The Computer as Fool:

A Reconnaissance of Post-technology and Its Participants

By David C. Williams

No! I am not Prince Hamlet, nor was meant to be;
An an attendant lord, one that will do
To swell a progress, start a scene or two,
Advise the prince; no doubt, an easy tool,
Deferential, glad to be of use,
Politic, cautious, and meticulous;
Full of high sentence, but a bit obtuse;
At times, indeed, almost ridiculous —
Almost, at times, the Fool.
The Love Song of J. Alfred Prufrock — T.S. Eliot

Introduction

This essay explores three commonplaces and offers a tentative critique concerning educational use of computers. Commonplaces are platitudes or truisms which range from profound to banal. The critique is tentative because it is hesitant. It is prepared as the author's first prolonged and voluntary interaction with computers reaches denouement. Its hesitance is induced more by conflict than confusion. And there its sharing with Jeremy Bernstein's **The Analytical Engine** (1964) stops, in part because such urbanity is difficult to match.

These are the commonplaces:

1. Computers do only what people program them to do (they are neither good nor evil).
2. There are and should be no limits to possible applications of computer technology (progress, like information, is a product).
3. Everyone is going to get a computer (and everyone is going to need one).

The critique has almost nothing to do with technicial aspects of the computer revolution. Indeed, it is a source of marvel that computer technicians are reducing and expanding relatively non-vicious things in a time when the precious shrinks and horrible prospects grow with ominous rapidity. And yet, one might worry, there is a nagging relationship between the machine in computer chess and the machine prepared to program the holocaust. In each, the human is the dependent variable. That is the source of any "critique" by an organic compound confronted with inorganic invincibility.

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Remarks on the inevitable must heap themselves with disclaimers and caveats, and this look shares that burden. Microcomputers in education, computer crime, computer war, computer money, computer recreation — all share a vision of progress. And so the first and most important exception for or from critique is that one cannot reasonably plead for abandonment of all progress, dreaming of return to some golden age blend of **Excalibur, Star Wars,** and **Clash of the Titans.** Whenever it was, things really were not better "back then" anyway.

A second and related limit to critique is that almost any advance in any aspect of computer use does some good for some people of the time. Democracy revels in that process which transform the arcane to the communal. A spurious focus of computer critique is the "nefarious machine versus the noble people" argument. Attention more appropriately directs itself at unfair advantage gained by individuals and groups over others via computer mastery or control, or at iatrogenic impact of computer applications. Such occurrences are represented, for example, in implanting microcomputer contact with learners where honest effort at human interaction has not been encouraged, refined and expanded. The author is aware of the belabored objection to such a claim: computers are intended to supplement rather than supplant human interaction. To the businessmen who controlled education long before Thorstein Veblen objected to them, such a statement is only one among many appeasing Munich Agreements.

Concern for iatrogenesis — the cure that kills — invites this essay's final disclaimer: people with computer savvy must be accountable for the social consequences of applying their skill, but they cannot be held accountable for being people. It may rightly be a matter of human nature that, among the species, humankind sedulously rediscovers fascination in invention and control of instruments in its service. This is on the "plus" side of critique. Less deserving of affirmation is implementation of devices in such a manner as to obscure the process of progress and the array of human glories and fallibilities. It is one matter to intervene via machine when humans err. It is another to selectively perceive mechanical mastery as deliverance from assumedly perpetual human folly.

The First Commonplace

> The mass of data and ideas with which the individual is bombarded by the modern communications media augments the scale of his biographical designing board. Once more this has both positive and negative implications for the individual. It may give him a sense of expansiveness and freedom. It may also mediate experiences of rootlessness and anomie.
>
> Peter Berger, Brigitte Berger, and Hansfried Kellner, The **Homeless Mind** (1973, p. 76)

GIGO — garbage in, garbage out — holds an honored spot among the oldest known principles of computer programming. The axiom belies power of late-model machines which program other machines. Further, it underestimates computers' impact as inchaote, subtle, and subservient influence-wielders, partially reflecting the role of the Shakespearean fool. Reliance on the cliche that computers do only what they are programmed to do deters one from pondering effects of sustained interface with computers on learners and technologists alike. The question of what computers "do" to people is different from questions concerning socio-psychological outcomes of their programs. For learners, what does one say of encounters with computers that become either invitation to or sanctuary from and ragogical drudgery? What does it mean to become caught up in the idea that, as a vanguard breed of technological wizards, instructional developers with computers "become agents in the evolution of man" (Mitchell, 1975, p. 127)?

Tiedeman (1981) notes that computers are not essential to liberating learning and environments. Rather, a commitment to holistic education, as opposed to the training of parts, is called for. The new technology, however, is as firmly entrenched in practice as it is complementary to prevailing educational philosophy. The latter emphasizes immediacy of feedback ("reinforcement"), tangibility of objectives, and replicability of outcomes. Its hallmark is overpowering fixation on "accountability" through performance standards and, less often, performance measures. It disdains what Polanyi (1966) enunciated as the "tacit dimension" and the subtlety of interactions described by Goffman (1959, p. 2): "Many crudical facts lie beyond the time and place of interaction, or lie concealed within it."

Again, however, the matter is one of imposition by humans, not machines, which abide as silently as Kubrick's monolith, as patiently as Yeats' sphinx. "The danger," warns Ellis (1974, p. 49), "is that we will use computers to *compensate* for educational problems, thereby never coming to correct these problems." Compounding the error entails "automating a procedure that is not worth doing at all, even by hand" (Ellis, 1974, p. 47). The trap is that of the Type Three Error (Mitroff, 1980, p. 189): using computers as tools to solve the wrong problems with the greatest precision.

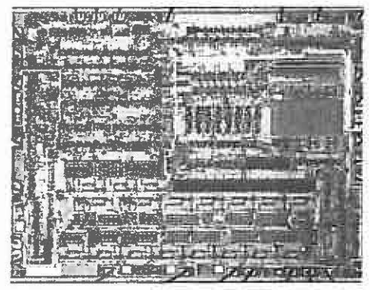
Educational machinery, like behavioral objectives, can manage the overt aspects of intended learning. But, as Dunlop (1977, p. 244) observes, much of what educators wish to be conveyed is "strictly unformulable and elusive." Beyond personal qualities, these range from "the application of moral principles to situations of real life" and "plausible historical argument" to "the ability to find the right word to describe things." The point is not that machines can assist in some of these endeavors. It is that as machines take on greater roles, humans lapse more rapidly into Skinnerian slots as occasional arrangers of contingencies of reinforcement. The UNESCO report, Learning to Be (Faure et al., 1972, p. 140), puts it this way: "One of the great merits inherent in mass media is that they relieve the teacher of exclusive concern with the transmission of knowledge and thereby enable him to pay greater attention to his mission as educator." While pondering such mechanistic dichotomization of roles, consider Jacques Soutelle's famous comment (Ellul, 1964, p. 99) on the atomic bomb: "Since it was possible, it was necessary."

Mastery of computer paraphernalia — either software or hardware — proffers an unusual invitation to the future. For the learner, recent events in the unwinding chain of computerization, especially the advent of microcomputers, could offer unparalleled modes of experience. But the transformation is even more dramatic for the programmer, designer, technician, and engineer. The mandarins of the past — industrialists and practitioners in the traditional professions — now find increasingly popular language, procedure, and environment commanded by a new class essentially beyond their comprehension. Since Comte, none of the sciences has so captured public imagination and perception of need, and all in a time of rising distrust for scientific rationality.

It is no small irony that such events unfold during eclipse of ethics of the scientific revolution. "Big science," invokes Karl Popper (1975, p. 84), "may destroy great science." As Popper decries the blurring of "scientific revolution" with "ideological revolution", Nisbet (1980, p. 340) isolates the "degradation of knowledge" as the contemporary nemesis. He borrows from William James to warn against *knowledge of* (that which is in "the common possession of all living beings" and which "describes simply the habits, adjustments, and techniques we employ in the business of living") supplanting *knowledge about* ("the province of the scholar, scientist, historian, philosopher, technologist, and others whose primary function is that of advancing our knowledge about the cosmos, society, and man").

Two issues must confront the new mandarins. The first asks, "In whose service are these new methods?" "Power in our time," observes Conor Cruise O'Brien (1967, p. 60), "has more intelligence in its service, and allows that intelligence more discretion as to its methods, than ever before in history." He warns that this event increasingly promotes "a society maimed through the systematic corruption of intelligence." The computer

NORTHERN TELECOM LIMITED



Northern Telecom filter-code chip used in advanced telecommunications **systems.**

revolution already provides new plateaus in criminality (Bequai, 1978). A more circumfluent problem is the overall role of data banks in a free society (National Academy of Sciences, 1972). While a power elite may not understand computers or computer people, they may well succeed as highest bidders for (and, therefore, manipulators of) their services.

However equitable the distribution of microcomputers, for example, the crucible must be control of input decisions. Aldous Huxley (1958, p. 5) foretold that "government through terror works on the whole less well than government through the non-violent manipulation of the environment and of the thoughts and feelings of individual men, women, and children." The demise of a critical intelligentsia (Lipset and Dobson, 1972, p. 138), its replacement with "managerial technicism" (Feuer, 1963), or the failure to enliven a new critical intelligensia with computerists in its midst, paves the way to new dimensions in both terror and manipulation. The Polish philosopher, Leszek Kolakowski, reminds (1968, p. 179) that "the less one is capable of ruling by intellectual means, the more one must resort to the instruments of force."

The second issue rests perhaps somewhere between force and manipulation. It is mediocrity, or, in education, the mediocratization of what is to be learned (Williams, 1974). Knowles (1970, p. 136) proposes that "the notion of some programmer predetermining what is desirable behavior for an individual and then controlling the stimuli and responses so as to produce that behavior conflicts with the concept of an adult as a self-directing organism." Is lifelong learning, abetted by microcomputers, to unfold as lifelong boredom? Even considering the hideous possibilities wrought of advancing research in isotope fractionation, aging, and extraterrestrial intelligence, more awesome is the failure of progress to come to grips with the Age of Leisure (Gabor, 1964). Perhaps microcomputers in education will save time principally for those who already have too much.

The Second Commonplace

> The single factor that most distinguishes the coming civilization, whatever one chooses to call it, is the subsitution of "communication" processes for traditional "work" as man's primary activity.
>
> Victor C. Ferkiss, Technological Man (1969, p. 108)

Economic and social systems in this century transformed with alarming rapidity, although the processes have been neither as alarming nor as rapid as some would like. In more developed parts of the world, organization of human effort billowed into the 1900s from an auspicious industrial base. Then came the technological society, followed by the service society, which has now metamorphosed as the information, or communication society. Economically advanced nations entered the century spurred by unchallenged faith in limitless growth. Today's information society spreads the doctrine of declining abundance and the limits to growth, except in computers.

Microcomputers represent the fastest growing area in educational technology. IBM estimates that up to "70% of its future worldwide growth potential" lies in microcomputer sales (Myers, 1980, p. 192). In business, the popularity of distributed data processing increasingly liberated from mainframe systems accounts for much of this growth. But education systems likewise revel at the prospects of such freedom. Fifteen years ago, Bowen (1966, p. 78) asserted that "computer usage will be decentralized to

the point where terminals will be available to individuals in offices, laboratories, classrooms, and homes where such usage can be economically justified." The arrival of microcomputers introduces a plateau of usage far beyond terminals, and, for some, holds the key to wholesale economic justification.

The educational technology community grasps an undaunted faith that microcomputers will not traverse the path of obsolescence so well carved by 8-track audiotapes, quadraphonic stereo, reel-to-reel video tape systems, and, probably, videodiscs. In fairness, such items probably were necessary building blocks in development. However, their diffusion throughout less-developed and middle-developed countries (LDCs and MDCs) represents as tragically pervasive incidence of inappropriate technology.

In highly developed nations, such matters as cost efficiency in educational technology might assume almost banal appearances. For example, Hershfield (1980) isolates cost as a major "systemic barrier" to technology-based (e.g. computer-assisted) courses in post-secondary institutions. Comparing such courses to human labor-intensive modes, his study detected five-year capital costs for technology-based courses to be five times greater.

The privilege of making such comparisons, without catastrophic consequences, evades most of the world. The "increasing entropy" (Weiner, 1956, p. 304) of the scientific ethic noted earlier has escorted a sense that cure for the problems of technology is more technology (McDermott, 1969). Technology, whether in education, commerce, government, or industry, is envisaged commonly as a self-correcting system. This is the altruistic, ameliorative image of a gifted "intellectual technology" (Bell, 1973, p. 26) rising to any challenge, except, perhaps, its own. That even the richest states can any longer finance such a vision attracts increasing evidence for doubt (Meadow et al., 1972).

For poorer nations — industrially and agriculturally deficient, energy dependent, and skill drained — more than doubt is in evidence. The denizens of technology and progress have dumped on this ill-fated group an array of obsolete machines and outdated gimmicks almost comic in dimensions and, unfortunately, pathetic in effect. Millions of fatal infant diarrhea cases attributed to unscrupulous "marketing" of formula in the Third World by Western manufacturers present one stark example. The substitution of television and computers for traditional forms of "mediating intelligentsia" (Gouldner, 1976, p. 168) in ideological, political, and cultural development offers another, perhaps more global case.

Some irony touches discussion of appropriateness. Reflection on the topic abounds among and within LDCs, whereas developed nations plunged into such areas as educational use of microcomputers without much attention to the parameters of appropriateness. Perhaps this is attributable to technological innovation not arising "out of thin air," as Schiller (1976, pp. 74-75) comments, but rather being "encouraged (or discouraged) by the prevailing social system . . . to achieve the objectives of the dominant elements already commanding the social scene." Allegiance to a crassly simplistic theory of market economy (promote whatever markets will bear and bear whatever markets will promote) exacerbates the scope of such conditions.

Microcomputers could be included among appropriate technologies in much of the world. Reddy (1979, p. 173) describes "appropriate" development as that which satisfies basic human needs in order to reduce inequalities, which promotes "endogenous self-reliance through social participation and control," and which increases harmony with environment. In the past, attention to technique and technology fixed on industrial and economic dimensions. Resources were so ordered as to achieve ends in those dimensions only and, as Ellul (1964) laments, were organized to their fullest capacity without regard for good or evil. Resources can be ordered in less mechanistic, more humane ways, especially when the human dimension assumes the prominence typically reserved for the magic of machines. Among other educators, Hall (1980) confronts this need in arguing for horizontal communication: that which facilitates discourse, participatory research, and action *among* rather than transmission of sterile bits of information *to*. Properly alligned, microcomputers in education might invigorate such communication. And so, while there might be limits to growth, there may be "no limits to learning" (Botkin et al., 1979). The trick, so to speak, is in willfully reversing patterns of misuse and neglect.

The Third Commonplace

> The effectiveness of a doctrine does not come from its meaning but from its certitude.
>
> Eric Hoffer, **The True Believer** (1951, p. 76)

The final commonplace concerns the inevitability of "everyone" getting a computer, either before or after "everyone" needs one. Of course, if "everyone" has or will have such a need, economy in finance and space would make powerful argument for microcomputers. But economy is not the issue here. The present concern is the ascription of need and the dimension of need.

If optimistic testimonials and fair-like hoopla are indications of need, microcomputers are about to assume their rightful place between automatic garage door openers and digital watches. At least one American company now markets a course complete with attache case-size kit for building a microprocessor/communication system. The National University in San Diego boasts programs based around an IBM 371/3031 and several microcomputers. These connect students with annotated bibliographies, research updates, key concept definitions in several disciplines, diagnosis and prescription of learning disabilities, inventories, statistical packages, curriculum ideas, and graduate student portfolios.

Bucknell University's Departmemt of Management offers an "Affordable Small Computer" course to assist in determining needs, rating different systems, selecting vendors, negotiating costs, and operationalizing a computer system. In May, 1981, the National Computer Conference sponsored in Chicago a one-day Personal Computer Fair. Planning abounds for computer-driven holograms to provide three-dimensional images for storage and display (House, 1978). Tiedeman (1981, p. 6) promotes use of guidance computers "prosthetically with the minds of learners." And from Bodington's, **Computers and Socialism** (1973), one learns that it has become necessary for Marxists to simultaneously embrace and deplore computerization.

Like wholesale educational use of pocket calculators, the urge to massively microcompute rides a wave of myopic inevitability (perhaps inevitable myopia). For some reason, it has become an automatic assumption that computer-based human communication systems (CBHCSs) are prerequisites for "flextime" (Best, 1980), "cyclic life plans," and consummate "non-linearization" of life sytles (Scher, 1980). Is it possible that people might want more "supportive interface" with each other rather than with machines?

Gelpi (1979) asserts that lifelong learning in its fullest implications will transform society. It seems that microcomputers, in turn, will transform lifelong learning. But will they transform the all-too-common political domination of what is to be learned and how one is to learn? Are microcomputers linked to lifelong adult education to offer only another form of dependence and guaranteed inadequacy (Ohliger, 1974)? For example, automated information retrieval, rather than expanding access in an egalitarian fashion, progressively limits access to those who can pay. More and more, librarians urge that information be priced according to laws of supply and demand. In the future, those who cannot pay may hope for, at best, some form of government-supported "information welfare" (Freedman, 1978).

Typical is the view (King et al., 1974, p. 35) that the ultimate "technological phase" in lifelong learning is "dependent on a much greater sharing of knowledge and experience, . . .with interchange and feedback as characteristics of widely diffused responsibility." But manipulated by it. Through simulation or whatever mode, a paramount reinfication results from promoting images of computers as "rethinking" their positions. In reality, the learner with the computer differs insignificantly from Bowers' student in traditional settings (1974, pp. 27-28): he unconsciously learns "appropriate question-asking behaviors . . . in such a way that they become part of his own perceptions." This student "is not likely to see that he has the right and the ability to make his own interpretation of appropriate question-asking behavior, and to engage in the political process of getting others to rethink their positions." Using computers "prosthetically" with the minds of learners presumes missing pieces in those minds, rather than in socio-political contingencies impacting on those possessing minds.

Conclusion

> The fear of machines is almost as old as industrial civilization. Oswald Spengler's prophecy that "Faustian Man will be dragged to death by his own machines" has never been quite forgotten.
>
> Dennis Gabor, **The Mature Society** (1972, p. 40)

Obviously, the three commonplaces discussed herein are related. Each points to the inevitability of computers and, specifically, microcomputer usage in education. These seem destined by market economy and human curiosity to permeate all aspects of educational endeavor as thoroughly as perfection and fallibility, wisdom and folly. In fact, the approaching universality of computerization may make such distinctions moot.

But saying that it has to happen may be simply crass, as crass as the blind optimism accompanying most statements on inevitability. It is crass because it detracts from impetus to resist, to criticize, to carve out a niche of viable rebelliousness. Churchman (1971) warns that, in information technology, designers design to please those who control the rewards. The very tangible rewards to which he alludes are beyond the ability of the renegade critic to dangle even momentarily as bait.

Again, one cannot invoke the computer as scapegoat. And, again, as Tricker (1980, p. 154) reveals, "the important questions, though brought into focus by the potential of computer and telecommunication-based systems, are not about computers at all." Computers are not really impartial observers; they are patient, sometimes cryptic Shakespearean fools. But the fool is not the question. The important question evolves from need for appropriate human authority patterns to link with the rising power of computer awareness. It is no good to fear, respect, smash, or adore the machine. It is one's own species that must assume a new aura.

As the inevitable marches to new heights and depths, it may borrow a not-too-distant lesson from the advent of sound films. Charles Chaplin and other producers disdained them for a time, fearing denigration of the expressiveness of acting, a demise of gesticular language (Martinez, 1979). Acting did not lose its value but adapted to a new medium. In the present case, the challenge of computers in education is who controls the modifications, producer or user.

Even if users can become producers, computers are not yet ranked among popularly endorsed mass communication forms. While this may be a disguised blessing, given the "electronic colonialism" (McPhail, 1980) so abundant in other media, the microcomputer movement may greatly benefit from considering its potential relationships with other knowledge areas. While not limited to these, proxemics (investigating the role of space in communication), mathetics (observing humans as they learn), and semiotics (studying signs and symbols and their inter-relationships) may further inform and sophisticate the drive to computerize.

The computer is a fool. The fool, Dahrendorf (1970, p. 54) suggests, "is defined by the very fact that he always acts out of character."

> The power of the fool lies in his freedom with respect to the hierarchy of the social order, that is, he speaks from outside as well as from inside it. The fool belongs to the social order and yet does not commit himself to it; he can without fear even speak uncomfortable truths about it.

As court jester of modern society, the computer makes relative all authority. It may entertain. One may ridicule it mercilessly; it will not budge. It may offer games, diversion, shortcuts, and tricks. One may come to assume its presence or availability, to be succored by its presence. The computer is a fool, and it may have, somewhere, the last laugh.

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Learning and Technology:
Dangers and Opportunities*

By Peter S. Sindell

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Introduction

Speaking to educators these days I get a strong sense of doom and gloom. Budget cuts, falling enrollments, and federal-provincial altercations about transfer payments are some of the causes of this negative tone. Educational institutions and the educators in them seem to be depressed, adrift, at a loss. They seem to be gearing down, or perhaps, winding down would be a better image. Winding down without much conscious analysis of the alternative — which is to consciously gear up for a new role in society, look ahead with excitement and energy to a new and different vocation.

Looking ahead even to 5 to 10 years — the near to medium term horizon — I assert that educators should be gearing up, not down. Why? The short answer is microelectronics. No one could accuse a humanistic anthropologist such as I am of being a blind idolator of the Goddess of technology, seductive as she may be. Yet I am optimistic because I see the ways in which the new microprocessor base technologies — microcomputers at home and at school, videodiscs, computer aided learning, satellite based learning systems and networks — all these and more can impact our schools and our citizens in a positive liberating way. Microelectronics is not a panacea but it can and will offer much to the world of education. Your fields stands to benefit the most from these new technologies if you can seize the challenge and make it yours.

You have heard a great deal, I dare say far too much for some, about the miracles of microelectronics and the ubiquitous chips on which these miracles are based. 1k, 16k, 32k, 64k bits per chip, LSI, VLSI, RAMS, ROMS — these and other technical terms are becoming common parlance. The technology is easy to get a hold of, to understand in a general way. Its implications are not.

Microelectronics is a transformative technology which is diffusing in Canada at a staggering rate. Most scientific or technological discoveries take 50-100 years before they are developed to the point of commercial viability. In contrast the microprocessor (the computer on a chip) was invented in 1971 and yet is already a multi-billion dollar industry which is affecting dramatically almost all other industries. Products using microprocessors are making possible the automation of our offices and our factories. How fast this process is going even in education is illustrated nicely by a comment Ontario Minister of Education, The Honorable Betty Stephenson, made on October 6th, 1981. She reported that an OISE Study in June of 1980 showed 649 microcomputers in Ontario schools (presumably primary and secondary only) while her ministry found 3239 microcomputers in September, 1981 an increase in a little over a year of more than 500%.

The changes coming in the wake of this technology will have so much impact on learning and on almost every other aspect of our daily lives that we can say, without exaggeration, that we are in the beginning stages of a profound revolution, an "information revolution". Controversy abounds about the effects on employment, about the potential invasion of privacy the revolution could bring, about the psychological and physical effects of living more and more with and through machines. What *is* clear at this point is that we will be searching for understanding, for the human meanings of this revolution for many years. Like chasing *butterflies* the search will take a great deal of energy, lead us into unexpected byways but, when we succeed, be most satisfying.

What I would like to explore in this paper are the two faces of this revolution — the dangers, on the one hand, and the opportunities, on the other. Because the changes which we shall see will be so pervasive they offer great risk or great promise. What we do in our daily work and life, as educators and as citizens, can and will influence the future shape and character of this revolution in Canada and in your home provinces.

Emotional and Intellectual Coping

Each of us has a role to play and we must, therefore, begin with our own feelings. Based on your feelings right now would you perceive yourself as a *technophobe*, someone who is afraid of microelectronic technology? Or are you a *technophile*, someone who feels comfortable with this technology? How you and I react to the new information machines, whether technophilically or technophobically, or some mixture of the two, will very much influence whether we accept the revolution, resist it, or reject it. In our work at GAMMA we have developed three key scenarios for an information society — the telematique, the privatique, and the rejection.

The Telematique Scenario (from the French *Tele-informatique* which refers to telecommunications-computer linkage) is characterized by a central electronic highway linking offices, homes, factories, schools, etc., the ubiquitous presence of terminals and computers in production and consumption activities, and international interconnection via satellite. In the educational context examples of the telematic approach would be networks built around databases about such subjects a continuing education courses available — where — when — cost, or jobs available for graduates (the federal employment database called CHOICE) or dial up networks offering access to specialized educational software and courseware which could be down loaded into your local microcomputer or "smart" terminal.

The Privatique Scenario is characterized again by the omnipresence of computers but interconnection via satellite and the central electronic highway is minimal. The Privatique Scenario in educational terms would imply stand alone word processors, computers — micro and maxi, and the individual purchase of, for example, VTR tapes, videodiscs. In contrast these could be ordered up telematically on line and sent to a cable compatible computer or another kind of terminal, even an ordinary television set.

The Rejection Scenario is characterized by the rejection of high-technology machines and a return to direct non-technologically mediated communication. GAMMA believes that the latter scenario ranks with the others in importance. Thus GAMMA has an ongoing programme of research which specifically concerns the person-machine interface and how this interface can be made harmonious and productive instead of threatening and destructive. This research relates to our research focus on the social impacts of the Information Society — privacy — education — employment — health — politics, etc. The other focus of the GAMMA Research Programme on the Information Society is industrial — balance of payments, industrial strategy, productivity, energy, etc.

Promoting Lifelong Learning

As I asserted before one of the most fruitful opportunities which is emerging for us all is the use of these new technologies to enrich and expand learning opportunities. With satellite transmission we are no longer bound by the constraints of geographical location. OECA and U.B.C., among others, have shown us how we may link willing learners and excellent teachers though they be separated by hundreds of miles by using this new tool, with a microprocessor managing the transponder in the satellite, time barriers too can be erased when a learner can access a computer at his or her convenience and enjoy access to data banks or CAL — Computer Assisted Learning — at any point in the 24 hour cycle of our day. Ontario and Alberta educators are leading the way in research on the potential uses of videodiscs in education and industrial traning as many other provinces explore the educational potential of Telidon. Preconceptions about the proper time in our life cycle for learning — 6 - 16, 18, 20 or 22 — must and will change.

Lifelong learning can change from being a tired cliche to a meaningful reality. The need for lifelong learning will become more and more acute as CAD/CAM, robotics and office automation are introduced by government and industry to reap the bountiful gains in productivity which they promise. The dilemma then becomes how we distribute the fruits of these productivity gains. Do we let hundreds of thousands of jobs go by the wayside with all the human tragedy this implies? Or do we seek other answers? Answers such as educational leave for everyone, regular sabbaticals for everyone, reduced working hours for the same pay, job sharing and so on. If we focus on people's needs for income — which can come from the productivity generated by the productivity by the new technology and not on saving jobs per se then, I believe, we shall be on the right track. Naturally this will require extensive cooperation between government, industry, and labor — what we have called "concertation" at GAMMA in our work on *Industrial Strategy and the Information Economy: Towards a Game Plan for Canada.*

In such a transition to a new kind of economic base educators and education will be central to a successful transition in human terms. In such a scenario we shall need both vastly improved opportunities for retraining and much greater activity in the leisure area in which adult and continuing education is a key stone.

Although Telidon cannot be used without a keyboard for truly interactive CAL, Telidon, personal computers, and microcomputers especially designed for educational uses will indubitably add up a new kind of *University of the Air*. Some have said that the epitome of the information revolution would be reached when we each can access all information in existence from anywhere at any time. Daily this rather extraordinary image is becoming closer to actualization. Already on the market there is an electronic briefcase with a built in screen, memory storage, communications capabilities, and features such as word processing. One California company even claims to have a briefcase sized satellite receiver station in the works. Many thinkers in this field have delineated the possibilities of a small plastic card which could hold and protect all of our personal medical, financial, business, educational, and other records. For those who are more Sartorial in their approach but still want the convenience of carrying their personal electronic filing cabinet, there would be neck ties like mine which hold a silicon memory chip.

Thus if I want to check a reference or see if I have paid a bill I just plug into my tie. Of course that's the opportunity side — no bulging filing cabinets taking up space, ready and immediate access via key word so you don't have to remember in which file you put any particular document, and so on. The danger is of course that others who you don't want to have

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