentage of traditional learning will take place by means of an electronic information/communications system.

The above should not be construed to mean that all education will, in the future, take place at home in front of a communications system television screen. Children will still go to shcool to talk, to play with other children, to engage in sports, to do group projects, etc. The function of teachers increasingly becomes that of 'knowledge counsellors' and 'information guides' rather than 'chalk and talk' lecturers. They will not remain as mere drill masters or the disseminators of specific information. A new class of teachers will be needed: 'grandmothers', mature women (and men) who are retired, have some experience with children, who will be paid by the state to work part-time perhaps 10-15 hours per week with 2 or 3 neighbourhood children in their own homes. Using older people to provide the cultural heritage and the personal touch would be of enormous benefit to both the young and the old. This 'electronic grandmother' combination, coupled to further technological developments in television and video-recording, will create a new education system of unparalleled power. It will also decentralise and individualise the education process." (A compilation of Stonier, 2nd March, 1982, pp.4-5 and Stonier, 1983, p.173).

At secondary school level there should be radical, innovatory vertical and horizontal changes to the conventional school curriculum. Whilst maintaining a basic core of traditional academic subjects, e.g. English language, mathematics, English literature, physics, history, geography, the actual subject content should not be run along exclusively straight lines and rigidly compartmentalised into totally isolated subject-themes. Innovations within the vertical subject content could facilitate, at least, the option and/or supplement of a horizontal inter-subject multi-disciplinary approach. For example, subject overlaps - the history of computing, mathematics, physics or chemistry within the specific history subject; and the

development of historical analysis within the context of the natural and social sciences, humanities and the arts. The optional and/or supplementary facility to integrate, where appropriate, the physical and social sciences, the humanities and the arts would, I believe, encourage an explosion in the diversity of interests of the individual student; and thus allow the student to develop his/her full potential in whatever subject/activity he/she may choose.

The student could have the option either to concentrate on particular subject-themes or diversify from internal or external subject sub-strands, research and develop their own particular interest and therefore considerably heighten subject-theme fascination. But perhaps the most important aspect of this new form of learning would be that it could link two radical educational innovations and encourage unparalleled levels of interest and enthusiasm: student interaction with computers; cable and satellite television and video/audio cassette/disc could become pleasurable activities in themselves, and coupled with the opportunity for individual students to research their own specialist subject preferences with the guidance of specialist communicators, the quest for further information and knowledge could become almost addictive. If this could be so for students, then why not for everyone?

(The subject and sub-subject themes mentioned are purely personal suggestions as to the possible diversity of multi-disciplinary subject/activity themes. A possible home education/secondary school subject/activity mix. Multi-disciplinary where appropriate).

English - Language, Literature - Writers' Workshop - Drama - Cinema, Theatre, Ballet, Opera Appreciation

Mathematics - Physics - Science History - Computer Science - Science for Fun

Technology - Science History - Media and Communication Studies - Computer Science - Sociological Perspective

Computer Science - Programming - Systems Analysis - Computer Appreciation, Workshop - Physics - Sociological Perspective

Sociology - Social Psychology - Social Skills - Social History - Computer Science (History of, Appreciation) - Social Effects of Microelectronics

Geography - Educational Travel - Conversational French, German, Greek etc.

Medicine - Health Care - Keep Fit - Biology - Sex Education, Enjoyment

Parental Skills

Financial, Legal, Marriage and Bereavement Guidance

Chemistry - Computer Science

History - Classical, Middle Ages, Modern, Sciences, Computing - Natural History - Conservation - Ornithology

Music - Classical, Contemporary, Popular, Rock, Country, Folk, Jazz etc. - Music Appreciation

Languages - French, German, Russian etc.

Food - Appreciation, Economy, Cookery, Wine and Beer Making - Gardening

Photography - Video - Film

Athletics, Cricket, Golf, Tennis, Soccer, Rugby (Union and League), Badminton, Squash, Swimming,. Gymnastics, Table Tennis, Skating, Hockey (Grass and Ice), Chess, Fishing etc.

(I would advocate a 33.3/33.3/33.3 per cent ratio of graduated examination, continuous assessment and project/essay work, a la music examination assessment).

Subjects should not be categorised within inflexible parameters and never be allowed to overflow and intermix. More importantly, the actual subject range should not be restricted by the parameters of the traditional school curriculum. Rather it should be comprehensively extended horizontally. Contemporary, relevant, useful, enjoyable subject-themes, irrespective of their diversity, should be introduced into the school curriculum.

All this would necessitate a radical and completely flexible approach to secondary school education. This total education concept would be virtually indistinguishable from the adult total education-activity-employment concept. The only differences would be in actual scope: adult education would be even more diversified; and in income: the individual could receive a substantial leisure/activity income at the age of 16.

In theory the multi-media integration hypothesis could facilitate the student with an extremely flexible, versatile, fascinating, enjoyable, self-enhancing and fulfilling education industry, but in practise, how close are we to realising this radical educational concept?

Professor Patrick Suppes of the United States Computer Curriculum Corporation believes that the most crucial development within the field of educational software will be in the introduction of an audio facility. "We have extensively researched the feasibility of utilizing computer generated audio. We think that the most important single technical step is to make available computer-audio: a computer system that has the capacity to talk to the student. 90 per cent of education is talking and listening. We feel that it is extremely important that we should be able to talk to students, via the micro-computer, and not simply give them software material in visual form." (Suppes, 6th September, 1982, BBC2 TV/Open University, E200 Contemporary Issues in Education).

Although this advance would in itself be revolutionary, it still only goes part of the way towards the development of totally integrated multi-media educational technology. And it is the possibility of such radical and unprecedented educational technological development that particularly interests Alfred Bork, Professor of Physics at the University of California:

"Our conventional computer material is highly interactive and

very much tuned to the individual student's needs, therefore he/she is able to play an extremely interactive role in the learning process. One of the most interesting future blending technologies, I think, will be the possibility of combining the optical video disc" (or possibly tape) "with the computer. This will allow us to integrate the best of our conventional computer material with a full multi-media capability. For example: a film segment could be shown at a given point within a computer program. Video, audio, and/or slides, and the computer program could be totally integrated and stored on one inexpensive and easily marketable disc" (or tape). "This symbiosis of mediums will facilitate the development of the 'intelligent video disc'." (Bork, 6th September, 1982, BBC2 TV/Open University, E200 Contemporary Issues in Education).

Or perhaps the intelligent video tape and/or disc, or the tele or video-computer. The integration of such a device with an interactive, and one-way, cable and/or satellite link would catapult educational, information and entertainment microelectronic orientated technology into a totally new and virtually infinite dimension. Televisions, micro-computers, video cassette recorders and video cassettes, video disc machines and video discs, hi-fi/audio systems and audio tape and compact discs, have in commercial terms developed independently of one another. The possibility of linking all these elements in a single integrated system is, I believe, a technical feasibility within the next 10 years. And once such an integrated system is developed any subject or activity could be learned or participated in via home-education-entertainment-information integrated communications system.

Suppes is in no doubt as to the future of microelectronic orientated education:

"I think that by the 1990's a massive increase in educational hardware and software development, writing and implementation is inevitable. It will be a many splendoured thing. There will be micro-computers in the homes, there will be increasing

computerised instruction at university, secondary and elementary school levels. We will even see programs on reading readiness for pre-schoolers. I expect that with the really marvellous reductions in the cost of the hardware (and presumably software) the spread of computers for instruction will be extremely rapid over the next decade." (Suppes, 6th September, 1982, BBC2 TV/Open University, E.200 Contemporary Issues in Education).

Bork's futuristic appraisal is even more radical and aligns closely with the views of Stonier (1983) and the author:

"One of the most interesting aspects of this whole 4th revolution of educational computer instruction will be to see what will happen to the educational institutions. Many people believe that they will not change, this they see them as conservative bastions that are very difficult to change. And universities are probably the last place where educational innovation tends to come." (A debatable point). "But nevertheless there will be enormous outside pressure from society. There will, for example, be new types of competing institutions and all of this will, I think, lead to a future where we will see very different kinds of schools and very different kinds of universities. I think the changes will occur at all levels.

One particularly fascinating view of the educational future is that in George Lennard's book, 'Education in Ecstasy', he pictures an elementary and secondary school of perhaps 25 years hence where the school has almost split its functions entirely. There is a learning component which is almost totally computer based with highly interactive computer material. And there is a second non-computer component which is designed exclusively for internal and external socialisation, for individuals getting to know themselves and learning to live agreeably with other people." (Bork, 6th September, 1982, BBC2 TV/Open University, E200 Contemporary Issues in Education).

To facilitate such a comprehensively diverse and open ended cirriculum and a parallel even more extensive adult education curriculum development, current staff levels of teachers and

lecturers (approximately 700,000 CSO Social Trends 1980, in Stonier, 1983, p.180) would need to be increased accordingly. I would suggest by a factor of perhaps 10 resulting in a teaching population of around 7 million. Including 'electronic tuition' I would estimate that this could produce a teacher-student ratio of about 1-5 or 1-3. The term 'teaching population' (used for convenience and simplicity) would necessarily encompass teachers, lecturers, tutors, doctors of medicine, nurses, social workers, counsellors, advisors, guides, specialist communicators, e.g. in television and video, coaches and enthusiasts etc. - teaching natural and social sciences, humanities, the arts, medicine, preventative medicine/health care, social and welfare work, software (computer, television, video and audio) production, law, leisure and sport; via conventional classes, lectures, seminars, counselling, advising and coaching sessions; leisure and sports clinics; computer programs, interactive cable and satellite television, video/audio cassette/disc and conventional television.

As this 'teaching population' figure of 7 million would encompass all forms of specialist communicating, the recipient 'student' population would cover the entire participating age-spectrum from pre-schoolers to nonagenarians. The present, I believe, ludicrous teacher-student ratio of 1-20/30 could therefore be reduced dramatically to about 1-5, 1-3, 1-1 or even 2-1 or 3-1 with 2 or 3 teachers for every student - this figure would also include personalised electronic learning via computer programs, interactive cable and satellite television and video/audio cassette and disc. This degree of individualised tuition and guidance, if required, coupled with the aforementioned multi-media technological mix would almost inevitably accelerate and enhance intellectual and social development; but perhaps more importantly, it could, irrespective of age, improve significantly the individual student's quality of life.

Education should become Britain's major industry and largest souce of activity-employment; it should no longer be inextricably associated with misery, boredom and frustration - rather it should become synonymous with enjoyment, fascination and freedom.

I would, therefore, urge the case for a radical re-definition of what we mean by traditional education and for a totally flexible multi-disciplinary microelectronically orientated education industry where anyone can learn about anything.

I believe that an education industry, whether for the individual it takes the form of a micro-computer, television, video, hi-fi/audio system or an educational centre etc. or a combination of all these elements, could provide the best opportunity for the majority of the British population to raise the pleasure threshold and content of all paid activities (see Chapter 3) and thus attain at worst some degree of work-leisure synonymity and at best levels of contentment, happiness, enjoyment, self-enhancement and fulfilment approaching that of complete self-actualisation.

CHAPTER 9: AN ACTIVITY/LEISURE ETHIC?

"Speaking of machines and electronics, the machines are working in place of people. We must re-think the role of people because of the problem of possible alienation. In the coming era, how will people use their time? Will they spend it in reading? Will they spend it in more imaginative work? Will they spend it in artistic activities? I do not know, but whether we like it or not, these are problems that will be arising." Dr. Shunkichi Kisaka, Executive Vice-President, Matsushita Electric - Parent Company of Panasonic, National and Technics. (Kisaka, October, 1982, in Abegglen and Etori, October, 1982, Scientific American, p.J23).

Following on from the previous chapter, could educational activity-employment compensate for a massive displacement of labour within traditional employment sectors and resolve a potentially enormous unemployment problem? Is conventional work relinquishing its traditional role as society's primary self-identifying ethos in favour of an activity or leisure based ethos? And could a microelectronically orientated education industry, facilitating a comprehensive range of activity-employment, result in the convergence of traditional work and leisure, an increase in the pleasure threshold and content of all paid activities to a level comparable to the paid activities that already enjoy (albeit varying degrees of) work-leisure synonymity and, finally, the development of an activity or leisure orientated ethos?

"In the future we will see a fusion of work and play. Play will be our work, as it is for children. Work will be our play: we will demand the right to occupy ourselves with deeply fulfilling activities." (Farson, 12th June, 1969, New Society, in Roberts, 1981, p.95)

This amalgamation of work and leisure usually occurs when people consider their occupation to be a pleasant, inherently satisfying activity and enjoy their work to such an extent that

they freely pursue it in the period normally reserved for a leisure activity.

Fred Best has forecast that increasingly, wherever possible, machines will displace humans in their place of work "... one person may, for example, be able to operate and supervise an entire hydro-electric or oil refining plant" (Best, ed., 1976, in Roberts, 1981, p.95). Farson has suggested that we should legislate for "the right not to work and still be considered a worthy human being". (Farson, 12th June, 1969, in Roberts, 1981, p.95). Parker (1971) also advocates and predicts a fusion between work and leisure exemplified by the individual in intrinsically satisfying work who would automatically extend this activity into his/her free time. The only conceivable method of transforming and expanding this elitest minority privilege into a majority perogative is to fully implement computerised automation throughout all sectors of employment and education and determine, by radical attitudinal innovation, to let the technology enhance, rather than diminish, the quality of life for everyone.

It is therefore imperative that we begin to discuss (within all social circles) the possibility of eliminating the indoctrinating and stultifying effects of the traditional Protestant/Puritan work ethic.

At present however Parker (1971) et al have noted 3 distinct forms of work-leisure relationships:

(1) The Opposition Pattern or Compensatory Pattern is exemplified by leisure activities that are deliberately unlike work. According to Parker, manual workers would fit into this category. Wilensky (1960, International Social Science Journal No.4) in his compensatory leisure hypothesis talks of the "explosive compensation for the deadening rhythms of factory life." (Wilensky, 1960, in Parker, 1971, p.58). In his 'spillover' leisure hypothesis (also outline by Engels, 1892, reprinted 1952) he describes how the depressingly dull, monotonous and tedious qualities of factory work permeate the individual's leisure time in the form of torpid apathy and lethargy. (See also Clarke, 1956, American Sociological Review, 21, p.301, Friedmann, 1961 and Gerstl, 1963, in Smigel ed.,

1963).

(2) The Neutrality Pattern does not constitute a mid-way point between the negative Opposition Pattern and the positive Extension Pattern - it is totally separate. There is neither a favourable or unfavourable attitude to work. Parker gives the example of banking staff. (See also Clayne, 1975).

(3) The Extension Pattern or a second form of 'spillover' hypothesis is exemplified by leisure activities that are similar to work - to the extent that there is very little distinction between the two. Parker argues that social workers are a prime example of this effect. However, the extension 'spillover' pattern, as designated by Parker (1971) and Roberts (1981) is currently only available to a very small section of the population. (See Clarke, 1956, American Sociological Review, 21, p.301, and Gerstl, 1963, in Smigel ed. 1963).

In early July, 1982, I wrote to Miss Sandra Mason, a principal of Leisure Consultants Limited., and co-author with Bill Martin of the February, 1982, study entitled Leisure and Work: The Choices for 1991 and 2001, outlining the crucial importance of attitudinal change to our concept of work and leisure. In her reply Miss Mason agreed: "...like you, we see leisure and people's attitude to it being critical in shaping our world over the next two decades".

The authors do not make one single prediction about future trends, rather they set out and project 4 alternative scenarios:

Work Orientated Societies.
Scenario A - Conventional Success:

Forecasts success and affluence within the framework of a conventional work centred society. Leisure periods are used for re-cuperative purposes, entertainment and discharging restless energies. Society becomes divided. (Presumably between the elitest technocrats and the unemployed).

Scenario B - Frustration:

Describes UK society at present: income restrictions, increased unemployment and free time - conventional societal goals are checked and nullified. Leisure becomes an escape mechanism - regional differences and inequalities are sharply contrasted.

New Attitudes to Work and Leisure.
Scenario C - Transformed Growth:

Unreserved implementation of microelectronic technology. Much more emphasis on, and the opportunity for, substantial increases in free time. Enhanced personal and social development - (a definite move towards a leisure orientated society). Voluntary work sharing. A radical re-distribution of work, leisure and income - considerable flexibility in personal work and leisure periods.

Scenario D - Self Restraint:

An acceptance of, and an acquiescence to, economic failure. A significant lowering and re-structuring of societal goals. Work becomes labour intensive to the point where it infiltrates an individual's free time, a palpable obfuscation of the borders between work and leisure - in favour of work.

"We believe that the failure to achieve the desired level of formal work will gradually force a major re-thinking, both among individuals and policy makers, about a wide range of social goals, including the relative priority to be given to work and income on the one hand, and leisure and personal and social development on the other. The choice, as we see it, lies between either maintaining a continuing commitment to a work orientated society from which a significant unemployed minority will be largely excluded, or giving a positive value and use to the extra free time that new technology has made, and will continue to make, possible." (Martin and Mason, Spring, 1982, Summary of

Paper to Leisure Studies Association on Work and Leisure, Leisure and Work: The Choices for 1991 and 2001, p.2).

I feel that Scenario C is easily the most desirable of the 4 alternatives but would go even further, i.e. I would like to see the palpable obfuscation of the borders between work and leisure *ensure* a leisured society in which 'activity' becomes the dominant ethos. We should not simply satisfy ourselves with less work and more free time. Undesirable work should become a thing of the past. People should only 'work' if they feel it compatible with, and analogous to, a form of leisure or pleasurable and/or contributory activity. The tragedy is that few people in today's society can ever hope to make that claim - *until we do something about it.*

Paradoxically, an indication of how an activity or leisure ethos could emerge is proposed by Jonathan Sleigh, co-author (and head) of the conservative optimistic CPRS 'Think Tank' report (30th November, 1978) (see Chapter 4). He admits that what is crucial is the 'wealth factor'. So long as a society is creating wealth in the manufacturing sector and in parts of the service sector then it does not matter how that wealth is created, whether it be by people or sophisticated robotics and computers. If the sector produces sufficient wealth then that society can determine what services it requires and what employment levels it requires.

These general thoughts are echoed by Robin Williams of the Technology Policy Unit at the University of Aston:

"The problem is that the new technology, when applied to the manufacturing industry, is amazingly wealth creating. It will be very easy for a small number of people to be employed in producing the wealth to sustain the nation. The problem then arises as to how we distribute the wealth that we have generated by the application of the new technology for the population as a whole. There is not a mechanism in existence for that distribution. You could have higher taxation, but clearly that is an unpopular approach at the moment. We already have a form of re-distribution of wealth where we have very large levels of unemployed people gaining a low standard of living on Unemployment and Supplementary Benefit. And we can see the

consequences of this in terms of social unrest and the decline of the inner cities. That is a scenario that I think we ought to resist. It is important, if there is going to be less employment overall, that that employment" (the author would suggest activity-employment within education) "is shared right across society so that everybody participates in creating the wealth of society and in so doing is actually a part of that society." (Williams, 10th October, 1982, BBC1 TV, Will Tomorrow Work?).

I believe that the pre-requisite to a considerably more equitable re-distribution of financial wealth and to a substantial increase in pleasure threshold and content of all paid activities is, as discussed earlier, the gradual convergence of the definitions of work and leisure. Indeed, they should become progressively indistinguishable until the definitions are totally synonymous. Paid employment should be no longer specifically associated with traditional work. The terms work and leisure should either become inter-changeable or be replaced and designated simply *activity*. In other words it would be irrelevant whether or not we call paid employment work, leisure, play or activity centred as long as the terms themselves become synonymous. Jenkins and Sherman's (1981) analysis takes a similar line "... we need to provide more of the same in leisure facilities; more sports and recreational areas, more pre-retirement training and better libraries". (Presumably electronic as well as physical). "Over time, if the goods and services required are capable of being funded and can be provided, using fewer workers and fewer hours worked than the separation of work and leisure which began in the first Industrial Revolution will have to be reversed. Consider the alternatives.

If the work ethic holds then those out of work will envy those in work even if the unemployment pay is at or above national average earnings. If, conversely, the work ethic is eroded or replaced by a leisure ethic, then those in work will feel aggrieved when seeing the others doing little or nothing. In either instance there would be great social dislocation. The only long-term solution in such a situation is to remove the words (and the concepts behind them) 'work' and 'leisure' from

our vocabulary. These words can be replaced by 'activity' and 'usefulness'. It does not matter whether a person doing a useful task is describing it as a working or a leisure time activity; it also pre-supposes that the person, or the family, is, at a minimum, financially secure. This would be the ultimate extension of the Beveridge welfare-state notions, now under historic counter-attack." (Jenkins and Sherman, 1981, pp.46-47).

And as I have suggested, the perfect mechanism through which to accommodate a massive shift in traditional employment patterns; the convergence of traditional work and leisure; a rise in the pleasure threshold and content of all paid activities to a level comparable to the paid activities that already enjoy (albeit varying degrees of) work-leisure synonumity; a substantial activity-employment leisure income; and the development of an activity/leisure orientated ethos is via an all encompassing education industry. I believe an education industry, as discussed earlier, could be financed by the comprehensive implementation of extremely efficient, productive and cost effective microelectronic systems throughout every sector of society, and could 'employ' the majority of the British population as either specialist communicators or students in virtually any subject or activity they wish to teach, learn, participate in or simply enjoy, whether it be:

ACADEMIC RESEARCH, ACTING, AMATEUR DRAMATICS, ANIMAL CARE, ARCHAELOGY, ARCHITECTURE, ASTRONOMY, ATHLETICS, BACKGAMMON, BADMINTON, BALLET, BEER MAKING, BEREAVEMENT GUIDANCE, BIOLOGY, BOWLS, BRIDGE, BINGO, BROADCASTING, CAR MAINTENANCE, CHEMISTRY, CHESS, CIDER MAKING, CINEMA APPRECIATION, CLASSICAL STUDIES, COMMUNITY CARE FOR THE AGED, COMPUTER CONSULTANCY, COMPUTING FOR FUN, COMPUTER PROGRAMMING AND GAME PLAYING, CONTEMPLATION, CONSERVATION, CRICKET, CROSSWORDS, DANCING (DISCO, BALLROOM), DO-IT-YOURSELF, DRAMA, DRIVING, ECONOMICS, EDUCATIONAL TOURISM, ENGLISH LANGUAGE, LITERATURE, ENGINEERING (ELECTRONICS, ELECTRICAL, MECHANICAL), ENTERTAINING, FAMILY LOVE AND CARE, FILM MAKING, FINANCIAL GUIDANCE, FISHING, FOOD (APPRECIATION, ECONOMY, COOKERY), FRENCH CONVERSATION, GAMBLING (HORSES, POOLS, CASINOS, BINGO, DOGS), GARDENING, GENEALOGY, GENERAL COMPANIONSHIP,

GEOGRAPHY, GERMAN CONVERSATION, GOLF, GYMNASTICS, HEALTH CARE (VISITING, LEARNING, TEACHING), HI-FI/AUDIO MUSIC APPRECIATION, HOCKEY (GRASS AND ICE), HOME DECORATING AND MAINTENANCE, HORSE RIDING, JOGGING, KEEP-FIT, LANGUAGES (LEARNING, TEACHING), LAW, LISTENING TO LIVE AND RECORDED MUSIC, MAKING MUSIC, MARRIAGE GUIDANCE, MATHEMATICS, MEDIA AND COMMUNICATIONS STUDIES, MEDICINE, MICROELECTRONICS RESEARCH, MUSIC APPRECIATION, NURSING, OPERA, ORNITHOLOGY, PAINTING, PHILOSOPHY, PHOTOGRAPHY (FILM AND VIDEO), PHYSICS, POETRY, POLITICS, PREVENTATIVE MEDICINE, PSYCHOLOGY, READING, RELIGIOUS STUDY, RUGBY (UNION AND LEAGUE), RUSSIAN CONVERSATION, SCIENCE FOR FUN, SEX EDUCATION AND ENJOYMENT, SKATING, SKIING, SINGING, SNOOKER, SOCCER, SOCIAL SKILLS, SOCIAL WORK, SOCIAL PSYCHOLOGY, SOCIOLOGY, SOFTWARE PRODUCTION (COMPUTER PROGRAMS, TELEVISION, VIDEO/AUDIO, FILM ETC.), SQUASH, STUDYING FOR A DEGREE, SWIMMING, SYSTEMS ANALYSIS, TELEVISION APPRECIATION, TENNIS, THEATRE APPRECIATION, TRADITIONAL OFFICE OR FACTORY WORK (IF AVAILABLE PERHAPS VIA SMALL CO-OPERATIVE ENTERPRISES), TRADITIONAL WORK BASED AT HOME, TRAVEL FOR FUN, VETERNINARY SCIENCE, VIDEO APPRECIATION, VOLLEYBALL, WINE APPRECIATION, WINE MAKING, WRITERS' WORKSHOP, YOGA, ZOOLOGY, ETC., ETC.

The aforementioned purely personal list (which does not presume to be comprehensive) of activities could be subjectively defined as work, leisure or play. Indeed, if these activities were defined as being work, then a work ethos re-defined as encompassing leisure, play and activity would, I feel, be entirely acceptable. However, the term activity-employment (or activity), I believe, pulls together the majority of the individual subjective concepts of what it is to raise the pleasure threshold and content of a paid activity to a point where total work-leisure synonymity is achieved. (See Chapter 3). The individual could participate in the activity of his/her choice and receive personal financial security, via a leisure income, for doing so. I would suggest therefore that if we could re-define our traditional concepts of work and leisure and satisfy the pre-requisites of the work and leisure ethos in the form of the convergence of paid-work-employment and

activity/leisure (as indicated in the previous list), 100 per cent activity-employment could be achieved almost immediately.

Individuals would be free to teach or participate in one or a multiplicity of activities. We would therefore require perhaps 7 million specialist communicators relaying specialist knowledge, information, skill and advice to 'students' and 'mature students' directly and/or via sophisticated computer programs, several vast local, national and international data bases (electronic libraries), interactive cable and satellite television, video/audio cassette/disc and conventional television, in order to encourage anyone to learn, appreciate, enjoy and participate in virtually anything.

Using the education industry as a base, new small cottage industries could be developed in such diverse subjects as software production: computer programs, television, video and film; educational, medical, social welfare, sports, legal and financial consultancy software etc.; and (intentionally) automation-free traditional arts and crafts. So, clearly, in addition to the wealth creation qualities of advanced microelectronic systems in outside traditional employment sectors, there is an enormous wealth creation potential from inside the education industry through the sale of specialised knowledge and information, but also, for example, in high quality, precision-made traditional arts and crafts products.

Max Kaplan argues for the development of a different set of values that will enable us to live a more natural leisure life-style thus creating a "'cultivated order'. What happens" asks Kaplan "to the parent-child relationship when father works four hours a day, or a 'normal day' of eight hours but for only half the year?" (Kaplan, 1975, p.216, in Roberts, 1978, p.140).

If these old values, exemplified in the form of the Protestant/Puritan work ethic, were displaced by an acitivity or leisure orientated ethos then at least we would have the opportunity to enhance significantly *all* relationships within nuclear and extended families.

Kenneth Roberts suggests that leisure values emphasise having a free choice, self-expressiion and "doing things for their own sake" (Roberts, 1978, p.140) which, Dumazedier maintains, filters

through into all aspects of life. The outcome of this is "... what used to be considered idleness when confronted with the requirements of the firm is now defined as dignity, what used to be called selfishness when confronted with the requirements of the family is now perceived as respect for the personality of one of its members. Part of what used to be considered sinful by religious institutions is now recognised as the art of living." (Dumazedier, 1974, p.42).

One of the principal protagonists of this leisure ethic or fun morality argument is Joffre Dumazedier (1974). He claims that leisure is rapidly becoming the central feature of an individual's self-identity - totally overriding all conventional class barriers. The increase in leisure has given rise to a "new social need for the individual to be his own master and to please himself". (Dumazedier, 1974, p.40). Clearly realising the future potential of new technology, he believes people will, in the late 20th - early 21st century, demand participation in absorbing, engaging and entertaining activies within a pleasant, congenial social environment through which they can enhance their quality of life and enjoy the art of living.

Similarly, Otto Newman argues that leisure has now superseded work as the principal source of self-identity and meaning.

"Undeniably the significance of work has universally receded into the background and centrality in the formulation of self-definition has passed within the compass of the non-occupational sphere, with leisure outstandingly the single dominant element. It is in his leisure that late-industrial man satisfies his need to feel adequate, derives his ego-definition and achieves skills instrumental towards social integration, possibly to the extent of even infusing meaningful content to his objectively overwhelmingly dull and monotonous work." (Newman, 1976, Ontario Psychologist, 8, pp.28-34, in Roberts, 1978, p.140). (See also Hirsch, 1977, and Kelvin, 1980, in Gilmore and Duck, ed. 1980) who also contend that the Protestant/Puritan work ethic has largely disappeared).

However according to Roberts (1981) the leisure centrality theory is extremely controversial. The radical prediction that

leisure will soon become a central feature of an individual's self-identity is, says Roberts, strictly limited to a very small minority of sociologists "... the most realistic approach to the work-leisure couplet is surely to presume that we are exploring a reciprocal and interactive rather than one-sided relationship." (Roberts, 1981, p.70).

Nevertheless, I would agree with Newman's analysis but fear that the pace of the technological change is far outstripping the pace of attitudinal change. The traditionally religious/puritanical doctrinal bias of the Protestant/Puritan work ethic has, for the past 5 centuries, determined, regulated and channelled all our social, economic and political thinking into the belief that we simply *must* work. Conventional work, as we know it, should cease to be a moral and economic necessity - it should become an option within a comprehensive range of choices. In other words, traditional work could still be done by those who want to do it.

Continuing this theme of radically re-thinking our traditional attitudes to work and providing, I believe, extremely persuasive arguments for revolutionary change are Rex Malik (23rd December, 1982) of The Guardian and Philip Hughes (1st January, 1984) of Logica. Because their views are particularly germane to this treatise they have been developed extensively and therefore form two appendices to this chapter.

APPENDIX 1*:

Technology author, journalist and broadcaster, Rex Malik (23rd December, 1982):

"There is going to be a radical change in jobs. No job that we do now will be unaffected ... probably 50-60 per cent of the jobs we have now will disappear altogether. But this does not mean there will be nothing to do. Think of the alternative, if we do not install microelectronic technology it could mean that instead of working a 40 hour week we may well end up working a 60 or 70 hour week. Everybody else is going to be using machines and to stay competitive we are going to have to compete with people who are using machines. We have a two-edged sword; one way we put people out of work as we have hitherto understood it and computerise, the other way, we do not do it, then everybody will have to work a lot harder and for no more income.

It has been traditional throughout the human race's history to say that employment creates wealth. The reality of the new situation is that we have divorced the creation of wealth from people ... machines create wealth. Our problem now is how do we distribute the wealth of machines to make sure that everybody has an income and to create the sort of situation in which people can do the things that interest them and are not socially disadvantageous to the rest of society."

But how can we provide everyone with an activity or leisure income?

"I have a theory that I call the Kuwaiti Solution - not necessarily Kuwait in particular, but the oil states in general that stumbled upon natural oil riches and proceeded to find mechanisms to give everyone a share of that oil wealth. They may be imperfect mechanisms but mechanisms exist - and it seems to me that we would do very well to look at the productive industries and treat them on roughly the same basis."

(Kuwait's standard of living ranks as one of the top five in the world producing $18,000 per capita income in 1979. (The United Arab Emirates produced $30,000 per capita income in 1980 and have the highest standard of living in the world). The vast majority of Kuwaitis do not work - labour is imported from Egypt, Syria, Iraq, Iran etc. Kuwait has free medical services, a free educational system at all levels, free telephone services and several sponsored social welfare programmes, public works and development plans - all financed by oil).

What will people actually do in a activity/leisure orientated society?

"What they want to do. We train people at present to play a role in society which is work based - work as we have hitherto understood it. If the role of people is not work based then it seems to me sensible to ask our society to train people for that other role. A large part of this new role will be 'play' and a large part would be learning to look after other people."

Do you believe a new activity or leisure orientated ethos will eventually replace the traditional Protestant/Puritan work ethic?

"Yes, and that is the historic flip-over point. This is a totally new situation. We have hitherto been bounded in our life - social discipline has been imposed on us by the fact that we have to go out and do work. By work I define as something we would prefer somebody else did. Suddenly work is no longer necessary. Therefore we are going to have to find new tools of social control, new methods of social discipline and new ways of organising people or letting them organise themselves."

Will this mean a shorter working week?

"I doubt very much a shorter working week. It seems to me to

make a lot more sense to have people work 3-4 months of the year and then take 6, 7 or 8 months off to be re-trained or to do their own thing - whatever it may be. And interestingly enough it is much easier to organise society that way.

The change will happen, you do get crunch points in the evolution of societies where everything flips over ... where a society says enough is enough - we've had enough of this way of doing things. I do not envisage the changes being any greater than the changes we had to face in the first industrial revolution. During this period of over a century, we took the majority of people from the land and stuffed them into new towns. They lived a totally artificial life in which for the first time they had to pay attention to the clock. People for the first time in the history of the human race all had to be in one place at the same time. It took a long time for that to sink in. It may turn out that the industrial society we look back on, for some of us possibly so fondly, is in fact an aberration in the long development of the human race. We are coming back to being ourselves ... graduating towards an activity ethos is a natural process. After all, the industrial revolution lasted 200 years - 200 years for whom? 200 years for us - nobody else has had it that long."

Do we utilize our human resources in the best possible way?

"People are too precious, too valuable to use in doing some of the nonsensical, boring work that most people have to do. They do it because that is what they know, that is the way they get an income and that is the way they get security. If you can show them there is another way to get an income, another way to get security and still have some fun, and do something interesting and make a contribution to society - which is what most people would like to do - then, I think that is the option they would prefer to take." (Malik, 23rd December, 1982, Channel 4 TV, How To Succeed With Sand, paraphrased in sections).

APPENDIX 1*:

In addition to the source references already quoted the previous account was based upon information gleaned from:

Cockburn, P. (23rd February, 1983), 'Foreign workers essential to the economy', Industry, Financial Times Survey: Kuwait, Financial Times, (23rd February, 1983).

Countries of the World and Their Leaders Yearbook: 1982, Volume 1, Gale Research Company, Book Tower, Detroit, Michigan.

McWhirter, N., ed., (1983), The Guinness Book of Records, Guinness Superlatives Limited, Enfield, Middlesex.

APPENDIX 2:

The author is in total agreement with Malik's innovative hypothesis. And in virtually identical theoretical alignment, Philip Hughes (1st January, 1984), Chairman of Logica presents an equally convincing case for rapid technological and attitudinal change:

"... the growth industries of the future will be those involved in computer hardware and software, television, cable, satellite, video and telephone communications; also the traditional professions such as consultant engineering, architecture, medicine, teaching - all of these are examples of what I would characterise as knowledge based industries. They sell knowledge, information, expertise, our intellect. The products of these industries are things like television programmes, films, teaching materials, designs, forms of medicine, architecture, engineering, specialist and generalised software ... anything that encapsulates our intellectual skills, our knowledge, and packages it for sale to the world. We are ideally placed. We have the right tradition. We have the right language. We can, I am convinced, create the wealth we need to concentrate on these industries ... but can we create the jobs?

High technology does create new jobs. Take for example, Swindon. Swindon is located in what is called 'Silicon Gulch'. It is one of the fastest growing towns in Western Europe. New industries come to Swindon every week, i.e. Lake Electronics (UK) Ltd., Emerson Industrial Controls, Intel, etc. In one Swindon factory, we (Logica vts) develop and manufacture advanced office equipment. The factory which used to make children's clothing, was forced to shut about 3 years ago. It was one of many companies (including most of Swindon's British Rail industries) that have been compelled to close down in Swindon. We have replaced 200 jobs here ... we employ 200 and in this factory we manufacture over £20 million worth of equipment for export around the world. But imagine how many factories like this are required

just to keep pace with the loss of jobs in Swindon. Even though Swindon is a boom town, perhaps the boom town of the country, unemployment has doubled here in the last 3 years.

I used to believe, rather as an act of faith than from evidence, that the new technology replaced as many jobs as it displaced. I thought we were in an era of painful transition, from one era of relatively full employment to another. I no longer believe that. Instead, I believe we are moving permanently out of full employment as we know it. We have to recognise that. There is no need to be afraid of it ... quite the reverse, we should welcome the extra leisure the new technology wins for us. We have to plan for a new era and a different mix of work and leisure. What will this new mix look like?

One's prime job will occupy less than half of the time it does now. This can be done through a 2.5 day week, or a 4 hour day, or a 23 week working year or a combination of the three. Housework, working on home improvements, growing food, teaching children, looking after old people, bringing up infants, the arts - all of these will be recognised as work. They *are* work after all, it is just that our society does not recognise them as such. The tax and social security system will need to be turned upside down in order to take care of this new future. It will be required to distribute the wealth created by very high levels of productivity by people working in the factories of the future: the technicians operating the electronic networks and the software engineers and designers. And in parallel we will need a national wage, essentially to pay for the types of work I have described that are carried out within the home.

Massive changes are required. They will not happen of their own accord. Inescapably the Government has a central role and unless we recognise this we cannot succeed. Let us look at employment. I believe the transition is so severe from our current industrial base to the future that we must, in the short term, be concerned with work creation as such. This mainly needs to be in the public sector. We need to repair and renew our hospitals, our roads, our sewers, our railways, our schools, etc.

- the total infra-structure of our society that we have allowed to be run down. Beyond this transition we must search for the fiscal systems that will re-allocate wealth according to the new society. We need to start doing this now. We will have to accept a split between work and reward. We may in fact need to be concerned with spreading work itself.

There are 3 other main areas of concern for the Government: communications, research and development and education.

COMMUNICATIONS: the infra-structure of the new industries is a communications network in the way that the railways were in the industrial revolution. The new technologies which have satellites, optical fibre, two-way cable, etc., will allow a totally different communications future.

RESEARCH AND DEVELOPMENT: it is very difficult in this country to get a planning horizon that goes more than 5 years - the life of a parliament. And yet we are creating and need to create technologies that stretch 20, 30 years away. We have to move to the way the Japanese work - to time horizons that reach well into the 21st century. Unless we do, they will just walk all over us.

EDUCATION: is by far the most important area. It is pivotal. Pivotal between the needs of the knowledge based industries and the needs of all of us to meaningfully occupy the leisure that the new technology can win for us. Education must be seen as an asset. Our key single investment for the future. Above all, we need it throughout our lives.

The City Literary Institute, in the back streets of Covent Garden, is a leading adult education centre. One of the longest established in the country. It serves a vast variety of needs, both in the subjects it covers and of the people who come to learn.

Here is an example of the subject mix offered:

HUMANITES AND SCIENCE

ADVANCED LANGUAGE SKILLS
LOOKING FOR JOBS
MARXISM FOR BEGINNERS
PSYCHOLOGY AND ART
HUMAN RELATIONS
ARTHUR IN HISTORY: LEGEND AND LITERATURE
WHAT'S IN THE NEWS
NOT THE SIZEWELL INQUIRY
SOCIETY AND THE OCCULT
THE STORMY SISTERHOOD
BRITAIN AT WAR: A SOCIAL HISTORY
SOUTHWARK EXCAVATIONS
WAYS INTO POETRY
KEEP FIT IN RETIREMENT
BASIC ENGLISH GRAMMAR
DEVELOPING MATHS SKILLS
EXAMINATION TECHNIQUES
ASSERTIVENESS TRAINING
THE BRITISH ECONOMY IN DECLINE
FRENCH FEMINISM TODAY
FROM LENIN TO CHERNENKO
GABRIEL GARCIA MARQUEZ: EARLY WORK
THREE MAJOR MODERN NOVELISTS
MODERN POETRY IN THE MAKING

DRAMA AND SPEECH

TV/RADIO WORKSHOP
DISCOVERING MIME
SHAKESPEARE FROM SCRATCH
TAI CHI CH' UAN INTRO
VOICE PROD. AND SPEECH TRAINING
TAP TECHNIQUES/ROUTINES

POETRY FOR PERFORMANCES

LANGUAGES

LATIN INTER.
LATIN ADV.
LATIN READING GROUP
SPOKEN CHINESE
USE YOUR FRENCH
FRENCH ADV., LANG. AND LIT.

The City Lit. attracts all sorts of people: the unemployed, who can come for £1 a year, the retired and people who come after work.

If I had to point to the future in education I would point to an institute like this: an education centre that serves the needs of students and teachers by offering a comprehensive variety of academic and general interest subjects. This is the kind of adult education we are going to require in our future.

This brings me to the deeper problem of the future. In a remarkable essay that Keynes wrote in 1930 called 'Economic Possibilities For Our Grandchildren' he foresaw the kind of future I have been trying to describe. He foresaw solving our economic problem, as he called it, and moved to man's permanent problem. Keynes wrote:

'Thus for the first time since his creation man will be faced with his real, his permanent problem: how to use his freedom from pressing economic cares, to occupy the leisure that science and compound interest will have won for him, to live wisely, agreeably and well'.

I am often asked if I paint as a hobby, as a relaxation. It's a question I can hardly understand because it's not a relaxation it's really the reverse. For me I suppose it's a necessity but it's really another kind of job. I have two jobs: one working as a painter (artist), the other working for Logica in computing. I think that this is going to form very much the

pattern of life in the future. I do not think we will have just one activity ... one main job ... it will be mixed up with things which are thought of as leisure with things which we think of now as work.

What we need is a clear sense that what we are aiming for is to make this country a fine place in which to live. A fine place for all of us to live, not just a selected few. A place in which to be occupied, entertained and inspired." (Hughes, 1st January, 1984, BBC2 TV, Beyond 1984: 'A Technological Tomorrow', an edited version of a television talk, paraphrased in sections).

CONCLUSION*

"We are arguing for a revolution and, moreover, the hardest one of all, a revolution in attitudes." (Jenkins and Sherman, 1981, p.185)

The previous views implicitly subscribe to the radical pessimistic approach as illustrated by Stonier (1983), Jenkins and Sherman (1979, 1981), and Pym (10th October, 1983). They advocate the elimination of the majority of traditional employment and of the Protestant/Puritan work ethic; and the development (I would suggest through a microelectronically orientated education industry) of an activity/leisure ethos. Leisure/activity should, they contend, supercede work as society's primary self-identifying ethos. I would suggest that microelectronic technology could facilitate the development of a flexible, integrated, multi-media education industry and thus probably the best opportunity for the majority of the British population to raise the pleasure threshold and content of all paid activities to a level where work and leisure become synonymous. We should therefore, as indicated earlier, radically re-define our traditional concepts of work and leisure and satisfy the pre-requisites of the work and leisure ethos in the form of activity orientated employment with a flexible, integrated, multi-media education industry.

The conservative optimists exemplified by the CPRS report (30th November, 1978) and Baker (10th May, 1982) cannot seem to equate microelectronics with activity or leisure. Whilst recognising to some extent the potential of micro-technology, they still (mistakenly in my opinion) appear to believe that:

(1) Direct, related and indirect new technology employment will adequately compensate for the displacement of labour within traditional employment sectors.

(2) Microelectronic technology should develop totally

independently of attitudinal change. An isolationist approach that pre-supposes the retention of the work ethic and disregards the possible development through education of an activity/leisure ethos.

(3) Micro-technology can only make possible the creation of work and the perpetuation of the work ethic, it cannot make possible an education industry and thus an activity/leisure orientated society.

(4) All arguments regarding microelectronics must be set within the context and parameters of traditional work; therefore all microelectronic technology debate must start from the base or assumption that the Protestant/Puritan work ethos is a fixed societal doctrine.

My impression is that advocates of the the radical pessimistic approach fully appreciate the potential and desirability of simultaneous technological and attitudinal change. I am in total agreement with the quintessential concept of the radical pessimistic approach exemplified by Stonier (1983), Jenkins and Sherman (1979, 1981), Pym (10th October, 1983), Kinnock (January, 1984), Newman (1976), Malik (23rd December, 1982) and Hughes (1st January, 1984), etc. To reiterate, I believe it is crucially important to urge the case for:

(1) The elimination of the majority of traditional employment and of the Protestant/Puritan work ethic; and the development of an activity/leisure ethos.

(2) The recognition that direct and related new technology employment will be minimal, measured in thousands rather than millions and will, and should, not compensate for those jobs lost in traditional employment sectors.

(3) Simultaneous, radical and innovatory technological and attitudinal change.

(4) The comprehensive proliferation and the unreserved implementation of microelectronic technology throughout every sector of employment and education.

(5) The provision of personal (life-time) financial security in the form of an activity/leisure income.

(6) The re-definition of our traditional concepts of work and leisure via the development of an activity-employment orientated flexible, integrated, multi-media education industry encompassing an infinite variety of subjects and activities facilitating a concomitant increase in the pleasure threshold and content of all paid activities to a level where work and leisure become synonymous, and thus the displacement of the traditional Protestant/Puritan work ethic by an activity/leisure orientated ethos.

These sentiments were enthusiastically echoed in a conversation I had with Ron Pickering, former British Olympic coach and currently a sports writer and BBC television sports broadcaster, in September, 1983. He believes that only through the radical and innovatory development and expansion of the educational/sports/activity process can we adequately restore the dignity and self-esteem of increasingly unprecedented numbers of unemployed.

I would suggest that voluntary technological saturation could be achieved perhaps by 1989-1994; compulsory technological saturation (for economic survival in the international market) will probably be reached by around 1994-1999. The radical pessimistic approach exemplified by voluntary technological saturation would probably indicate, perhaps as I have outlined, the development of some form of education activity-employment industry and a concomitant activity/leisure orientated ethos.

The conservative optimistic approach exemplified by compulsory technological saturation will regrettably, I feel, indicate the perpetuation of current policies: an exclusive

emphasis on microelectronic technology itself and no social debate on the potential and desirability of attitudinal change, the retention of the work ethic, mass unemployment (potentially, I believe, 10-12 million by 1994-1999) and the concomitant inevitability of mind deadening boredom, misery, frustration and massive social disruption.

Throughout this thesis I have suggested and advocated the development of a leisure income as a mechanism for providing personal financial security. I would envisage perhaps an amalgamation of current infinitesimal education grant, Unemployment Benefit and Supplementary and Pension Allowance into one single, substantial leisure income package. This could consist of some form of sliding scale activity-employment income rising from a base of personal financial security for those who wished to opt for the activity/activities of their choice, to a level perhaps 100, 200, 300, 400 per cent etc. higher for those vocational, dangerous, and unpleasant activities generally regarded as being of premier social value. Such an activity-employment leisure income could be linked to a free education industry (at all levels), free medical services, free telephone services and several sponsored social welfare programmes, public works and development plans - all financed perhaps via a combination of government, CBI and TUC approved income re-distribution and a compulsoy microelectronic technology revenue/tax on company/organisation profits. Microelectronic technology could in effect be Britain's wealth equivalent to Kuwait's oil riches as suggested in Malik' (23rd December, 1982) Kuwaiti Solution example. (See Appendix 1). The vast majority of Kuwaitis do not work - labour is imported: the vast majority of Britons need not work (in traditional employment) yet could still be 'employed' in the activity of their choice within an education industry facilitated by the wealth created through the implementation of microelectronic systems.

If traditional, low status, low income work such as the

delivery of milk and post, the collection of refuse and the driving of street cleaning vehicles etc. defy automation (although I would envisage the automation of even these tasks via 'intelligent' super-robots and sensor/camera regulated driverless vehicles) then the specific activity should be transformed into a labour intensive, high grade, high income vocational activity. Those involved could become second-line, supplementary social workers and welfare specialists in their own right. They could receive extensive training in delivery/collection and social interaction skills. Because the activity would be labour intensive, the individuals would 'work' perhaps 2-3 hours per day (possibly on a rota basis) or longer if they so wished, and could therefore integrate and supplement their primary delivery/collection duties with home visits to anyone who might require assistance, friendship, companionship or just a 10 minute chat.

Clearly, this is an extremely complex issue. Further analysis (although restricted by lack of space) should in any case be conducted by economic specialists. I am not an economist, but feel that the aforementioned outline could be developed and deserves further extensive research by a fiscal specialist and could form an entirely separate thesis in its own right.

Looking towards the future, as I outlined in Chapter 8, within the next 10 years I could envisage the development of a flexible, multi-media, integrated, home-education-entertainment-information communications system.

The HARDWARE could consist of a communications console accommodating:

(1) An integrated television, video recorder, video disc machine, a talking (via human digitised voice) super-micro-computer, super-workstation, super-word processor; and hi-fi/audio stereo system.

(2) Television, video and hi-fi controls.

(3) A computer keyboard, voice recognition sensors and thought recognition touch sensors.

(4) Video/audio cassette/disc and floppy disc drive inputs.

(5) Small screen video phone.

(6) Video camera and microphone for two-way audio-visual communication.

(7) Laser-printer.

The console could be linked to a flat television screen (of virtually any size 1-100 inch) providing high definition, digital (as opposed to 1984 analogue technology), 35 millimetre film, picture clarity with an integrated stereophonic sound system. The screen would be touch and voice recognition sensitive, have a split-screen capacity allowing several channels to be displayed and monitored simultaneously and the facility to zoom-in on specific sections of the screen.

The SOFTWARE could consist of:

(1) CABLE AND SATELLITE SUBJECT/ACTIVITY CHANNELS: for teaching, advising, coaching, learning, enjoying, participating in, etc., virtually any academic, leisure subject/activity. Channels accommodating an infinite variety of subjects/activities as diverse as astronomy, athletics, bingo, computing for fun, conservation, cricket, fishing, gardening, German conversation, golf, jogging, keep-fit, medicine, ornithology, photography, physics, preventative medicine/health care, skating, skiing, sociology, social psychology, tennis, wine appreciation/making, etc. (See subject/activity list Chapter 9). Fibre optic communication could facilitate in excess of 15,000 interactive television channels and Direct Broadcast Satellite (DBS) communication, via a one-metre parabolic dish aerial (£150-250),

or, by the year 2000, a 3 foot square waveguide antennae programmed via a home computer to automatically receive and transmit the strongest, interference-free DBS signals, which could facilitate 150-300 interactive television channels from, and to, anywhere in the world. Theoretically, almost every specialist subject/activity (two-way or one-way communication) could be accommodated on its own individual television channel.

(2) BBC1, BBC2, ITV, CHANNEL 4: Teletext (BBC1 and 2: Ceefax, ITV and Channel 4: Oracle) and Videotext (British Telecom: Prestel) information and entertainment services.

(3) FEATURE FILM CHANNELS: (a comprehensive choice of film entertainment):

Cable: The Entertainment Network (TEN): The Movie Channel, Television Entertainment Group, Premiere, etc.
DBS: BBC, ITV, Thorn EMI, Telefusion etc.

SPORTS CHANNELS: (extensive choice and coverage of majority and minority sports):

Cable: Screen Sport; Cable, Sport and Leisure; Mirror-Sport, etc.
DBS: BBC, Channel 4.

GENERAL ENTERTAINMENT CHANNELS: (feature films, sport, light entertainment, comedy, music, drama, documentaries, specialist programmes, etc.):

Cable: Thames/Granada, Mirror-Vision, etc.
DBS: BBC, ITV, Sky: The Entertainment Channel, etc.

MUSIC CHANNELS: (pop, rock, popular, classical, country and western, jazz, etc. videos, concerts etc. Non-stop 24 hours every day):

Cable: Music Box: Thorn EMI/Virgin/YTV (pop/rock), Music

Television (MTV)1 (pop/rock), MTV2 (popular), MTV3 (classical), MTV4 (country and western), Capital (popular).

NEWS CHANNELS: (headlines/features. Non-stop 24 hours every day):

Cable: BBC World Service, Reuters, The Guardian/Observer, The Times/Sunday Times, Mirror-News, Ted Turner News, etc.

CHILDREN'S TV CHANNELS:
Cable: Disney Films, etc.
DBS: BBC, ITV, etc.

ARTS CHANNELS:
Cable/DBS: ballet, concerts, opera, plays, films, arts specials.

FOREIGN TV CHANNELS:
DBS: American, Australian, New Zealand, Canadian, European, Japanese, Soviet Union.

LOCAL INFORMATION CHANNEL:
Cable: news, weather, sport, events, concerts, etc.

(4) INTERACTIVE CABLE TELEVISION SERVICES

CABLE SERVICE CHANNEL 1:
Tele-Banking: bank, building society and post office transactions. (E.g. an individual could call up his/her current and up-dated bank/building society statement/account, pay in/withdraw cash, issue cheques, etc.)

CABLE SERVICE CHANNEL 2:
Tele-Shopping: viewing, ordering, purchasing and arranging delivery of goods from Department Stores and Supermarkets, etc.

CABLE SERVICE CHANNEL 3:
Tele-Travel: holiday and travel information and booking.

CABLE SERVICE CHANNEL 4:
General Services: cinema, concert, sport, theatre guides and bookings, restaurant guides, menus, recipes and bookings. Advertising, buying and selling houses, cars, general goods etc.

CABLE SERVICE CHANNEL 5:
Electronic Mail/Publishing: the transmission of electronic data via a vast network of fibre optic cable computer and telephone links. E.g. personal, OHMS, electricity, gas, water, telephone, rates correspondence and transactions. Electronic encyclopaedic local, national and international data bases, (electronic libraries) accommodating fiction and non-fiction books, infinitely larger than conventional paper libraries; international, national and local newspapers and periodicals could all be accessed in their entirity (or simply the required sections) and relayed via the screen or 'hard copy' (including colour photographs) high definition print-outs via a line or laser-printer. Moreover, direct electronic publishing: newspapers, periodicals, books etc. via super-word processors, super-micro-computers and/or super-workstations and fibre optic and/or Direct Broadcast Satellite communication.

CABLE SERVICE CHANNEL 6:
Specialist Advice, Expert System/ Knowledge Refining: an encyclopaedic data base of jargon-free composite knowledge, information and experience gleaned from medical, educational, social welfare, financial, legal, marriage, sports specialists etc.

CABLE SERVICE CHANNEL 7:
Home Security: direct link to the police.

CABLE SERVICE CHANNEL 8:
Polls Voting: European, national, local issues, interactive access to political discussions etc.

(5) PERSONAL VIDEO/AUDIO/COMPUTER SOFTWARE CASSETTE/DISC LIBRARY: entertainment, education, activity, sport, information tapes and discs.

(6) PERSONAL HOME VIDEO RECORDING, 35 MILLIMETRE FILM/VIDEO STILL PHOTOGRAPHY LIBRARY.

(7) INTERACTIVE COMPUTER SOFTWARE CHANNELS: Sinclair, BBC/Acorn, Apple, IBM, etc.

(8) COMPUTER CONTROLLED (VIA PORTABLE, CALCULATOR SIZED, REMOTE CONTROL CONSOLE OR VOICE RECOGNITION) HEATING AND LIGHTING; AND SECURITY SENSORS.

Such a communications system could facilitate comprehensive choice and encourage the extensive development of the particular activity or activities concerned. For example: people interested in jogging, keep-fit and ornithology could have their enthusiasm and fascination heightened by watching and interacting with, numerous specialist programmes, seminars and lectures etc., which could prompt participation in the activity itself, i.e. individually, with family, friends and/or joining the respective clubs. Or, if the individual so wished, he/she could simply become an 'armchair enthusiast', or perhaps enjoy some combination of all the aforementioned options.

(The communications system could be financed via a combination of individual subscription, (i.e. pay-per-view), multi-national corporations, company groups and international government sponsorship etc.).

The activity-employment created, via this technology, would be principally in the enormously wealth creating area of software production: acting, writing, broadcasting etc., in fact those activities with a high level of work-leisure synonymity, as outlined in Chapter 3.

Furthermore, within the next 20 years, I could envisage the

development of battery or solar-powered portable micro-communications consoles - brief case, pocket calculator and wrist watch sized versions of the aforementioned flexible, multi-media, integrated home-education-entertainment-information communications system.

The portable micro-communications console would have a digital, brilliant, high definition liquid crystal display (LCD)/electroluminescent flat screen, an appropriately scaled down keyboard (pin-head touch-sensitive pads in the case of the wrist watch version operated via an ultra fine optical laser-pen) or voice/thought recognition sensors, micro-cassette and disc drive inputs for 1-3 inch micro-video/audio cassettes/discs and 1-3 inch diameter Winchester micro-laser-hard discs (capacity 1 million billion characters, average access time 0.0005 attoseconds) and an in-built laser-printer and micro-waveguide antennae. It could therefore be possible to watch 'Never Say Never Again' and/or 'Local Hero' via cable television, 'The Day of the Jackal' and/or 'Chariots of Fire' via micro-video cassette/disc, participate in an academic seminar at the University of California via interactive satellite television, watch an international music festival live from Sydney Opera House via satellite television or write a paper or book via the micro-computer, workstation or word processor whilst relaxing on a Lakeland hillside in Cumbria.

Moreover, projections calculated by the 'Delphi' forecast group (1973) at the Stanford Research Institute, Sir Clive Sinclair and Sozaburo Okamatsu of Japan's Ministry for International Trade and Industry have suggested the following:

Table 18: MICROELECTRONIC TECHNOLOGY PROJECTION TABLE

	Prototype Date	Commercial Date	
Automatic Identification System	1976	1977	(achieved)
Industrial Robot	1976	1977	(achieved)
Automatic Diagnostician	1977	1978	(achieved)
Voice Recognition System	1978	1982	(achieved)
Talking Micro-computer	1978	1982	(achieved)
Electric Car	N/K	1984	
Microprocessor Controlled Artificial Organs	1980	1990	
Talking Typewriter/ Word Processor/Workstation	1982	1987	
Robot Tutor	1982	1987	
Automated Intelligence System	1985	1989	
Intelligent Thinking, Talking Computer	1990	1995	
Robot Chauffeur	1992	2000	
Robot Domestic Servant	1992	2003	
Totally Automated Personal Vehicles (controlled via intelligent computers and capable of speeds in excess of 200 m.p.h.)	1994	2005	

(Source: a compilation of Shaw, 3rd June, 1981, Microelectronics and Society, unpublished Post Graduate Certificate of Education treatise, typescript, p.23; Sinclair, 21st November, 1983, in Rook, 21st November, 1983, Daily Express, p.9; Sinclair, 24th April, 1984, The Guardian, p.17, and Okamatsu, October, 1982, in Boraiko, October, 1982, National Geographic, p.445).

All the previous hardware/software outlined in the communications system/console account and in aforementioned micro-technology projection table have either already been developed or will probably be developed within the next 10-20 years and is therefore an approximate indication of a potential microelectronic technology futuristic developmental time-table.

As indicated earlier, my analytical research into the effects of microelectronics on employment and education, the conflicting opinion and evidence, the latest international research and development, the actual and potential effects of computerised automation upon a comprehensive range of numerous occupations and personal case study research has led me to the conclusion that the radical pessimistic argument overwhelmingly outweighs that of the conservative optimists both in terms of persuasive argument and evidential illustration.

Unless we quickly begin to debate the effects of microelectronic technology on employment and education emphasising the potential and desirability of simultaneous technological and attitudinal change, I fear that the disastrous consequences of the conservative optimistic approach will prevail. We have an unprecedented opportunity to eradicate permanently the Protestant/Puritan work ethic, to develop an activity-employment self-actualising education industry, an activity/leisure orientated ethos and thus lead the world in social engineering. It is an opportunity we should not waste.

The intention of this thesis was to enhance the two-fold argument for simultaneous technological and attitudinal change by persuasive advocacy, evidential illustration and by promoting further, extensive and lively discussion. I hope I have succeeded.

CONCLUSION*:

In addition to the source references already quoted the previous account was based upon information gleaned from:

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