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Computers: Their Human and Cultural Impact

In January 1983 the cover of TIME magazine featured not the usual photograph of the Man of the Year but an illustration of the Machine of the Year: the personal computer.

TIME's cover was a dramatic illustration of how the computer, in only six or seven years, had entered the everyday world of the average American. The computer was becoming ubiquitous and commonplace, as familiar a household item as television set and telephone.

But the TIME cover reminds us that the computer is more than a mere consumer durable. According to TIME the "greatest influence for good or evil" in 1982 was the computer. In the popular imagination the computer is more than a mere machine; it is a potent force actively shaping our social and private lives.

What does the assimilation of this powerful machine into daily life mean for the lives of individuals and societies? How will people in various countries and cultures, not to speak of different generations, come to terms with the computer at work, at home or in school? Will contact with computers encourage people to think differently about themselves, their cultures, and their world? How will people in a computer-rich society differ from their forebears or their contemporaries in other less industrialised countries? What effects will the computer have on communication, on work and leisure?

This issue of TRENDS highlights research which has begun to explore such questions. A future issue will consider the computer and its place in education.

REVIEW ARTICLE

Redefining The World: The Computer As Cultural Metaphor

J. David Bolter. *Turing's Man: Western Culture in the Computer Age.* Chapel Hill, NC: University of North Carolina Press, 1984.

Bolter argues that the computer has become the latest "defining" technology in Western culture. Defining technologies in the past have been the potter's wheel and the loom in Ancient Greece, the clock in 17th century Europe and the steam engine in the 19th century world. These technologies, like the computer today, provided key cultural metaphors which helped people explain themselves and their world.

The Computer as a "Defining" Technology

The Ancient Greeks, for example, drew upon the familiar principles of manual technology to think about their cosmos. Plato imagined the heavens revolving around a "spindle of Necessity". Descartes and his followers found in the pendulum clock a metaphor and model for a mechanistic universe: a mechanism designed and set running by a divine "clockmaker". In the 19th century the dynamic technology of steam encouraged thinkers and writers to consider the universe as a gigantic "heat engine". According to Bolter the computer in modern culture is helping "redefine" the world in two major ways. First, its capacity to simulate human thought is stimulating people to reconsider what they mean by thinking, and secondly, the inherent constraints and limitations of computer technology are encouraging people to rethink the ideology of progress.

Computers and Human Beings as Information Processors

Computer programs can mimic the versatility of the human mind as no previous mechanism could do. Computers can not only perform "command and control" functions beyond the capabilities of human operators, (e.g., in coordinating the thousands of decisions required to launch a space vehicle); they can also capture the essential elements of human expertise in a particular discipline or field of work. There are computer programs (so-called "expert systems") which in medicine, for example, can provide doctors with reliable diagnoses of specific diseases, while the chess-playing computer has become a commonplace consumer toy.

The success of the computer in simulating thought processes helps

explain why it has come to serve as a metaphor for the human mind or brain. Some psychologists, for example, speak of the brain as a combination of hardware and software and of thinking itself as the processing of information. Just as Descartes and his followers thought of the material world in terms of clockwork mechanisms, so modern thinkers understand both living organisms and complex technologies in terms of information processing systems. For some thinkers human beings and other life forms are carbon-based information systems; computers are silicon-based information systems.

Artificial Intelligence: Do Machines Think?

Such a belief is most clearly expressed by the followers of English mathematician Alan Turing, who in 1950 considered the question whether machines could think and initiated the discipline known as "artificial intelligence". Turing did not answer his question directly but instead proposed the following test. Imagine an experiment in which one room contains a computer and another a human being. From a third an interrogator tries to find out which is which. If the answers the interrogator receives are such that it is impossible to tell computer and human apart, on what basis do we ascribe intelligence to the human and deny it to the machine?

Whatever the answer, from Turing's point of view the test establishes a common framework within which the behaviour of human and machine can be described. The functional equivalent of intelligence is, for all practical purposes, intelligence. If computers can simulate perfectly intelligent behaviour then it makes sense to speak of machine or artificial intelligence. Today those who accept Turing's answer can be said to have made a radical break with Western tradition which asserts the unique and superior status of human beings vis-a-vis their technological creations.

The Limited World of the Computer

The computer provides a metaphor not only for thinking about human intelligence, but also for considering the relationship of mankind to the natural world. The internal world of the computer is a limited and finite one, and the computer engineer is constrained by his materials in a manner reminiscent of the craftsman of the Ancient World. Consider, for example, the computer's greatest strength, its capacity to solve mathematical problems requiring enormous numbers of rapid calculations. The computer imposes limitations by requiring its users to interpret their problems in terms of space: the amount of electronic storage (physical space) and logical structure. Even the fastest, most powerful computer is limited in comparison with a human mathematician by its inability to cope with concepts (e.g. infinity) that cannot be reduced to a series of electronic pulses.

Turing's Man: Loss and Gain

The attitudes engendered by the computer have both positive and negative aspects. On the positive side an awareness of the need to conserve natural resources and manage them more intensively is a welcome change from technological hubris. On the negative side a functionalist and limited view of human beings and their capacities devalues the human spirit. Bolter argues that the age of "Turing's Man" will need to emphasize uses of the computer which serve rather than replace human talents and abilities. He thinks, for example, that we should abandon the pursuit of the chimera of machine translation. Instead of trying to do badly what people do well, the computer should be used to provide the information which will enable human translators to do their jobs better.

The History of US Computing: the Dynamics of Technological Change

John. M. Staudenmaier, S.J. *Technology's Storytellers: Reweaving The Human Fabric.* Cambridge, MA: London: MIT Press, 1985.

Bolter's concept of the computer as a "defining" technology prompts one to ask two important questions. First, what are the historical processes by which a technology achieves such a central place in a society as to be considered "defining"? Secondly, how is this "defining" function experienced and articulated by individuals and social groups within the culture?

Technical Designs in their Cultural Ambience

The remainder of this review will be taken up with research that, from a variety of perspectives, grapples with one or other of these questions. None of this research has a developed theoretical model of the relationship between a technology and its cultural context which might serve to explicate precisely how, why and to what extent the computer is a modern "defining" technology. Historian of technology, John Staudenmaier, however, has developed a model which offers one way of unifying research on the cultural impact of the computer.

Staudenmaier's *Technology's Storytellers* is a study of the emergence of the history of technology as a distinct academic discipline in the USA. It tells the story of the genesis and birth of the Society for the History of Technology (SHOT) and analyses the scholarly articles which appeared in SHOT's journal, *Technology and Culture*, between 1958 and 1980. From this analysis of the language, themes and methodologies employed by historians of technology, Staudenmaier is able to show how difficult it has been to integrate technology and culture into a "contextual history". In particular historians have had difficulty in freeing themselves from deeply ingrained tendencies to treat technology as a quasi-autonomous force or as an agent of inevitable "progress".

Technological Change: an Interpretative Model

The interpretative model proposed by Staudenmaier is explicitly designed as an assault on "progress talk". It is built around the concept that every technological design is also a cultural artefact which expresses specific cultural values, choices and purposes. No technology can be considered either autonomous or value-neutral. Three stages in the development of any successful technology and three related constituencies of interest are identified in the model.

Staudenamier proposes that each technology passes through a design stage, a stage of momentum (when the technology becomes accepted and "takes off"), and a stage of senility (when the technology is out of phase with its cultural ambience). Associated with the design stage is a design constituency which promotes the new technical design, and with the momentum stage a maintenance constituency which acts to support the technology's present and future operation. The third constituency is composed of the "victims" of the technology, and is known as the impact constituency.

The manner in which these developments and stages interact in relation to computer technology is revealed clearly in the following studies by Stern, Fisher et al., Freiberger and Swain, and Mattelart and Schmucler.

The US Computer Industry: the Design Stage

Nancy Stern. *From ENIAC to UNIVAC:An Appraisal of the Eckert-Mauchly Computers.* Bedford, MA: Digital Press, 1981.

There is a moment in the history of every technical design when it is not yet the source of further technical or social change. This is the *design stage*. It is characterised by flexibility as the technology's later adoption or specific design constraints are neither inevitable or obvious. The source of an original design is an individual or group which can be called the *design constituency*. This constituency influences the emerging technical design through its technical expertise, but also through its relationship to social, economic and political pressures, and its particular world view and value system.

Word War II and the First Digital Computers

The electronic digital computer is a child of World War II. In Britain the first electronic digital computer (COLOSSUS) was operational by the end of 1943 at the code-breaking establishment of Bletchley Park. Around the same time, 1943-1946, John Mauchly and J. Presper Eckert at the Moore School of Engineering at the University of Pennsylvania were developing ENIAC, the world's first fully operational large-scale (100ft long, 10ft high, 3ft wide and containing 18,000 vacuum tubes) electronic digital computer. Later Eckert, Mauchly and mathematician Johann Von Neumann, developed the first stored-program computer, EDVAC. This was the first computer in which programs did not have to be fed into the machine each time it was used.

Stern's study makes it clear that the dominant element in the ENIAC design constituency was the military. ENIAC was designed to help the Army Ballistics Research Laboratory solve the computations involved in providing firing tables for new artillery. Established scientists acting as government advisors were on the whole sceptical of the ENIAC project, either because they were committed to other computer designs or because they believed ENIAC was a scientific or technical impossibility. By contrast, the military were unhampered by such prejudices and ready to back any research which might eventually help solve military problems.

Technological Momentum: The IBM Era

Franklin M. Fisher, James W. McKie and Richard B. Mancke. *IBM and the US Data Processing Industry: An Economic History.* New York: Praeger, 1983.

The flexibility of a technology's design stage gradually gives way to design rigidity. Each decision in the design process closes more options as a single pattern begins to take shape. Once the design is complete the perceived costs (technical, economic, social, or political) of introducing major alterations tend to assure that innovations are enhancements to the existing structure. This combination of design rigidity and the difficulty of stopping or changing course constitutes the stage of *technological momentum*. As the technology becomes embedded in its cultural context it begins o exert an influence on that context. A *maintenance constituency* emerges of individuals, groups and institutions which have adopted the technology, adapted to its constraints, and are dependent upon and profiting from its operation.

IBM Enters the Computer Business

The work of Fisher et al. is, in terms of the Staudenmaier model, a detailed account of technological momentum in the US computer industry between 1950 and 1980. Their economic history of IBM highlights its role as the major industry actor in the maintenance constituency that supported and promoted business computer use.

The demand for IBM's office machinery in World War II changed it from a $40 million company into a $140 million corporation, but it took the Korean war to bring IBM into the general computer business. Tom Watson Snr and his senior managers believed that only a few large scale (*mainframe*) computers would be bought by government, universities and some corporations. The military demand for computers during the Korean War, however, persuaded IBM to build its Defense Calculators 701 and 702. These proved so profitable that IBM developed the first mass produced general purpose computer, the 650. Planned as scientific computer the 650 proved unexpectedly attractive to business and so alerted IBM to the existence of a new and unforeseen commercial market.

Promoting The Use of Computers

Once IBM had identified the business computer market, it quickly became the dominant force. By 1956 IBM had 84.9% of the domestic business market. This position was achieved because IBM made computers its principal business before other corporations like Rand, GE, Burroughs, NCR, RCA and Honeywell. IBM realized early that it was good business to ensure that the computer maintenance constituency was built upon the widest possible base and so it sold data processing applications and not simply computer hardware. At the end of 1970 IBM had world revenues of over $7.5 billion and 35,000 systems installed in the US.

The technological momentum of the computer industry and the widening of its maintenance constituency embedded the large computer in US government, academia, and business. By 1970 the US government owned 5,277 computers and agencies like the National Security Agency and NASA (National Aeronautics and Space Administration) actively promoted computer technology. By 1964, encouraged by government and by computer companies' educational discounts, there were 400 computers in colleges and universities.

Personal Computers: A Response to Technological Senility

Paul Freiberger and Michael Swaine. *Fire in the Valley: The Making of the Personal Computer.* Berkeley, CA: Osborne/McGraw-Hill,1984.

Staudenmaier argues that the inherent structural rigidities of any technical design will eventually produce tensions between it and its cultural ambience. When the emergence of radically new technologies or shifting value commitments begin to render the echnology's normal operation unacceptable or impossible, the technology has reached the stage of *senility*. At this stage the maintenance constituency is forced to act, either to try to force the cultural ambience back into conformity with the technology or to find its way to a new design stage. The extent of its success or failure will be seen in the success or failure of rival technical designs and their associated constituencies.

The story told by Freiberger and Swaine illustrates how, by the mid-1970s, mainframe and minicomputers had reached the stage of technological senility for a large number of people. This technological senility prompted the emergence of a new technical design (the microcomputer or personal computer) and a new design

constituency. In turn these developments forced the existing computer industry maintenance constituency (IBM and other companies) to adapt their business strategies. The Freiberger and Swaine study ends at the point at which the maintenance constituency has begun to integrate the new technical design into the established industry framework.

A Counter-Cultural Design Constituency

In January 1975 an unknown US computer company called MITS offered for sale the Altair 8800, a small computer built around the 8080 microprocessor chip. The Altair came in kit form and sold for just $397. Its appearance launched the personal computer industry, by the end of 1975 microcomputer companies were springing up everywhere. A software industry developed and the first computer games (e.g., Star Trek, Micro Chess and Atari's PONG) appeared.

The personal computer design constituency was linked by a network of computer clubs, of which the most influential was the Homebrew Computer Club in Menlo Park on the edge of California's so-called Silicon Valley. Homebrew members were young computer engineers brought together by a fascination with the new technical design and a dissatisfaction with the existing organization of the computer industry. They believed existing technology was too impersonal, large-scale, centralized and managed by a "priesthood" of technicians, engineers and data processing managers. The hobbyists wanted a counter-cultural transformation in which computers would serve human needs before corporate profits. Many microcomputer companies formed in the next few years were imbued with that philosophy and idealism.

Personal Computers for a Mass Public

In 1977 came the Apple II computer. Apple Computer had been founded by Steve Jobs and Steve Wozniak, who epitomized the counter-cultural spirit of personal computing. Steve Jobs showed quickly he had entrepreneurial flair, too, as the Apple II became the first personal computer to be sold as a consumer item for the general public. The name Apple was a counter-cultural statement (computers are a "natural" technology), which rapidly became a marketing ploy (computers are easy to use, and friendly). In addition the growing availibility of business software extended personal computers into the small business market. By 1981, Apple employed more than 1500 people and had worldwide sales of $300 million.

The success of Apple persuaded the established computer companies to enter the personal computer market. The arrival of IBM and other corporate giants signalled the counter-attack by the established computer maintenance constituency. In 1981 IBM announced the IBM PC, a name meant to assert that the IBM personal computer was the de facto industry standard. Very quickly the once diverse personal computer market became dominated by IBM and machines which claimed to be IBM compatible. Counter-cultural ideals gave way to corporate marketing. Of the personal computer pioneers only Apple held on to a substantial market share, and even it became just another large corporation.

The Computer Impact Constituency: Winners and Losers in Latin America

Armand Mattelart and Hector Schmucler. *Communication and Information Technologies: Freedom of Choice for Latin America?* Norwood, NJ: Ablex, 1986.

The third constituency identified by Staudenmaier is the *impact constituency*: that set of individuals, groups and institutions which lose because of the success of a particular technical design. Members of this constituency may be both victims and beneficiaries at the same time. Women workers in the semiconductor assembly plants of South East Asia, for example, may be exploited compared to their counterparts in the industrialized world but are comparatively well off compared to other women workers in the Third World. The views and interests of the impact constituency tend neither to be perceived nor taken into account by members of the design and maintenance constituencies, unless they, too, are adversely affected by unintended consequences of the original technical design, e.g., workers in the computer industry who find their jobs replaced by computer-controlled robots.

In the field of computing, as in many other areas, the Third World provides some of the clearest examples of impact constituencies. A recent study of a whole region as an impact constituency is Mattelart and Schmucler's analysis of computerization in Latin America.

Technology Transfer and Technological Momentum

Mattelart and Schmucler are convinced that technological choices are political choices. A truth they claim is constantly being obscured in Latin America. Computers are presented to the public as technological necessities, as the obvious solution to a variety of administrative, economic and even educational problems. In this context Mattelart and Schmucler draw attention to the efforts of IBM to win acceptance for the computer, not least by promoting professional computer studies. Between 1974 and 1980, for example, IBM in Latin America gave computer studies scholarships to 520 students.

IBM, like other multinational computer firms, wants to open new computer markets by accelerating the transfer of computer technology. Technology transfer in this instance means no more than the extension of technological momentum from the industrialized world into another culture. Instead of being able to build their own design constituencies and develop their own technical designs, Latin American countries find themselves the recipients of technologies forged in the US. Only Brazil has made a significant effort to control and mitigate the effects of this technology transfer in the computer field by using trade controls to protect its home computer firms from foreign competition.

Computer Rhetoric and Computer Reality

The public needs to distinguish between the rhetoric and the reality of computerization, a confusion well expressed in the case of the microcomputer which the maintenance constituency claims will help disperse and diffuse economic and social power. This maintenance constituency is composed of banks, airlines, government offices, the military and big business, especially subsidiaries of multinational corporations. Mattelart and Schmucler argue, however, that microcomputers are essentially tools for corporate business and government. The rhetoric of decentralization camouflages computer uses which help increase administrative centralization and reinforce economic concentration. The first computer in Latin America, for example, was installed in the Venezuelan offices of the Creole Petroleum Corporation, which became the launching pad for computer expansion throughout the country.

Brazil's development of a domestic computer industry means that it has the greatest number of home-produced computer engineers and programmers in Latin America. Mattelart and Schmucler observe that some of these technicians are now questioning the direction and control of government computer policies. This questioning is significant because these technicians are a key group in the computer maintenance constituency. The technicians are in a position to inform and educate the public about the political and social choices which need to be made if computer technology is to be socially beneficial.

Computer Cultures: Thinking Through and Living With the Machine

Historical and socio-economic research helps clarify the social and cultural context in which the computer became available to act as a "defining" technology, but it does not explain how and why the computer has been appropriated as a "defining" technology. Research is needed which probes the perceptions and behaviour of particular individuals and groups within the design, maintenance and impact constituencies. This section reports on such research in the fields of communication studies, anthropology and psychology. Chen and Paisley report research which examines how computers are entering the lives of children and Sherry Turkle attempts an ethnography of emerging computer cultures.

Extending the Computer Culture: Computers at Home and School

Milton Chen and William Paisley (eds). *Children and Microcomputers: Research on the Newest Medium*. Beverly Hills, CA: London: Sage, 1985.

Milton Chen notes the enduring influence of the media effects tradition in prompting research on the size and characteristics of the microcomputer "audience", the effects of violent computer games on children, and the extent to which computer use displaces other leisure time activities. Research on computer use and leisure has recognized the social importance for some children of video game playing and there is some indication that computers might compete with television viewing. Studies of computer clubs and camps show some children making friends and achieving peer group status through their computer expertise.

Children and Computers: Uses and Effects

Debra Lieberman finds that research on children and microcomputers has focused on five main areas: 1. *Learning effects* (Computer Assisted Instruction (CAI) studies, group learning with microcomputers, evaluating software for children, feedback to the student, word processing, writing and data base searching). 2. *Cognitive effects* (research on the effects of writing programs, studies of individual differences in cognitive skills). 3. *Attitudinal effects* (studies of attitudes to microcomputers, effects of computer use on attitudes and self assessment). 4. *Access and use* (studies on access and use of microcomputers in schools and in homes, and of video and computer games). 5. *Social effects* (research on the relationship of computer and video game use to other leisure activities, effects of computer use on social status and peer relationships).

Access and Use: The Role of Class and Gender

Socio-economic status is a key variable in relation to computer access and use. In a study by Watkins and Brimm in 1983 many adults indicated that they had bought a personal computer "for the children", though there was also evidence of "high-technology" households in which the computer is one more gadget along with the VCR and video game unit. Not unexpectedly children from minorities and lower status groups were found to be potential members of the computer impact constituency. They were less likely to have access to computers at home and at school than their white and wealthier contemporaries and so were seen as less well equipped for survival in a computerized world.

Computer use and positive attitudes to computing show marked bias in favour of boys. Girls could be considered a computer impact constituency. The reasons for this gender difference are to be found in lack of female role models, the tendency of parents and teachers to give boys more encouragement to take up computing, and greater access by boys to computers at home and school. In addition most computer games seem designed to appeal to boys, while teenage girls are reluctant to compete in what is seen as a male domain. However, the majority of teenage girls seem ready to take computer-related college courses.

The research on children and microcomputers suggests that, in the US at least, white middle class males are likely to be the main beneficiaries of the cultural framework within which women, minorities and the poor encounter computer technology. In this context it becomes clear that a "defining" technology may act as a stimulating and creative metaphor for the dominant segment of a culture while less favoured groups may find it alienating or oppressive.

The Subjective Computer: The Self and the Machine

Sherry Turkle. *The Second Self: Computers and the Human Spirit*. New York: Simon and Schuster; London: Granada. 1984.

The Evocative Object

Turkle regards the computer not as a "defining" technology for a whole culture but as an "evocative object" for individuals which fascinates, disturbs and precipitates thought. The computer is a constructive medium, enabling people to build private worlds, and to engage in self exploration, exploring and developing their personality, identity and sexuality. Experiences with computers become reference points for thinking and talking about education, society, politics, and human nature; the computer, in Papert's phrase, is an "object-to-think-with".

Turkle studied 200 children between 4 and 14 by interviewing and observing them. Turkle's study of children and their relationship to the computer draws heavily on her use of Piaget's stages to divide up the developmental process. There are three main stages: In the first stage, very young children tend to ask metaphysical questions as they seek to make sense of the world. They ask: do machines think? Do they feel? Are they alive?

Young children divide the world into the physical and the psychological. In this schema the computer is a marginal object which is not easily categorized: it seems to be alive and notalive; it seems to think and yet is a "dumb" machine; it thinks but does not feel. It forces children to try and define its place in relation to definitions of matter, life and mind.

Mastering the Machine

In the second stage, which begins around the ages of 7 to 8, children start to explore their competence and their mastery of the world. At this stage computer video games can become, for some children, a primary source for coping with challenges and learning to develop control over their environment. The interactive nature of computer microworlds created by video games, like rule-driven fantasy games such as Dungeons and Dragons, have a considerable imaginative attraction for certain children, mostly boys. These microworlds are fantastic, compelling and exciting, but at the same time

comprehensible and logical in terms of the underlying rules. The danger is that some children may become so infatuated with the challenge of computer-simulated worlds that they come to prefer them to the real one.

What children make of the computer and how they appropriate it vary considerably, though certain general psychological and gender differences are identifiable. Turkle studied child programmers in a number of schools and was led to divide them into two groups: the "hard" and "soft" masters. "Hard" masters, are children, predominantly boys, who work with computer programs in ways that emphasize their control and mastery of the machine's actions; "soft" masters, who are predominantly girls, tend to emphasize the aesthetic and unpredictable in the programs they write. Turkle believes that the possibilities of using the computer as an "expressive" medium may help more girls to break into the male dominance of the computer world.

Adolescent Identity and the Computer

In adolescence children become more reflective and introspective. Adolescents may use the computer to articulate and express their complex feelings about themselves, to explore a different side to their nature, and to assert control. Turkle's interviews reveal how adolescents have picked up the computer-influenced language of popular psychology (e.g., reprogramming, debugging, etc.) to analyse their own feelings and ideas.

Mastery and Transparency: The Control of Technology

Adults, who as children developed a mastery of computer programming, may find themselves entrapped by such mastery so that they fail to engage with the world of people. These adult "hackers" build instead a relationship with the machine itself. As Turkle describes it, their culture is one of mastery, individualism, and non-sensuality. Hackers delight in technological ambiguities but try to avoid amibiguities in dealing with people. One might identify hackers as belonging both to the computer's maintenance constituency and to its impact constituency. Their very commitment makes them both masters and victims of the technology.

Hackers seek to master the computer in an almost magical way: they do not want to analyze the machine itself. Many of the first personal computer owners, on the other hand, were most interested in using the computer for transparent understanding. As we have seen the first designers and buyers of personal computers were hobbyists who wanted to own computers they could put together and take apart by themselves. With the emergence of the personal computer as a consumer item that transparency has become rarer, and most personal computer users are faced with an "opaque" technology. However, even the less technically proficient owners have a sense that the personal computer is a machine they can control. For many such owners their engagement with their computer is a way of thinking through wider political and social issues about freedom and control.

Redefining the Self

The third set of adults discussed by Turkle are the proponents of artificial intelligence (AI). AI scientists relate to the computer not as a machine but as a formal system. These scientists believe they can capture in computer programs the workings of the human mind by employing self-analysis and introspection to derive the formal rules which they claim underlie all so-called "intuitive" processes. AI scientists are even willing to separate the mind from the self, maintaining that a unitary "I" or ego is not essential for thought to be possible.

These scientists,like psychoanalysts before them, are intellectual "colonizers", staking the claim of the computer program to be the new interpretative cultural metaphor which explains all aspects of the human mind. In Turkle's view this "colonization" is becoming ever more successful as AI concepts enter popular culture. Just as pyschoanalysis encouraged people to interpret their actions in terms of subconscious motivations, so now people interpret those same actions in terms of programming errors.

PERSPECTIVES ON COMMUNICATION RESEARCH

Computers and Culture: Building a New Research Tradition

In modern societies the computer is a fundamental technology. Computers provide the technological structure which orders the command and control processes of scientific, technical, industrial, military, and communication systems. The versatility and complex nature of the computer requires that it be studied in a variety of social and institutional settings.

The Computer as a Structuring Technology

A very important field for research in this context is that which considers and critiques the ways in which the computer is used to integrate people into formal organizations. The computer as a command and control technology has an influence on the way the working life of many people is structured. This is particularly true of women office workers and secretaries who are having to adapt to the rhythms set by the word processor and the desk top computer. Critical research on such topics could be used to strengthen existing studies in participatory design of technological systems.

The study of the technological dimension needs to be one that also considers the computer as a structuring technology for other media. One obvious area for further research is the influence of computer graphics technology on films and television programmes. How far, for example, are films like *Star Wars* structured around the technical possibilities of computer simulations? How does the availability of computer technology influence the thinking and practice of film and television directors and producers? How also do audiences perceive and relate to the use of computer graphics and simulations in films and on television?

The Computer in its Cultural Context

The work of Bolter and Turkle indicates that the computer's role as a "cultural metaphor" is one that demands further exploration. The concepts of "defining technology" and "evocative object" need to be tested and refined in studies which examine the computer cross-culturally and within cultures.

A major effort should be devoted to understanding the culture of the computer industry and related scientific and technical disciplines. It is after all within this cultural matrix that the basic decisions are made concerning the design of computer systems. If we are to understand better the cultural values which technical designs embody we shall need more case studies of the culture of the computer's design and maintenance constituencies.

Another important research area concerns the impact constituency of the Third World. How, for example, do different Third World cultures use the computer (which is an imported technology structured by alien values) to interpret their own cultures? What are the cultural conflicts engendered by the transfer of computer technology? How do groups within the culture perceive and react to Western computer technology? How can these cultural conflicts be resolved in a way that preserves and enhances cultural diversity? And, finally, what are the possibilities for Third World cultures to create their own technical designs adapted to their particular social and cultural context?

Overcoming "Progress Talk"

All of these proposals for research are aimed at moving the focus away from "effects" and towards the analysis of cultural values.

In a technological society there is a profound need for a sustained critical examination of the values which inform technological systems. Unless research can uncover and explicate these values people will tend to become victims of an instrumental ideology which simply assumes that technical "progress" is a good in itself. The challenge for researchers is to build a new research tradition which avoids technological determinism and in Staudenmaier's words "rescues technology from the abstractions of progress talk". That rescue can, in turn, be the starting point for thinking about ways to make our technologies better suited to the service of all groups in society.

Jim McDonnell

Current Research on Computers and Culture

AUSTRALIA

Prof John M. Bennett (Basser Dept of Computer Science, Univ of Sydney, Sydney, NSW 2006) studies the use of computers in relation to information retrieval by home videotex systems.

Dr Stuart Macdonald and **Prof Donald Lamberton** (Information Research Unit, Dept of Economics, Univ of Queensland, St Lucia, Brisbane 4067). Dr Macdonald studies the role of information in the process of technological change, especially the importance of informal contact in high technology. Prof. Lamberton is writing a new book on the economics of information.

BELGIUM

Prof Jacques Berleur, SJ and **Prof Yves Poullet** (Insitut d'Informatique, Facultes Universitaires Notre-Dame de la Paix, B-5000 Namur). Prof. Berleur is the head of the **Unite Informatique et Societe**, which reflects upon the social, economic, cultural and political impact of new information technologies. Prof Poullet is the head of the **Centre de Recherche Informatique et Droit**, which is researching computer contracts, computing and privacy, computing and legal decisions and telematics.

Gina Fierlafijn (Artificial Intelligence Laboratory, Pleinlaan 2, Building K2, Vrije Universiteit Brussel, B-1050 Brussels) studies the impact of computer technology on the media.

CANADA

Andre H. Caron, Luc Giroux and **Sylvie Douzou** (Dept de Communication, Universite de Montreal, CP 6128, Succursale A, Montreal, Qc H3C 3J7) have conducted a study of 800 adopters and 1157 non-adopters of home computers. Report in "Diffusion et Adoption des Nouvelles Technologies: Le Micro-ordinateur Domestique". *Canadian Journal of Communication*, Vol.11, no.4, (Winter) 1985, p.369-389.

CHILE

Gabriel Rodriguez (Instituto Latinoamericano de Estudios Transnacionales(ILET), Casilla 16637, Correo 9, Santiago) directs the project "Design of a microcomputer communication network between Non-Governmental Organizations in Latin America".

FRANCE

Association Futuribles (55 rue de Varennes,75007 Paris) undertook a collective study in 1983-4 entitled "What computing for what development?".

Madame J. Conquy Beer-Gabel (Centre d'Etudes et de Recherches de Droit International (CERDI), Universite de Paris 1, 12 Place du Pantheon, 75005 Paris) has published *Informatisation du Tiers Monde et cooperation internationale*. Notes et Etudes Documentaires. (Paris: La Documentation Francaise, 1984).

Henri Delahaie (27 ter Bd Diderot, 75012 Paris) continues to investigate the impact of new technologies (computers, video etc.) in the world of work.

Michel Delapierre and **Jean Benoit Zimmermann** (CEREM, Universite Paris X, 92000 Nanterre Cedex) have done a study on industrial cooperation in innovation in computing between France and the Third World.

Philippe Pascual (17 Avenue de la Fondemadran 33600 Pessac) is working on a thesis on national computing policies in Cameroon, Ivory Coast, Gabon and Senegal in relation to political power, technological progress and development models.

Christian Mullon (Institut International d'Administration Publique, 2 Avenue de l'Observatoire, 75272 Paris Cedex 6) is preparing a study for ORSTOM (Institut Francais de Recherche en Cooperation pour le Developpement) on the forms the computerization process takes in developing countries.

GREAT BRITAIN

Dr Raphael Kaplinsky (Institute of Development Studies, Univ of Sussex, Brighton BN1 9RE) has written *Microelectronics and Employment Revisited*. (Geneva: ILO, 1986).

Michael Shallis (Dept for External Studies, Oxford University, 1 Wellington Square, Oxford OX1 2JA) studies the social, physical and mental impact of computers.

SPAIN

Alberto Rosa Rivero (Universidad Autonoma de Madrid, Ciudad Universitaria, Canto Blanco 28049, Madrid) is studing the educational uses of computers.

UNITED STATES

Annenberg School of Communications, Univ of Southern California, (University Park, Los Angeles, CA 90089-0281) **Dr William H. Dutton** has co-authored with **Kenneth L. Kraemer** (Public Policy Research Organization, Univ of California, Irvine,CA 92717) *Modeling as Negotiating: the Political Dynamics of Computer Models in the Policy Process*. (Norwood,NJ: Ablex, 1985) and **Prof Ronald E. Rice** looks at the relationship between task complexity, media use habits and adoption of new communication technologies.

Prof Ronald E. Anderson (Dept of Sociology, Univ of Minnesota, 267 19th Avenue S, Minneapolis, MN 55455) researches the impact of home computer use on family interaction and social stratification. Has published on gender differences in computer problem solving.

Dr Craig Brod (1017 Postal Avenue,Oakland, CA 94610) has recently completed *Mindscopes: A Health Handbook for People Who Use Computers*, to be published by Shuei Sha, Japan, 1986.

Dr Milton Chen (Graduate School of Education, Harvard University, Larsen Hall, 4th Fl., Appian Way, Cambridge, MA 02138) studies educational technology (including microcomputers, networks, databases) use by and for children and gender differences among users.

Dr James A. Danowski (Dept of Communication,Univ of Illinois, Box 4348, Chicago,IL 60680) is developing automated methods for mapping the content of electronic mail messages.

Dr Robert Johansen (Insitute for the Future, 2740 Sand Hill Road, Menlo Park, CA 94025-7097) studies the organizational opportunities and impact of new information technologies.

Prof Sara B. Kiesler and **Dr Lee S. Sproull** (Dept of Social Sciences and Robotics Institute, Carnegie Mellon University, Porter Hall 319, Schenley Park, Pittsburg, PA 15213) are writing a book on computers and communication. A book is planned on *Computer U: the penetration and assimilation of computing at one university in the 1980s*.

Dr Rob Kling (Dept of Information and Computer Science, Univ of California, Irvine, CA 9271) studies value conflicts in computing applications.

Debra Lieberman (Dept of Telecommunications, Indiana University, Bloomington, IN 47405) investigates the social and academic orientations of children using computers primarily for programming or video game playing.

Profs. Geoffrey R. Loftus and **Elizabeth F. Loftus** (Dept of Psychology, Univ of Washington, Seattle, WA 98195) Prof. Goeffrey Loftus works on the acquisition and loss of visual information in the memory. Prof. Elizabeth Loftus is engaged in cognitive research.

Dr David Myers (Dept of Communications, Loyola University, 6363 St Charles Ave, New Orleans,LA 70118) studies computer-mediated communications play and the aesthetics of computer games.

Dr Amy F. Phillips (12648 Miranda St, North Hollywood, CA 91607) and **Pamela Pease** (Univ of S. California) are preparing a case study of computer teleconferencing in an adult education course in management.

Diana Polak (455 Washington St, No.6, Brookline, MA 02146) studies electronic mail systems and communication patterns among geographically dispersed researchers.

Dr James Rule and **Paul Attwell** (Dept of Sociology, State Univ of New York, Stony Brook, NY 11794-4356) are studying the computerization of work in business organizations.

Dr Gary W. Selnow (Dept of Communication Studies, Virginia Polytechnic Institute, Blacksburg, VA 24061) considers the impact of computers on human relationships and is studying the socio-economic aspects of the availability and access to computers.

Dr Charles Steinfield (Dept of Telecommunication, Michigan State University, East Lansing, MI 48824) with Janet Fulk (Univ of S. California) is assessing relevance of organizational theories to the study of computer-mediated communication systems.

Dr Sherry Turkle (Science, Technology and Society Program, E51-201C, Massachusetts Institute of Technology, Cambridge, MA 02139) continues to study how computation influences the formation of complex cultures, particularly in universities and corporations.

WEST GERMANY

Dr Klaus Haefner (Fachbereich Mathematik u.Informatik, Universitaet Bremen, 2800 Bremen) is studying the impact of information technology on education, models for an economy using fully automated factories, and democratic control of computerized military systems.

The Computer's Human and Cultural Impact: Additional Bibliography

General Interest

Forester, Tom. (ed.) *The Microelectronics Revolution: The Complete Guide to the New Technology and its Impact on Society.* (Oxford: Basil Blackwell, 1980) and *The Information Technology Revolution.* (Oxford: Basil Blackwell, 1985). Anthologies of significant articles on all aspects of the computer revolution. The 1980 volume has material on the technology, the microelectronics industry, economic and social implications and key articles by Daniel Bell, Joseph Weizenbaum and Hebert Simon. The 1985 volume covers AI and the fifth generation, computers in homes, schools and offices, and the consequences for work and society in general. Each volume has extensive bibliography.

Large, Peter. *The Micro Revolution Revisited.* (London: Frances Pinter, 1984) Comprehensive introduction, by a technology journalist, to the current social impact of the microchip.

Solomonides, Tony and Les Levidov. (eds.)*Compulsive Technology: Computers as Culture.* (London (26 Freegrove Rd, N7): Free Association Books, 1985) A collection of critical essays, including critiques of *Turing's Man* and *The Second Self.* Annotated bibliography.

Zorkoczy, P. I. (ed.) *Oxford Surveys in Information Technology.* (London: Oxford University Press) Vol. 1, 1984, Vol.2, 1985. Vol.1 reviews fifth generation computers, national and international IT policies, international trade issues in information and communication services, data protection, and computer teleconferencing. Vol.2 has articles on US videotex, the evolution of ISDN, fifth generation research in Eastern Europe, office systems, software and international standards.

Artificial Intelligence

Dreyfus, Hubert L. *What Computer's Can't Do: A Critique of Artificial Reason.* (New York: Harper and Row, 1972) Analysis and critique of early work in AI.

Feigenbaum, Edward A. and Pamela McCorduck. *The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World.* (Reading, MA: Addison-Wesley, 1983) The West must commit itself to research on fifth generation computing if it is not to become "knowledge dependent" on Japan in the 1990s.

Michie, Donald and Rory Johnston. *The Creative Computer: Machine Intelligence and Human Knowledge.* (Harmondsworth, Mddx.: Penguin, 1985) AI and "expert systems" will develop into "creative" computers which will enable mankind to solve problems of poverty, hunger, disease and political strife.

Ritchie, David. *The Binary Brain: Artificial Intelligence in the Age of Electronics.* (Boston: Little, Brown, 1984) AI will culminate in the "binary brain": man and computer linked via the "biochip".

Searle, John. *Minds, Brains and Science.* (London: BBC Publications, 1985) Philosophical critique of AI.

Yazdani, M. and A. Narayanan. (eds.) *Artificial Intelligence: Human Effects.* (Chichester, Sussex: Ellis Horwood; New York: Halsted Press, 1984) Studies of social implications of AI, AI and law and education, philosophical questions, and AI methods.

The Computer/Microelectronics Business

Braun, Ernest and Macdonald, Stuart. *Revolution in Miniature: The History and Impact of Semiconductor Electronics.* 2nd ed. (Cambridge University Press, 1982) Detailed history of the genesis and growth of the semiconducter industry.

Fishman, Katharine Davis. *The Computer Establishment.* (New York: McGraw Hill, 1981) Detailed historical analysis of the US computer industry to 1980, focusing on IBM.

Hanson, Dirk. *The New Alchemists: Silicon Valley and the Microelectronics Revolution.* (Boston: Little, Brown, 1982) Journalistic history of the US microelectronics and computing industry.

Hazewindus, Nico and John Tooker. *The U.S. Microelectronics Industry: Technical Change, Industry Growth and Social Impact.* (Oxford: New York: Pergamon Press, 1982) Covers applications of microelectronics technology, integrated circuit technology and products, research and manpower issues and government policies.

Kidder, Tracey. *The Soul of a New Machine.* (New York: Avon Books, 1981) Classic inside account of the development of a Data General minicomputer, and the engineers who designed and built it.

McClellan, Stephen T. *The Coming Computer Industry Shakeout: Winners, Losers, and Survivors.* (New York: John Wiley, 1984) The economic problems of the US computer industry.

Rogers, Everett M. and Judith K. Larsen. *Silicon Valley Fever: Growth of High-Technology Culture.* (New York: Basic Books,1984) Describes and analyses the businesses and people that work and live in and around "Silicon Valley". Unlike many books also takes note of those who are "losers" in the high-technology business environment.

Thomas, David. *Knights of the New Technology: The Inside Story of Canada's Computer Elite.* (Toronto: Key Porter Books, 1983) Computer industry entrepreneurs in Canada.

Computers and the Third World

Agence de Cooperation Culturelle et Technique. "Ordinateur et Developpement". *Direct,* No. 5, 1984. p.10-24. Articles on various aspects including the formation of computer personnel, computers and rural development, computers and health and computers and education.

Bennett, J.M. and R. E. Kalman. (eds.) *Computers in Developing Nations* (Amsterdam, New York: North-Holland, 1981) Considers computer policie especially in india and Southeast Asia.

Crawford, Morris H. *Information Technology and Industrialization Policy in the Third World: A Case Study of Singapore, Malaysia and Indonesia.* (Cambridge, MA: Program on Information Resources Policy, Harvard University, 1984).

International Institute of Communications. "Communications, Computing and Global Development". *InterMedia,* Vol.12, No.4/5 (July/September) 1984. Whole Issue. Articles covering all aspects of computing and its convergence with communications.

Kalman, R.E. (ed.)*Regional Computer Cooperation in Developing Countries.* (Amsterdam: New York: North-Holland, 1984).

Computers and Working Life

Briefs, Ulrich, C. Ciborra and L. Schneider. (eds.) *Systems Design for With and By the Users.* (Amsterdam: New York: North-Holland, 1983) Articles exploring a wide range of issues concerned with "participatory" design of computer systems.

International Labour Office. *Technological Change: The Tripartite Response, 1982-85.* (Geneva: ILO, 1985) Comprehensive international survey of the effects and implications of computerization.

Kaplinsky, Raphael. *Automation: The Technology and Society. (Harlow, Essex:* Longman, 1984) Offers a systematic account of automation and considers its impact on capital, labour and the Third World.

Pitt, D.C. and Smith, B.C. (eds.)*The Computer Revolution in Public Administration.* (Brighton: Wheatsheaf Books, 1984) Covers political and ethical issues arising from the use of the computer: centralization, power shifts within administration, more open or closed government.

Williams, Shirley. *A Job to Live: The Impact of Tomorrow's Technology on Work and Society.* (Harmondsworth, Mddx.: Penguin, 1985). Discusses the effects of computerization on employment and education, especially in Western Europe.

Psychology/Human Cost

Brod, Craig. *Technostress: The Human Cost of the Computer Revolution.* (Reading, MA: Addison-Wesley, 1984) People are suffering psychologically because the computer is too central in their lives.

Simons, Geoff. *Silicon Shock: The Menace of the Computer Invasion.* (Oxford/New York: Basil Blackwell, 1985) lists the possible dire consequences for personal and social life as the computer invades.

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