IN DEFENSE OF THE NAKED MIND

■

INTRODUCTION TO THE SECOND EDITION

THE COMPUTER AND GENERAL LUDD

■

There are computer enthusiasts I have met who will hear no evil spoken of the machine they hold dear. They tend to regard every critic they encounter as the latest species of "Luddite," those notorious machine-wreckers of the early industrial revolution who are remembered in the textbooks as mindless enemies of progress. For example, one reviewer of the first edition of *The Cult of Information* declared in *Business Week* that the author's views would appeal to "closet technophobes and incipient Luddites." It is a book, he said, that "caters to their hidden fears and biases about what the computer is doing to their lives."

The Luddites have come to play a peculiar role in technological history. They are usually invoked as convenient whipping boys whose function is to squelch critical discussion of machines and

their uses. Once the label "Luddite" has been attached to you, the inevitable next question is, "How would you like to go back and live in a cave?"

Historians now tell us that the original Luddites may have taken a bad rap. The hard-pressed weavers of northern England who rallied around the mythical General Ludd appear to have had no grudge against technology in and of itself; their grievance was with those who used machines to lower wages or eliminate jobs. General Ludd's "army of redressers," as they named themselves, never attacked one of the new power looms unless its owner had violated the workers' interests. Though they were desperate men fighting to feed their families, their hostility was carefully targeted. They asked how the machines were being used, by whom, for whose benefit—and then normally tried negotiating a better deal with their employers. Only when that effort failed did they feel forced to resort to violence. But to begin with, theirs was essentially an appeal for justice and humane treatment.

I am quite willing to have this book seen as a "neo-Luddite" treatise in just that sense. It belongs to that same tradition of passionate but, I hope, measured criticism. In this respect, I count myself an ally of all those serious students and users of information technology who hold a reasonably balanced view of what computers can and cannot, should and should not, do. Many of those who read the first edition of *The Cult of Information* recognized that the book, far from being a wholesale rejection of high tech, sought to discriminate between the use and abuse of computers. For example, in an on-line conference convened in 1986 on one of the country's most respected electronic bulletin boards (The WELL, operating out of the San Francisco Bay Area), there were some contributors who saw the book as nothing more than an outburst of "technophobia"; but others were sympathetic to the effort. One participant said in the author's defense,

> I'm really puzzled about why this book pissed you off so much.... He attacks the hype and the misuses of the technology, not what most of us are trying to do....Those of us who are working on what we consider humane, democratic, decentralized projects should welcome critiques which make the public more skeptical.... In other hands, with only slight variations, it could be centralist and propagandist. And the

myth that surrounds it—which is the true target of Roszak's critique—will determine how people will react.

Lest there be any misunderstanding, then, let me preface this edition with a clear statement of my admiration for this remarkable technology. Like all the works of *homo faber,* high tech, this latest chapter in humanity's ongoing industrial saga, deserves to be honored as a manifestation of the astonishingly inventive genius of our species. I use a computer to earn my way as a writer; I might even qualify as a highly proficient user. I marvel each time I boot the machine at the cunning that has found a way to translate so much of human culture—numbers, words, graphics, music, three-dimensional design, animation, fractals—into simple digital symbols that can be read as electrical signals. I am astonished at the speed and compaction that has been achieved by computational devices in little more than a generation. I can even understand how some might (though mistakenly, I think) identify an accomplishment of this magnitude as an incipient form of superior intelligence.

If there were not thousands already applauding the skill of those who have fashioned this technology, I might be the one to do it. But there are more than enough who stand ready to praise; indeed, one of the things that worries me most is the great number who are handsomely rewarded for doing so. The "data merchants," as I call them, find their careers or their investments tied to the extravagant promises that attach to computers; they have every reason to believe that there is nothing computers cannot do and should not be doing. The result has been the creation of a mystique of information that makes basic intellectual discriminations between data, knowledge, judgment, imagination, insight, and wisdom impossible.

Again, so that I will not be misunderstood: as a writer and a teacher, I admit to having a healthy appetite for information. I value having plenty of data readily available as much as the next person. *Unless,* that is, the next person happens to be a computer manufacturer, a software mogul, an advertising executive in charge of the IBM account, or an Artificial Intelligence expert under contract to AT&T. Whenever I hear vested interests like these speaking of information as if it were *all* the human mind needs to think with, I begin to feel as if I might have strayed into some strange sect where all about me I find people worshipping light bulbs. No question but that light bulbs are useful devices; I would not want to live

without them. But I never would have thought of them as objects of veneration.

So too with information. The cultlike status it has attained both bewilders and troubles me. The eagerness some enthusiasts (as well as many academics, intellectuals, and journalists who should know better) display to globalize the word until it covers all the cultural ground in sight seems to me blatantly wrong—especially when it comes to teaching the young. If they had their way, they would flatten the natural hierarchy of the mind until people cannot tell the difference between the telephone directory and Homer's *Iliad*. So in these pages I raise a small protest on behalf of the naked human mind, its creative powers, its animal resiliency, its undiscovered evolutionary potentiality, its deep enigmas of aspiration and self-transcendence. I seek to remind readers of the obvious that so often goes unobserved. There have been works of genius, indeed whole golden ages of culture—many of them the creation of peasant peoples and tribal folk—based upon nothing more than human speech, imagination, and memory. The heights of intellect and vision have been scaled by people gathered around campfires to tell stories, by poets scratching away with a quill by candlelight, by scribes bending over a sheet of parchment, by inspired painters working on the wall of a cave. There is, of course, no reason why we should not, in our time, look for other, more expressive media of communication, but I find it important to recall that mind has never been dependent on machinery to reach the peaks of achievement.

Though that reminder is not meant as a rejection of machinery, which is itself a glory of our species, I am sure some will see it as a typical humanist response to the overweening claims of the technician. Well, perhaps it is. But where high tech is concerned the disposition of forces ought to be obvious to anyone who has as much as a passing acquaintance with the shape of the global economy. High tech is the biggest thing going in the world of financial and political decision; it enjoys the unstinting support of governments and great corporations. Billions of dollars stand behind every computer chip. There is not the least chance that the most extreme humanistic critic of these machines and their makers will register as more than a minor annoyance to economic power of this magnitude. The computer establishment is the Goliath in this confrontation; before it even the most militant critic stands like David without his slingshot.

HOW ARTIFICIAL CAN INTELLIGENCE BE?

■

Since the first edition of *The Cult of Information* there have been some noteworthy changes in computer technology, as well as many wrenching transformations in the high-tech industries. Whole new waves of innovation have crested and subsided; the price of just about everything on the market has dropped; major corporate players are passing through a period of drastic restructuring. The mighty IBM has suffered setbacks that were unthinkable in the early 1980s; the long-standing Kulturkampf between elite Big Blue and populist Apple has ended with the two rivals looking more and more like partners sharing a troubled and uncertain market. In the eyes of some, the printed page is a more endangered format than ever before—and happily so; one still comes across people for whom there is no distinction between *culture* and *computer.* Yet book publishing continues to thrive as a business, and people in all lines of work continue to regard "hard copy"—print on paper—as the "real thing." As a society we are still paper bound and paper based. A decade after the front cover of *Time* magazine substituted the personal computer as "machine of the year" for its usual "man of the year," home computers, now cheaper than ever, have still not penetrated more than a third of American households. And most of those who own the machine struggle to find any more interesting use for it than typewriting, record keeping, and game playing.

Where these changes touch upon the thesis of this book in some significant way, I have sought to bring things up to date; the more important of these developments are catalogued and discussed in this introduction. But little of what has happened during recent years in the computer industry and its economics affects my main concern, which has to do with the philosophical status of information and the art of thinking, issues that contextualize the technology, in much the same way that what we take "health" to be contextualizes the practice of medicine, or what we take "sanity" to be contextualizes the practice of psychiatry. Information is what information-processing technology processes; but if we have no clear idea what information is and what it is not, what questions it can and cannot answer, what its relationship is to other intellectual faculties—

indeed, if we are not certain as to whether there *are* any other intellectual faculties besides the processing of information—then we can have no clear idea what authority this technology should hold over our lives.

One change that does relate to a major concern of the first edition has to do with the general orientation of cognitive science and research in Artificial Intelligence. As long as it was believed that "thinking" was merely some form of rapid data processing, it seemed reasonable to assume that faster machines accessing ever-greater amounts of data would one day surpass ordinary human-headed thinking. In the mid-1980s inordinate claims were still being made for the future of machine intelligence, despite the fact that all the predictions made along those lines in the past had fallen flat. Even Marvin Minsky of MIT, one of the most unrestrained proponents of Artificial Intelligence, has come round to a far more complex model of mentality. In his book *The Society of Mind*, the mind is no longer the "meat machine" he once took it to be; it has become a sort of United Nations bureaucracy, a collection of autonomous "agencies" that represent the variety of knowledge and somehow manage to form working coalitions among themselves to produce intelligent behavior. The all-important "somehow" remains far from explained.[1]

As our understanding of human intelligence deepens, one hears somewhat fewer predictions about how soon the computer will equal or surpass the mind to become the inevitable next stage in intelligent evolution on our planet. Since the human mind remains the baseline for measuring progress in the field of Artificial Intelligence, one still comes across extravagant claims about the prospects of developing near-substitutes for real intelligence—especially among those who see the best hope for AI in neural networks, a form of nonprogrammed machine learning that copes remarkably well with pattern recognition and natural language. But all the more ambitious predictions about the future of AI are being placed farther off in the future and have a more guarded ring to them. Marvin Minsky continues to tell us that we can expect to see the invention of "artificial scientists, artists, composers, and personal companions"—but it will be "over the next few generations." (Technological prognostication that extends beyond the lifetime of the prognosticator is always a safe bet.) But he concedes that AI has come upon what may be an insurmountable barrier to its effort to unlock

the mysteries of mind. It is called "common sense." I noted this point in the first edition; now I would emphasize it even more.

Almost in spite of itself Artificial Intelligence research has taught us a significant truth about human thought. We have learned that computers that can rival grand masters at chess do not have enough sense to come out of the rain. Literally. The newspaper-in-the-rain situation task I describe in Chapter 6 continues to plague AI research —to the point of finally looking like an insurmountable barrier, rather like the limit imposed in physics by the speed of light. If so, that would be a discouraging conclusion for those who regard the mind as a "barrier" that needs to be "surmounted." Simple matters like this turn out, under close analytical scrutiny, to be not quite so simple after all—at least not for a computer. Similarly, programs that are intended to master the hidden intricacies of a child's daily routines—going to school, buying candy, raiding the refrigerator, making a jelly sandwich, playing with others—continue to fail miserably. As Minsky puts it, "Experts are simpler than novices!... Whenever... children speak or play, they combine a thousand different skills." It is primarily because of the stubbornly elusive nature of common sense that the philosopher Hubert Dreyfus, one of the keenest critics of Artificial Intelligence, calls the field a "degenerating research program," a once promising paradigm that now yields fewer and fewer useful results.[2]

It seems the context for the seemingly humble mental talent we have named "common sense" is a sprawling, lifelong blur of cumulative, largely ineffable personal experience that defies formal representation. A consensus may at last be forming that true intelligence embraces the entire bewildering pattern of learning and behavior called "being human." As baffling as that pattern may be, most students of AI would now agree that it has something to do with being born, and having a body, and growing up in families, and belonging to societies, and walking around in the real world, and meeting people, and doing things, and (for all we know) having "intimations of immortality." Farther back still, intelligence may, as John Searle believes, have something to do with the basic biological constitution of the brain, an indispensable evolutionary element that eludes machine simulation.[3] In any case, there are fewer and fewer computer enthusiasts who still believe this messy, fluid field of living experience can be turned into the sort of computational "data" a machine can understand.

Though some continue to try. Bart Kosko believes that "fuzzy logic," which seeks to express the vague, grey-scale tones that lie between black and white, may one day come closer to capturing common sense.[4] Doug Linnat at the Microelectronics and Computer Technology Corporation in Austin, Texas, has similar hopes for project Cyc, one of the longest-running and most expensive AI programs ever undertaken. Cyc seeks to corral the seemingly infinite ambiguities of human language by the brute-force method of identifying and anticipating all the possibilities of machine misunderstanding. Cyc programmers are out to contextualize every connotation of every word in the English language, so that their computers can tie into an ever-expanding web of common-sense scenarios. But what Cyc may actually be proving is how unbridgeable the gulf is between human and electronic mentality. Program all the known biographical details of Abraham Lincoln's life into one of Cyc's computers and the machine comes up asking, "If Lincoln was in Washington DC on July 2, 1863, was his left foot there also?" Or, "Were all of Lincoln's children younger than him?" What we have here is a curious new form of literature, a sort of high-tech Zen Buddhist koan that jars our understanding into sudden self-awareness: questions no sane human being would ever have thought of asking.

There is an ironic but highly valuable quality to AI in all its forms. The effort to simulate or surpass human intelligence is uncovering subtleties and paradoxes about the human mind we might never have imagined. By way of heroic failures, AI is teaching us how truly strange real intelligence is. There is an intuitively immediate all-at-onceness to superficially simple everyday projects like making breakfast or going shopping that seems to have nothing to do with the formal step-by-step procedures that go into programming a computer. One field of AI, however, has made remarkable progress in elucidating the ineffability of intelligent activities like this. Often, by quizzing specialists closely about their work, computer programmers can tease out procedures, assumptions, values that can then be formally specified. The result is an Expert System, one of the few practical applications of AI. Edward Feigenbaum sees such systems as the gateway to the next era of machine intelligence; he calls it "knowledge processing," as opposed to mere *data* processing. Whatever he may mean by "knowledge," it surely represents a more complex approach to thinking than once prevailed in the field.

Expert systems are ingenious, but they remain narrowly specialized in ways that clearly leave something essential about the human mind unexplained. While individual expert programs may perform impressively in neatly defined areas like medical diagnosis, selecting stocks, or prospecting for oil and metals, no one system can be designed to do what any other system can do. Yet it is precisely such global integration that characterizes human intelligence. This is indeed what makes judgment possible: the capacity to step outside the decision and see it from a different perspective. As helpful as Expert Systems may be in many areas, in matters where judgment and personal responsibility matter (like the practice of medicine) nobody would want to rely on the machines for more than preliminary guesswork. After all, how many software firms would be willing to run the risk of medical malpractice suits if their diagnostic programs glitched?

MEANWHILE, BACK AT THE CARNIVAL...

■

On the other hand, if AI scientists have pulled back on their claims, the computer industry continues to tout its wares as flamboyantly as ever. With the Cold War and the arms race generating less budgetary support, Information-the-Science may now be less compromisingly connected with Information-the-Weapon; but it still remains embarrassingly beholden to Information-the-Commodity. So the merchandising of hardware and software remains as much of a carnival act as ever, with endless new attractions along the midway, all of them being brazenly oversold. While the price of such basic items as memory chips and hard disks continues to fall, new fascinations like desktop publishing, multimedia, and interactivity serve to keep the consumers consuming. New hardware and software constantly push toward the purchase of bigger, faster equipment and more complex programs, none of which is nearly as necessary to have, as cheap to buy, or as friendly to use as the advertising pretends. What P. T. Barnum earned by convincing everybody in the nation that they just *had* to buy a ticket to see Jumbo the elephant amounts to peanuts

compared to the billions that Bill Gates of Microsoft has taken in from sales of Windows, a big, expensive, and (in its early versions) clunky imitation of the Macintosh graphical user interface. What made so many people rush to buy Windows? Gates made it seem like the only relief in sight from the cumbersome DOS program he had foisted upon his customers in the first place.

And what, overwhelmingly, do the hardware and the software get used for outside their day-to-day business applications? The computer industry remains embarrassingly dependent upon much that is simply tawdry. Games and amusements continue to be the mainstay of the technology in the mass market. As of the early 1990s American parents were paying more for video games (over $5 billion) than for tickets to the movies. Manufacturers are hoping to increase that figure tenfold by the end of the decade by including 3-D, virtual reality, adult versions of "Star Trek" and "Yoshi's Cookies"—probably spiked with a heavy dose of pornware, or "erototronics," as it is called in *Future Sex,* a magazine that specializes in computer-mediated titillation. "Adult" bulletin boards have proven to be one of the growth areas of the technology. Advertising "A Hundred Lines of Hot Modem Fun At Your Fingertips! With Both Straight and Gay Sections," the language and imagery have grown potent enough to raise issues of censorship. Responding to police raids in some cities, system operators have addressed the question of X-rated material at conferences with some urgency. "More and more boards are including the X-rated material for a simple reason—their subscribers want it."[5] Most of these amusements are benign, if silly; some are not. In Austria kids can now purchase neo-Naziware videogames called *Aryan Test* and *KZ Manager* which allow players to run death camps and gas inferior races.[6]

Even the business community gets suckered into wasting precious resources on expensive computer digressions like chasing fonts through desktop publishing programs and cranking out 256-color graphics-laden fast-step CD-Rom "presentations" that are more sizzle than substance. One study I have come across estimates the amount of time spent fussing with in-house newsletters, especially trying out this and that font, may cost American industry tens of millions of dollars in lost time.

The electronic bulletin boards, in which some see adumbrations of a new democratic forum, are also frequently taken up with trivial or less-than-idealistic pursuits: dating services, jokes, ticket sales,

soap opera summaries, investing, and, more and more often, shopping. In France, it is estimated that more than half of what passes through the national Minitel computer-telephone network is sexual banter. The Internet has set aside an entire branch of the system (Alt.Sex) for pornographic chat and pictures. Perhaps this is inevitable with a technology that shades off so abruptly into entertainment, but it is nonetheless disappointing—as if the mighty railroad train, once the leading-edge invention of civilization, had been dependent on selling cut-down versions of itself to be used as roller coasters in amusement parks. Admittedly, an objection like this is a matter of taste and should not be pressed too seriously. But I have often wondered how cognitive scientists and idealistic hackers must feel, knowing that the technology some among them regard as the salvation of democracy and the next step in evolution is being squandered on so many unbecoming uses.

THE END OF THE WAR MACHINE?

Another issue that was central to the first edition: the power of the computer to concentrate ever-greater decision-making power in the wrong few hands. Of the problems I discuss under that heading in Chapter 10, one has decidedly and surprisingly improved—though not for technological reasons. What I refer to as "the War Machine," the computerized control of thermonuclear weaponry, has receded as a threat to our freedom and survival in recent years. Though the Russian government that has taken over from the former Soviet leadership still possesses more than thirty thousand nuclear weapons (ten thousand of them capable of reaching targets in the United States), the complex of international political changes we refer to as "the end of the cold war" has made the forty-year balance of terror seem far less terrifying. The worst danger to which I addressed myself in dealing with the military uses of high tech—that of all-out Soviet-American nuclear war initiated by computer error or by the hair-trigger response of forces kept on instant alert—has all but disappeared. Much that I say about that grim possibility might have been removed from this edition. But I have decided to let the section

stand, with minor corrections, for an important reason. I present it as Exhibit A in the indictment I serve against the cult of information. The underlying concern I voice in dealing with nuclear weapons is not really tied to the particular facts and figures of the arms race at a given point in history. Rather, it has to do with the overweening confidence of computer scientists in their systems—and with our willingness as a society to believe what those scientists tell us about the absolute reliability of their programs.

At the same time, we should bear in mind that much of that military technology still exists and is as error-prone as ever. In one respect, we may even be worse off than before. As nuclear weapons proliferate around the world, the chance of regional conflicts achieving nuclear proportions increases. We now have more nuclear powers than ever before, many of them living side by side in deep distrust, their armed forces on round-the-clock alert, their undertrained technicians nervously fingering the red button. As Daniel Ellsberg warns us, "Worldwide, although the risk of nuclear war between NATO and the former Warsaw Pact powers has virtually vanished, the chance that some nuclear weapons will kill humans somewhere may be higher than before."[7]

Another study by Scott Sagan reminds us that computerized weapons systems must still remain a cause for serious concern precisely because the cold war has ended.

> The collapse of the Soviet Union has subjected its nuclear command and control system to unprecedented and unanticipated tensions.... Intercontinental-range strategic nuclear weapons are likely to be deployed in Russia, Kazakhstan, and Ukraine for many years to come, and the safety of these weapons will likely be strained by emerging political, ethnic, and civil-military conflicts in the region.

Sagan observes that many of the new nuclear powers that have been created out of the fragments of the old Soviet Union "may not be able to afford even a modicum of mechanical safety devices and modern warning sensors and will therefore be more prone to accidents and false warnings."[8]

As things now stand, our military leaders can have no clear idea who controls the world's remaining thermonuclear weapons systems; all accountability is being lost in the progressively fragmenting

international community. Nor can anybody say with certainty what programs those weapons now obey, or how competent their new and anonymous keepers may be in dealing with this delicate and deadly technology. The "War Machine" is far from being a historical curiosity.

THE ADVENT OF THE MONEY MACHINE

■

Even as the threat of thermonuclear Armageddon lessens, in another area of our lives, almost by way of negative compensation, things have grown more menacing. To the other categories of computer abuse I list in Chapter 10 of this book (the Surveillance Machine, the Polling Machine, the War Machine) I would now add "the Money Machine." As in the worlds of law enforcement, political campaigning, and the military, so now in the world of high finance the computer has fallen into the wrong hands and is being used in ways that have radically altered international economic affairs. Programmed trading, a form of Expert System that has been steadily under development since the 1960s by some of the best mathematical brains in the nation, has at last become a disruptive and all but dictatorial force in world finance—to such a degree that patterns of investment and speculation generated by computers have become an independent factor determining the shape of the market.

Electronic cash management and funds transfers using the speed of computers and global telecommunications networks date well back into the 1960s; but the first indication the public received that the technological magic that made same-day funds possible might be a mixed blessing came in May 1984 when, following little more than rumors in the press, Continental Illinois Bank of Chicago, the seventh-largest bank in the United States, was reported to be insolvent. Foreign banks, mainly Japanese, responding to rumors about Continental's dubious financial health, had suddenly withdrawn billions of dollars in one-day overnight deposits. A massive run on the bank had begun in the international banking community. Continental, it was feared, was carrying far too many bad loans and was not financially stable. The reports turned out to be true; the bank

had made many big, bad investments, mainly in oil companies. Poor judgment in the banking world is nothing new; what was new about the story were the scale of the misjudgment and the way in which such immense mismanagement could be kept out of sight. As the story unfolded, it became clear that Continental had been covering up its true condition by using its state-of-the-art instant-communications capacity to execute the sort of rapid electronic transfers of short term funds that computers and global telecommunications make possible. The transfers amounted to as much as $8 billion in overnight funds and $35 billion in one-week deposits. Now Continental had fallen victim to its own sleight-of-hand methods; the same electronic network it had been using to stay afloat had turned against it to produce a bank failure so huge that the federal government had no choice but to bail Continental out at the public expense.[9]

A year after the collapse of Continental Illinois, a major brokerage house, E. F. Hutton, was indicted by the Justice Department in a multimillion-dollar computer scam. Hutton was caught fast-shuffling funds between scores of banks throughout the United States in such a way that the company could write checks against deposits that did not exist except as computer records flashing across the electronic network—a form of high-tech check kiting.

Front page sensations like these were the public's first significant experience of the destabilizing potential that computers had assumed in the financial markets. Over the next year, commentators raised questions about another new computer-driven business practice: programmed trading. Might it be introducing too much speed and speculation into the markets? Not everybody saw much to worry about; there was certainly nothing illegal about the practice. *Time* magazine quoted optimistic insiders who even believed the new high-speed technology represented the "threshold of a golden age of capitalism." Other observers were more skeptical; they saw in the growing use of neural networked systems ominous possibilities for new forms of financial manipulation that would be dominated by a handful of institutional investors and programmed traders equipped with the best expert investment systems money can buy.[10]

The skeptics turned out to be right. In October 1987, programmed decisions to buy and sell by large institutional investors triggered the worst collapse in the history of the New York Stock Exchange.

In effect, too many of the programs that had been cleverly devised by the "rocket scientists" (as the hackers of the financial world are called) at major brokerage firms were doing the same thing at the same time. What each of the institutional investors was seeking to do was to protect itself by choosing the safest selection of risk-reducing options and futures: "portfolio insurance," as it is termed. But the net result was a cascading series of self-fulfilling prophecies operating as a feedback loop. The market went haywire.

After the crash, the Securities and Exchange Commission imposed "circuit-breakers" to head off any future disaster of this kind. But these are of limited value in a financial marketplace that has become round-the-clock and international; damping the panic in one stock exchange will only divert it elsewhere.

The simple fact is that, thanks to the computer, information about money has now become as valuable as money itself. And those who can process the most information the fastest are in the best position to profit—often in ways that escape any effective legal control. The computerized hand can move faster than the regulatory eye. As a result, the instability produced by high-speed computerized operations has become endemic. It has in fact been institutionalized in the signature financial instrument of the nineties: the "derivative," by far the most exotic and elusive entity ever to appear in the world of money.

Derivatives are new categories of financial "products" that could only achieve the prominence they enjoy where lightning-fast transfers are possible. They allow a variety of speculative maneuvers keyed to minute fluctuations in the price action of markets that deal in interest rates, foreign currency, stock indices, collateralized mortgages, and commodities. One observer calls derivatives "a concept out of *Alice in Wonderland*.... In this strange and eerie electronic world, Japanese pension funds can buy American bonds backed not by gold or corporate assets, but by stacks of car loans made by Detroit."[11]

Interest rate swaps are among the most popular derivatives; these allow speculators to "surf the yield curve" between the day-to-day (or even hour-to-hour) differences in long-term and short-term obligations—for example, the spread between fixed and variable mortgage interest rates. Traders can make contracts on future interest rates, then trade the contracts separately from the money to which the rates were originally attached. Major banks are among

the big players in these tricky games. Since the accounting practices associated with derivatives are terra incognita even to regulators, nobody knows for certain how much money is tied up in this new market, but the figure is certainly in the hundreds of billions. The credit exposure of the banks on sums like this is enough to worry *Barron's* magazine, which asks in a major editorial report if the explosive popularity of derivatives might not lead to a "meltdown" on the global market greater than the panic of '87.[12]

Those who are complacent about the risks rely heavily on the sort of "dynamic hedging" that only programmed investment can provide. This is among the chief services provided by the "quants," the computer experts who account for the ascendancy of derivatives in the markets. Creating an optimum portfolio made up of such complex abstractions requires the ability to assimilate huge amounts of information with maximum speed. So too, the split-second trading in currencies by speculators that has played havoc with monetary policy around the world is uniquely a computer phenomenon. In 1993 the French government, after expending billions in an effort to shore up the franc, was forced to capitulate and devalue its currency. The traders it was up against not only had the capital to get their way but the computer power to take instant advantage of currency fluctuations and to move funds at the push of a button.

> The new masters of the universe [*Barron's* reports in its survey] are as likely to have degrees in engineering or computer science. In their high tech world of probability curves and elaborate securities pricing models incorporating lots of Greek letters, there's little room for the once-venerated qualities of trading intuition and social polish....These days [the nerds] even have their own trade group—the International Association of Financial Engineers. Imagine that.

As the financier Felix Rohatyn sees it, "twenty-six-year-olds with computers are creating financial hydrogen bombs."[13]

But risk is not the only liability to these computer games; an opportunistic preoccupation with quick and massive profit-taking may pose a greater problem, especially as banks grow more and more involved with derivatives and other speculative financial products. For the high rollers in the marketplace, the temptation to make overnight billions by shuffling electronic values has become a major

distraction. Most worrisomely, banks have been seduced into diverting their capital away from what Joel Kurtzman calls "the real-economy... where products are made, trade is conducted, research is carried out, and services rendered. The real-economy is where factory workers toil, doctors tend the sick, and teachers teach, and where roads, bridges, harbors, airports, and railway systems are built."

But in the real-economy, profits can take a long while reporting in. These days smart guys don't waste their time in the real-economy; they vandalize it and move on across the buzzing networks. Inevitably, restless and globally footloose capital drifts toward the international electronic casino where the returns come at the speed of light. Writes Kurtzman:

> Over the years, especially during the 1980s, real-economy companies have been hit by wave after wave of corporate takeovers, with the stock market conspiring in those takeovers by camouflaging rather than revealing true value. These companies have also been handed a big bill from the firms that sell their stocks for the thrill of participating in financial markets that are rigged against real-economy companies.

So Kurtzman asks of the high-flying "megabyte marketplace" that now devours the true wealth of nations: "When the economic unit is the globe, where do people fit in?"[14]

Like the other examples I offer of computer power "in the wrong hands," the money machine raises issues about the social value of the computer that make for neo-Luddite pessimism. The question of balance once again is central. List the pros and the cons of the technology and give them their proper weight. Granted, it is now possible for concerned citizens with PCs and Macs to log into electronic conferences on their local bulletin board, to debate, to gripe, to complain and petition. On the other hand we have the money machine, which makes possible the electronic highjacking of the world's financial markets by a small number of privileged traders who play the game for paper billions. As a result, the capital resources that we need to generate paychecks, useful products, research and development, and helpful services are diverted from long-term investment to short-term speculation. What citizenly use of this technology can counterbalance a shift of power on this scale?

One comes back to the basic economic fact of the matter: computer technology, both the hardware and the software, is a commodity on sale to those who can afford it—and the most powerful machines continue to be in the wrong hands.

EDUTAINMENT FROM APPLE II TO METROID II

■

A particular interest in the 1986 edition of *The Cult of Information* was the role of the computer in education, a lively topic of discussion and promotion at that time. The computer industry continues to cultivate the field, but I would judge that a great deal of the shine that once surrounded the vision of the electronic classroom has rubbed off—at least among the educators. Even though there are more computers than ever in our schools (since the early 1980s, the number of personal computers in U.S. schools has risen from fifty thousand to 2.4 million), their place in the curriculum remains highly uncertain. Certainly the predictions that were being made a few decades ago that public education would be revolutionized by the advent of the electronic classroom have fallen flat. In 1969, for example, the National Education Association confidently predicted (in a report titled "The Teacher and His Staff") that by 1994 every student in the United States would be equipped with "computer-information bank consoles" and international video phones.

Computers are only the most recent wave of educational technology; since the 1950s educators have been through two generations of hype about all the good things they can expect from various kinds of "teaching machines." They have learned to be skeptical. As two close students of educational technology observe, "We thought that mere acquisition was sufficient to begin using these new technological delights, but have learned that there were no quick and easy roads to success.... We have learned that educational technology is a problem-solving process, not a product."[15]

More to the point, an increasing number of educators have begun to recognize that classroom technology is emphatically *not*