SPACE SCIENCES LABORATORY

TECHNOLOGY AND MORALS -- AN OLD STORY

by

Ida R. Hoos

Internal Working Paper No. 90

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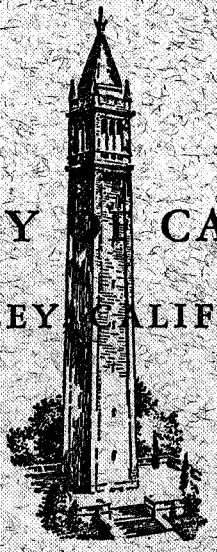

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Since man first discovered fire and invented the wheel, he has asked the same old question: can we control technology? With the present phenomenal breadth and pace of technological advance, this is a matter of more than philosophic concern, for every facet of our lives is affected as we break old records and open new frontiers. And so now, in the late 20th century, it becomes important to reassess our position to find out how we stand. To control is first of all to understand and next to predict. Technology, woven deeply into the fabric of history, must be approached in some kind of historical context. History, as the dialogue between past, present, and future, speaks many thoughts, however, and its facts emerge only as the historian evokes them. (Pirandello had one of his characters say that a fact is like a sack; it won't stand up until you've put something in it!) To ask, therefore, whether we can control or direct technology is to make the assumption that we know the drive and direction of the forces of history. A brief review of several of the better-known historiographers for their conception of the dynamic of world events will, perhaps, place the role of technology in a time perspective and help us understand its cause and effect, cost and consequences.

Oswald Spengler[1] traced the life course of the various cultures through successive stages that he labelled Primitive, Springtime, and (old and ripe) Civilization. Discerning what he called "the beat of cosmic cycles," he found that the "irresistible rhythm of the generation sequence" is now leading us to the destruction of Western civilization as we have known it. A titanic force

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[1]Oswald Spengler, The Decline of the West, Vol II, N. Y. Knopf, 1929, pp 506-7.

hastening mankind's doom is technology, which has altered the face of the earth and made high priests of its engineers. But, he promises the machine, the "real queen of this century," will succumb, for the last conflict is at hand, -- the conflict between money and blood. "And so the drama of a high Culture -- that wondrous world of deities, arts, thoughts, battles, cities -- closes with the return of the pristine facts of the blood eternal that is one and the same as the ever-circling cosmic flow." Our direction is, according to Spengler, obligatory and willed. We have the freedom to do the necessary or nothing. In other words, we are doomed if we do and doomed if we don't.

The distinguished British scholar, Arnold J. Toynbee, has claimed that a post mortem examination of dead civilizations does not enable us to cast the horoscope of our own or any other living civilization. Although he agrees with Spengler that there is uniformity in the disintegration and dissolution of civilizations, of which he traces 21 such instances, he nonetheless argues that the cyclic view of history, if taken seriously, "would reduce history to a tale told by an idiot, signifying nothing."[2] He attributes the demise of earlier civilizations to their failure to meet the challenges of their time but maintains that there seems to be no reason why modern man could not come up with a succession of victorious responses ad infinitum. We could, he thinks, achieve the purposeful enterprise, the divine plan, that might be guiding the "still inscrutable destiny of our world-encompassing Western civilization." Except for one thing -- the formidable technology that has linked all mankind under the menacing mushroom cloud of total annihilation. Once the world was bigger, and destinies a local affair. In about 200 A.D.,

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[2]Arnold J. Toynbee, Civilization on Trial, London: Oxford University Press, 1946, p. 14.

for example, the Chinese Empire dissolved, but this caused scarcely a ripple in faraway Rome. When, a century or two later, the Roman Empire collapsed, the Chinese world, beginning to revive, felt no impact.

Where once the eggs of humanity were happily distributed among many baskets so that some could remain intact even though others got broken, now they are all in one basket, and all are vulnerable to the same dangers. The poem he quotes illustrates his point nicely:

> Gone are the days when madness was confined
> By seas or hills from spreading through mankind:
> When, though a Nero fooled upon a string,
> Wisdom still reigned unruffled in Peking:
> And God in welcome smiled upon Buddha's face,
> Though Calvin in Geneva preached of grace.
> For now our linked-up globe has shrunk so small,
> One Hitler in it means mad days for all.[3]

If you will note, Toynbee, like Spengler makes a kind of demonolatry of technology. He regards technology as superhuman in force and inhuman in effect. It generates intolerable shock to social institutions and to the soul and psyche as well. Can mankind withstand its fearful power? Toynbee surveys the rubble of past civilizations and finds one ray of hope for ours -- the ultimate reconciliation between science and religion. But this can take place only if science becomes humble by admitting its limitations and shortcomings. Religion will provide salvation to those whose suffering is great and whose spirit is contrite.[4] One might summarize Toynbee's philosophy with the irreverent couplet:

> "God and the doctor we all adore
> On the brink of disaster and not before."

The tongue of history lashes us through the pen of P. A. Sorokin, who

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[3] Poem by Martyn Skinner, quoted in Arnold J. Toynbee, The Prospects of Western Civilization, N. Y., Columbia University Press, 1949, p. 21.

[4] Arnold J. Toynbee, Prospects of Western Civilization, op. cit., pp. 96-7.

at one and the same time caricatures our civilization and casts the mold for the 21st century as some futurists see it. Sorokin scanned the past so as to discover the pattern of social change. He called the dynamic the "law of imminent causation," with every culture generating the seeds of its own destruction and bringing about the next stage. In making a typology of the recurrent cultures, he maintained that each had an internal consistency, with its own mentality, system of truth and knowledge, its own philosophy and Weltanschauung, its own type of religion and standards of holiness, its own system of right and wrong, mores and laws. All this provided a functionally related background for a certain type of personality with its own peculiar mentality and set of values. In his analytic scheme, there were two main types of cultures, the Ideational and the Sensate.

He classified ours as the Sensate type, by which he meant that it was one in which only that which was presented to the sense organs was real. In such a culture, values are empirical and material, always relativistic and lacking in sacred, eternal imperatives. Its pervasive goal is control over nature and other men; science and its system of truth dominates. As Sorokin observed the dynamic of other societies which had gone through this period, he looked for trends and foresaw crisis, as sensate values become more relative and atomistic. "The boundary line between the true and false, the right and wrong, the beautiful and the ugly, positive and negative values, will be obliterated increasingly until mental, moral, aesthetic and social anarchy reigns supreme."[5] "Freedom will become a mere myth for the majority and will be turned into an unbridled licentiousness by the dominant minority." "Governments will become more and more fraudulent and tyrannical, giving bombs instead

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[5] P. A. Sorokin, Social and Cultural Dynamics, Boston, Porter Sargent Publishers, 1957, p. 698-701.

of bread; death instead of freedom; violence instead of law; destruction instead of creation." "Divorces and separations will increase until any perceived difference between socially sanctioned marriages and illicit sex relationship disappears." "Quantitative collossalism will substitute for qualitative refinement, the biggest for the best; a best-seller for a classic; ....technique for genius; ...'operational manipulation' for an enlightening intuition." The great cultural values of the past will be degraded: "Michaelangelos and Rembrandts will be decorating soap and razor blades, washing machines, and whisky bottles." "Suicide, mental disease, and crime will grow. Weariness will spread over larger and larger numbers of the population."

Sorokin's characterization of our culture was really in the nature of a forecast, for he wrote a generation ago, long before anyone dreamed of using the Mona Lisa for a hair dryer advertisement! Evidently, professional futurists, those who try to predict the pattern of life in the 21st century, regard Sorokin as correct in his assessment of most facets of our culture. They therefore use the Sensate era as he defined it as the basis for extrapolation of trends into the future. Their picture of the year 2000 looks like us, only more so. In fact, there is no brave new world, just a blown-up version of the present one.

How would these historiographers have responded to the question, "Can we control galloping technology?" They would probably have seen it as a manifestation of the prevailing Zeitgeist, spirit of the times. And, because of their implicit or explicit determinism, they would probably have regarded the consequences as inevitable. This position would foreclose further discussion. Whether technology was man's servant or master would be an idle and frivolous forensic exercise.

Such complete abdication of the role of free will goes against the

grain of rational man, however. In quest of a more positive role in history, he is more likely to regard himself as using technology to meet real needs, unaware that he may be making a kind of Faustian bargain. As you probably recall, the scholar, Faust, made a compact with Mephistopheles.[6] Under its terms, the devil increased Faust's knowledge of magic and gave him a life of pleasure and power for 24 years. After that, Faust was supposed to deliver his soul to the devil.

In the present context, the Faustian analogy is useful. From time immemorial, man has developed technologies to cope with his needs. In fact, progress has been equated with their rate of introduction and level of sophistication. The course has been one of devil-take-the-hindmost, and each succeeding generation chooses to look at the accumulated power and products as its heritage and overlook the cumulative costs. To control the momentum and direction of technology at this hour in history would require conscious and intelligent trade-offs between the benefits and the costs, now and in the future. I wonder, considering our Zeitgeist, how really sincere we are, how many of the "pleasures" we are willing to forego, how many benefits we are willing to place on deposit for future generations. I wonder, also, as technology becomes more complicated and its workings calibrated with those of our private, social, economic, and political beings, how we can make informed judgments. In other words, do we want to and would we know how to control technology? Let's start with an examination of our Zeitgeist, the spirit of our times, to bring into focus our value system, our notion of the good life. Then, let us see how technology reflects this ethos and shapes our future.

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[6] Historia von Doktor Johann Fausten, 1587.

The labels attached to the second half of the 20th century are a clue to the tenor of the time. Ours has been dubbed the Scientific Civilization, the Technological Era, the Space Age. The cult of efficiency pervades our concept of progress, and our orientation is largely quantitative. The more the better is the principle governing everything from transportation to information, with speed the bench mark in the design of cars, aircraft, and computers. "The biggest bang for the buck" is national policy; quantity counts. Thus, the concepts of quality, of value, are anachronisms. Even if they sometimes receive lip service, they do not show up on the balance sheet. Efficiency in the conduct of our affairs, military, industrial, and domestic, calls for more and more power. To this end, the atom has been unleashed. We have nuclear energy for war and peace, and our capacity for kill and over-kill in both is dreadful beyond imagination. The long, slow process of human evolution has been speeded up. Man for the first time in history can improve on natural selection, not only through replacement of weak or faulty organs by artificial or borrowed transplants, but through prenatal improvement of the stock. Molecular biology has made selective genetics a distinct possibility, and experimenters have succeeded in controlling the sex of unborn offspring.

When we turn back a page of history to the teen years of this century, we find that the automobile was already taking its place as an accepted mode of transportation and a means of recreation. High adventure, in my New England childhood, was associated with family excursions in the Overland, splendidly equipped with a self-starter mechanism, which almost always made the crank unnecessary. My contemporaries hardly need be reminded of the 15-mile per hour speed limit that many of our vehicles could barely achieve, to say nothing of exceed. The ultimate in reckless pace found expression only

linguistically; "a mile a minute" signified breakneck speed. Counting time spent on roadside and roadbed emergencies, our average on a Sunday afternoon drive to Norridgewock was probably not much different from the 11 miles per hour estimated for a trip across Manhattan Island in 1968. Moreover, we utilized all the horsepower our vehicle possessed, plus, on occasion, the addition of a team of Percherons to rescue us from deep Maine mud! The year 1929 saw the American public spending $3,236,000,000 for automobiles and accessories. In 1966, with some 73 million public and private cars registered in the United States, the total fixed investment was over $210 billion.[7]

This enormous growth had clear social impact. It affected mores and morals. Living style, location of home, use of leisure, mode of recreation, the very contour and configuration of our land, -- all reflect the influence of the automobile. A way of life, a mode of transportation, and a status symbol, the car is designed to reflect the mood and preference of the times. Manufacturers pander to the public taste, of course, and chrome and power are the features dominating both advertising and construction. Convinced through market surveys that safety has little appeal to the potential customer, car-makers concentrate on gimmicks and gadgets. Ralph Nader, in testimony before Congress, asserted that annual price increases were justified by car makers as "vaguely attributed to safety features but actually including other costs such as styling changes."[8] Mr. M. Cecil Mackey, Assistant Secretary for

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[7] U. S. Department of Commerce, The Automobile and Air Pollution, Part II, December, 1967, pp. 91, 92.

[8] Hearings before the Subcommittee on Executive Reorganization of the Committee on Government Operations, Prices of Motor Safety Vehicle Equipment, 90th Congress, February 2, March 29 and May 1, 1968, pp. 75 ff.

Transportation for Policy Development, had sharp criticism for automobile manufacturers, although it must be recognized that the fault is not theirs alone:

> "Their sales and their profits have permitted them to employ thousands of scientists and engineers. It would hardly have been beyond this key industry's economic or technical capability to develop and offer to the public -- on its own initiative -- safer automobiles and improved safety equipment. Why then has so little been done in this important area and so much attention concentrated on the development of new color schemes, the contour of body lines, the design of more powerful engines, and the perfection of such marvelous contributions as the lighted ashtray?"[9]

In sickening apposition to the findings of Senator Ribicoff's committee that safety gets low priority from car manufacturers is the report of a group of U. S. Public Health Service statisticians in the Journal of the American Medical Association. The investigators, led by Robert E. Markush, found a sharply rising rate of death among infants and young children from motor vehicle accidents and attributed this to the fact that the car is being used increasingly for home-making activities -- the errands and the shopping. A high percentage of today's mothers are to be found in the most accident-prone age group, the young adults.[10]

With trends in passenger travel (measured in person miles of travel) indicating a 53 percent increase over the next quarter century,[11] there is no

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[9] U. S. Official Says Car Makers Emphasize Styles over Safety," New York Times, February 21, 1968.

[10] "The Young and the Dead," The Scientific American, March, 1968, Vol. 218, No. 3, p. 54.

[11] New York State Department of Labor, Industrial Bulletin, October, 1967, p. 19.

comfort to be derived from the conclusion that "the rate of increase diminishes as age increases." Having escaped becoming a gory statistic in one's youth is no guarantee that one can live happily ever after. Advancing years lower resistance to chronic respiratory diseases, such as bronchitis, bronchial asthma, and pulmonary emphysema. And these are brought on and aggravated by exposure to polluted air, of which Los Angeles smog is a horrible example. There, University of California doctors last August issued a statement advising anyone who did not have compelling reasons to remain to move out of certain sections of the Basin. A 1960-61 survey revealed that during the previous year Los Angeles physicians had told some 10,000 patients to leave; the health hazard of air pollution was cited as the reason.[12]

While individual sources of air pollution are as varied as the processes and products of modern technology, automotive vehicles constitute the major part of the carbon monoxide, as well as the emissions of hydrocarbons and oxides of nitrogen. The following table depicts graphically the sources of air pollution in the U. S. Note that motor vehicles account for 60.6 percent of the total, 86 million of the 142 million tons per year. In New York City alone, every motor vehicle which operated daily produced more than one ton of carbon monoxide and contributed to the year's total of 1,536,000 tons.[13]

TOTAL U. S. AIR POLLUTION BY SOURCE - 1966

Source	Tons/Year	% of Total		Tons/Year
Industry	23,000,000	16.8%	(Carbon Monoxide	66,000,000
Power Plants	20,000,000	14.1%	(Oxides of Nitrogen	6,000,000
Motor Vehicles	86,000,000	60.6%	----(Hydrocarbons	12,000,000
Space Heating	8,000,000	5.6%	(Sulfur Oxides	1,000,000
Refuse Disposal	5,000,000	3.5%	(Lead Compounds	190,000
	142,000,000		((as lead)	1,000,000
			(Particulates	

Source: THE SOURCES OF AIR POLLUTION AND THEIR CONTROL, Department of Health, Education, and Welfare, 1966.

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[12] Philip M. Boffey, "Smog: Los Angeles Running Hard, Standing Still," Science, Vol. 161, September 6, 1968, p. 990.

[13] Howard A. Rusk, "Air Pollution Challenge," New York Times, November 13, 1966.

Those of us who remember New York City's killer smog of November, 1966,[14] are aware of the growing health hazards. Some of us may be less familiar with the damage to food, forage, and ornamental crops in many metropolitan areas of the country. Cash crop losses related to air pollution are estimated to be on the order of six to ten million dollars annually in California alone. Few of us realize that the rising levels of carbon dioxide which are in the atmosphere because of the increasing rate of combustion of fossil fuels may have dire meteorological effects. In other words, automobile exhausts may be an important factor in changing the climate. Scientists differ as to hypothesis, but the implications are portentous. One group tells us that the infrared absorption properties of carbon dioxide cause radiant heat going out from the earth to be captured near the surface. The result, an increase in the temperature of the atmosphere, is called the "greenhouse effect." If current rates of carbon dioxide are allowed to continue, there may be melting of the polar ice caps and a rise in the ocean level. Another hypothesis sees change in the opposite direction. Dr. James P. Lodge, Jr., a scientist at the National Center for Atmospheric Research at Boulder, Colorado, finds that the earth's average temperature has dropped one-half of one degree since 1950. This is equivalent to moving the frost line 100 miles south. Air pollution, according to his theory, blocks some of the sunlight from reaching the earth. If the present rate continues, North America will experience another Ice Age by the year 2030.[15] Still others have a different view. They see air pollutants at the inversion layer over urban areas as contributing to the

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[14] David Bird, "November Smog Killed 168 Here," New York Times, October 27, 1967.

[15] "Dip in Temperature Linked to Dirty Air," New York Times, October 9, 1967.

selective formation of raindrops and ice crystals. Research by a meteorologist at New York University's atmospheric sciences center indicates that the lead particles from exhausts act as seeding agents. Dr. Vincent J. Schaefer found that a single invisible particle of lead iodide introduced into a supercooled cloud serves as a nucleating center for ice crystal formation that will grow 10,000 times in size in 30 seconds. This, he said, is like a golf ball swelling to the size of the Empire State Building.[16] Despite the divergencies of opinion as to the ultimate effects of pollution, the proximate effects seem clear. What Malthus' pestilence and war do not accomplish, our one-man, one-automobile formula will!

Do not fear that, in my examination of our speedy society, I have forgotten the jet airplane. Not only is its contribution to pollution substantial, but each aviation breakthrough represents a quantum leap in propulsion. Last July first, the C-5A "Galaxy" took to the air. Designed originally to move troops and battle equipment, this plane, tall as a six-story building and wide as eight bowling alleys, is capable of carrying almost 1000 persons per trip and will render obsolete all present notions of civilian air travel. Lockheed's price tag to the U. S. Department of Defense was $20 million, and they plan to sell a modified version to commercial air carriers. The speed of this giant is not phenomenal, probably not much more than the same old 600 miles per hour we have come to regard as commonplace. This could, perhaps, be forgiven in our quantity-minded era, except that the French, with some financial help from Britain, are building a plane that will travel 1500 miles an hour. The Concorde, expected to carry passengers in three years, has ushered us into the era of the sonic boom before we have come close to

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16 Vincent J. Schaefer, Science Magazine, December 23, 1966.

solving the pollutant of subsonic jet aircraft noise.[17]

Far from deploring the possible damage to people and property, the President of the United States, on January 29, 1968, proposed the spending of $351 million for the development of a supersonic liner in fiscal 1969; this represented $223 million in new appropriation.[18] The Boeing prototype, 318 feet long, is designed to carry 300 passengers at 1800 miles per hour. It was estimated by Senator Clifford P. Case of New Jersey that the U. S. supersonic transport fleet may eventually number from 200 to 1200 planes.[19] Concerned physicists have supplied us with information about the generation of a boom that is unavoidable for any object which travels in the air at a speed exceeding that of sound. The sonic boom produced by a supersonic transport plane accompanies the plane throughout its supersonic flight path; thus, a single flight across the U. S. would affect 10 to 40 million people. No one really knows the extent of shock experienced. Tests of acceptability of the boom were conducted in 1961 in St. Louis, in Oklahoma City in 1964, in Chicago in 1965, and Edwards Air Force Base in 1966. But they were carried out by engineers and without the participation of physicians, psychologists, or psychiatrists. The human subjects were young, healthy, and prepared. Thus, the startle effect was not assessed. There was no consideration for infants, the aged, or the nervous. Taken into account were solely the least crucial circumstances. Although the Federal Aviation Administration publicly proclaimed that only poorly constructed buildings were affected by the booms, it quietly paid a number of damage suits. Boom claims presented to the U. S.

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[17] Statement of Hon. Herbert Tenger, Hearings Before the Subcommittee on Transportation and Aeronautics of the Committee on Interstate and Foreign Commerce, House of Representatives, 90th Congress, Aircraft Noise Abatement, November 14, 15, 21; December 5, 6, 1967; March 19, 20, 1968: p. 15.

[18] Harold D. Watkins, "SST Funding Faces Hurdles in Congress," Aviation Week & Space Technology, February 5, 1968, pp. 30 ff.

[19] Science, Vol. 160, May 3, 1968.

Air Force during fiscal years 1956-67 amounted to almost $20 million.[20] Approved claims during that time came to only $1.3 million, but the extent to which booms weakened other buildings was and remains incalculable and unpredictable.

An articulate opponent of supersonic transport voiced his views as follows: "In a city with a million housing units, there will...be a hundred of them damaged...approximately one for every passenger on the plane, who will save less time than it takes to repair the damage produced. This is in addition to the discomfort, the disturbance of normal activity, and the interruption of conversation or of thought of hundreds of thousands of individuals."[21]

The Ethos of Efficiency calls for power, for wartime and peacetime pursuits. As our population increases, so, by inexorable exponential, grows the need for power. Dr. James P. Lodge, Jr., mentioned earlier, put it this way: every man, woman, and child in the country has at his command the equivalent of 195 "slaves" in terms of the energy produced from power plants and automobile engines.[22] The environmental pollution emanating from 39 billion "people" is, of course, enormous. But there is more and worse to come as population multiplies, engines grow in size and number, and the electric power industry expands. In order to keep up with public demand, which has doubled every ten years, this industry understandably welcomes the prospect of a cheap and inexhaustible source of fuel to replace conventional fossil deposits,

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20 U. S. Department of Transportation, "Summary of Sonic Boom Claims Presented in the U. S. to the Air Force, Fiscal Years 1956-67," Washington, D. C., 1967.

21 Cyril Stanley Smith, Letter to the Editor, Physics Today, Vol. 21, No. 6, June, 1968, p. 9.

22 Speech at Annual Meteorological Society meeting, San Francisco, January 30, 1968.

supposedly in danger of eventual exhaustion. Hence, the enthusiasm for nuclear technology.

By August, 1968, there were 15 nuclear power plants in operation; 31 under construction, 42 under review or awaiting license, 14 on order. There were also an operational commercial fuel reprocessing plant, 2 more planned, and 100 additional licensed nuclear reactors and facilities (primarily research).[23] AEC projections indicate that by 1980, fully 20 percent of the nation's electricity (over 100 million kilowatts) will be produced by reactors. "Nothing," said a spokesman for that agency, "does its work more quietly than the peaceful atom." Such performance, in a noisy world, is to be commended. But this is not to mention other forms of pollution to which the atom, peaceful and otherwise, makes a deadly contribution.

There are three different ways in which radioactive contaminants from reactor operations endanger the general public: (1) In the course of day-to-day activity, nuclear plants release into the environment "low level" stack gasses and effluents which require close and constant evaluation because total radioactivity includes both short- and long-lived isotopes. Those which enter the food chain to man may have profound biological significance. (2) In any industrial operation, there is always the possibility of a major accident. There have been ten serious reactor accidents since 1949. In 1957, an accident at the experimental reactor in Britain (Pile No. 1 of the Windscale reactor) released 20,000 curies of radioactive iodine to the atmosphere. A reactor core explosion in Idaho in 1961 resulted in a significant release of radioactivity in the environment. Part of the reactor core at the Fermi installation in Michigan melted down in October, 1966, and a quantity of radioactivity entered

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[23] Joel Alan Snow, "Guide to Educated Guessing," Scientist and Citizen, August, 1968, pp. 157-158.

the environment. (3) Reactor-generated radioactivity can enter the environment through contamination from high-level wastes, too active to be dispersed in water or air. The toxic effluents of conventional industrial processes are usually tolerated in concentrations amounting to a few parts in ten million. By contrast, radioactive fusion products must be limited to one one-hundred-millionth of the non-nuclear concentration.[24]

Competent observers criticize the national nuclear power program for its bias in the direction of technological advance. They claim that successively larger and more sophisticated generations of reactors are being licensed and constructed even though there is a lack of sufficient operating experience to form a judgment of risk. The regulatory program of the Atomic Energy Commission is seen as providing inadequate protection since this agency is at one and the same time responsible for, committed to, and under great political pressure to speed development of nuclear power.[25]

Far from receiving local praise for contributing to the cornucopia of energy, designation of sites for nuclear plants appears to be the occasion for local protest. From California's Bodega Bay to Cochonoe Island, in Long Island Sound, concerned citizens voice apprehension over the effects of thermal and radioactive pollution. With respect to a proposed plant at Lake Cayuga, a group of Cornell University professors presented well-documented objections: All power plants, whatever fuel they use, draw in water from a lake, river, or ocean for cooling purposes. This is returned to its source at a higher temperature. Nuclear reactors use more water than fossil-fueled plants to

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[24] C. R. McCullough, Safety Aspects of Nuclear Reactors, Chapter 7, D. Van Nostrand Co., Inc., 1957.

[25] Harold P. Green, "'Reasonable Assurance' of 'No Undue Risk,' A Lawyer Dissects Reactor Licensing Procedures," Scientist and Citizen, Vol. 10, No. 5, June-July, 1968, pp. 136-137.

produce the same amount of electricity. The Cayuga installation would add a hundred million cubic feet of heated water (65-70° F) to the lake every 24 hours, all year round.[26] With sites for large-scale nuclear generating plants already in short supply, the trend toward choosing locations close to one another compounds the hazards. Problems of radioactivity on area, regional, and even national scales could result.[27]

Public relations releases of the AEC[28] to the contrary, one of that agency's spokesmen conceded that there might be a few risks.[29] But his attempt at reassurance was neither convincing nor comforting. He asserted that thermal pollution from nuclear plants was no more damaging to marine ecology than fossil-fired plants, exhorted his audience to find uses for all the heat that was ejected, and suggested that, after all, warm water may be more beneficial than cold for irrigating some crops!

Waxing enthusiastic over the benevolent promise of the atom, the Director of the AEC extolled it as a food-saver. Through irradiation, root crops will not sprout, fruit ripening can be delayed, insect damage to grains can be controlled. The AEC's food irradiators can deinfect 5,000 pounds of bulk grain an hour and salvage 9 million tons of cereal grain annually, food for nearly 300 million people. Of course, this program has attracted the lively interest of a number of foreign governments. In April, 1968, the AEC claimed success for the irradiation of meat. "The Food and Drug Administration

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[26] "Heating up Lake Cayuga," Scientist and Citizen, Vol. 10, No. 5, June-July, 1968, p. 141.

[27] J. G. Terrill, Jr., Director, Center for Radiological Health, U. S. Public Health Service, paper delivered at the American Society of Civil Engineers national meeting on environmental engineering, Chattanooga, Tennessee, May 15, 1968.

[28] "Your Body and Radiation," U. S. Atomic Energy Commission.

[29] Dr. Gerald F. Tate, "Application of Science and Technology for Social Betterment," Address at Annual Meeting of Southern Interstate Nuclear Board, Hot Springs, Arkansas, April 1, 1968.

has approved irradiated bacon for public consumption, and pending its clearance for irradiated ham, a large pilot plant for meat irradiation (capable of processing three million pounds per year) will be built and operated by private industry in Pennsylvania. The contract for this project has already been signed."[30]

Although no irradiated bacon has yet been produced for the commercial market, 15 tons were used by the U. S. Army, for tests and experiments. All such uses have now been banned by the Food and Drug Administration which, on July 30, 1968, rescinded original approval granted in 1963 because new data revealed some dangers. Tests on animals showed adverse effects on the reproductive process, caused antinutrient factors, and had apparent ill effects on mortality, body weight gain, and red blood cell count and hemoglobin.[31]

The gap between wishful and hard thinking is not bridged by the disclosures of discrepancies between the safety standards as written and enforced. A nuclear fuel reprocessing plant near West Valley, Cattaraugus County, New York is a case in point. Its effluents pass through a creek and into a stream that winds through dairy farm land. Questioning the claims of the company that its radioactivity is within the legal limit, a professor of biophysics at the University of Rochester put on hip boots, took his own sample of the waters in question, and analyzed his and the AEC Health and Safety Laboratory readings of Strontium 90. According to the figures of the AEC, there was 36,000 times the permissable amount of Strontium 90 in the effluent. The Health and Safety Laboratory of the AEC, charged with monitoring radioactivity, took no action

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[30] Dr. Glenn T. Seaborg, "The Atom -- New Progress and Prospects," Paper at meetings of South Carolina-Georgia Nuclear Council and the Joint Council of Engineering and Scientific Societies of the Central Savannah River Area, Agusta, Georgia, April 15, 1968.

[31] Andrew Jamison, "FDA Cans Irradiated Bacon," Science, Vol 161, August 16, 1968, p. 669.

until this finding was made public. Only then was an error in its own readings claimed by the AEC. Even with correction, however, the level of radioactivity in Buttermilk Creek was found to exceed the legal limit by a factor of two.[32] Note that I do not say "the safe limit." Biochemists tell us that Strontium 90 has a half life of 28 years (that is the length of time it takes half the amount to decay), that it concentrates in the bones, and that it follows much the same physiological path as does the calcium in the milk which we urge upon our children, but with the opposite effect. It is carcenogenic. It doesn't build; it destroys. It has no tolerable human level. There is no "safe limit."

In our "high energy era," speed and power are the forces spurring another technological revolution -- that which is associated with the computer. Thanks to its ubiquitous appetite, we have all become data to be processed. All in the name of providing ourselves with faster service, we have seen our individuality reduced to punches on an I.B.M. card, our privacy a nostalgic memory, and every facet of our lives affected. And, far from reducing the paperflow, the busy working computer has so inundated us that we are experiencing an information explosion. This, to be sure, does not signify an increase in knowledge. In fact, the technology which not so long ago brought about a toto reductio ad datum is fast completing the cycle in a reductio ad absurdum. It takes another computer to digest and interpret the output of the first one, and, like the Sorceror's Apprentice, this will probably go on and on. The computer is the G-O-D (Guarantor of Decisions); what enters its electronic brain counts. The rest does not enter into the cost-benefit juggling going

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[32] Rochester Committee for Scientific Information, "Industrial Radioactive Waste," Bulletin No. 3, February 28, 1968.

into public planning, research design, or policy-making. Thanks to the imperative of quantification, it has been said that ours is becoming a nation that knows the cost of everything and the value of nothing.

Our calligraphy must be machine-readable, so that our records may be processed quickly. Fine writing style must be eschewed in favor of sterile statements so that they can be abstracted and coded for computerized dissemination. Our children's education is part of big learning business, a $50 billion-dollar-a-year market in which micro-teaching, mini-programs, and canned curricula abound. Whether the aggressive invasion of schools by big technology will lead to an educational-industrial-complex, in which large corporations determine what children shall learn, or a generation of spectators so addicted to the one-way communication of a machine that they will never acquire the skill or savor the pleasure of interpersonal relationships we cannot say. To judge from the amount of youthful alienation this decade has already experienced, and the basic human need apparently being met by the formation of ersatz primary groups, such as those sponsored by Esalen, I suspect that there are already cues and clues to the causes of this phenomenon.

Surveys have shown that children under the age of six spend more than 54 hours per week in front of television sets, their viewing time in inverse proportion to family income. A current $8 million educational television program for preschoolers will, in my opinion, add another dimension to the cultural deprivation of the poor! The rationalization for this manifestation of efficiency goes like this: About 5 million children, four years of age, are candidates for preschooling. Cost of teaching them in conventional schools, exclusive of cost of buildings is $2.75 billion. The only advantages that I can see to this kind of socialization is that the youngsters will not suffer too great cultural shock when, as they progress through the school system,

their I.B.M. one-way disposable report cards tell them that a punch in column 1 means that they are behavior problems and/or did not turn in assignments. They will be psychologically prepared to submit to rigid, "efficient" programs that do not respect their preferences as to teachers, time, or electives. When they receive "counselling" from a tape in a box, they will take it lying down. Could it be that the spirit of revolution, 1976 model, will be in the form of a young rebel burning his I.B.M. card on the school house steps?

Thinking man is not entirely devoid of sensitivity to the problems enveloping the future of his society and his universe. Convinced of the ugliness of pollution, he carries a litterbag in his car as he speeds toward Yosemite and a weekend of camping in what authorities call a sylvan slum. He would gladly book his cross-country flights on a noiseless, smokeless jet, especially if it were faster and cheaper than the 747 that carries him now. A year ago, he marvelled at headline news of the first transfer of a healthy, beating heart from a dead body to a living human; he failed to notice back-page items about the resultant medical and moral dilemmas regarding death. Traditional criteria no longer are valid; once, cessation of respiration and circulation meant the end of life. Now it is up to doctors to decide when to turn off the respirator and let the patient die. A thirteen-man committee from Harvard Medical School proposed a set of guidelines and emphasized that "the decision should be made by physicians not involved in any later effort to transplant organs or tissue from the deceased individual."[33] Ambivalent about doctors anyway, he probably concludes (1) that they have always made arbitrary decisions about life and death and (2) that doctors, better than any other group, should make these vital decisions. Faced with the information

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[33] Journal of the American Medical Association, "A Definition of Irreversible Coma," August 5, 1968.

that spectacular breakthroughs in genetics will soon enable man to direct the course of human evolution,[34] our average citizen asks what those strange people in white coats will dream up next. He reads of successful experiments in mind control through electrode implantation, drugs, and psychological techniques, and he wonders why all the fuss about 1984. Why, he asks, is it so different from any other year?

As science and technology advance, they become more complex, their effects interlocking and farther reaching. If the average citizen has failed to comprehend their magnitude or has appeared to respond in cavalier fashion, this may have been due to a kind of defense mechanism. Short of crying "Stop world, I want to get off," the best any individual could do, perhaps, was to try to preserve private sanity and personal stability. Such a state of solipsism is, of course, intolerable in the mass society of the present and certainly provides no base for shaping the future. Not surprisingly, therefore, better ways of coping with mankind's current and coming problems are being sought, and, consonant with our times, it is to science and technology that we turn for solutions. Persuaded that "a civilization that can get a man to the Moon can get Dad to work on time," we assume that the managerial and technical engineering skills that have built spacecraft and conducted spectacular missions can reduce crime, curb urban blight, design low cost housing, provide better transportation, and cure our myriad social ills.

This new look in social engineering is known as systems analysis and gets its prestige from its Pentagon ancestry, its appeal from its "logical," "mathematical precision," and its enthusiastic support from a vast array of entrepreneurs seeking to do the public good at a price already in the billions. Their quantitative techniques will define the future; their model will encompass

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[34] Discussion, Society for Evolution, 12th International Congress of Genetics, Tokyo Prince Hotel, Tokyo, Japan, August 20, 1968.

all the factors that they regard as important. The data they consider valid will justify their course of action. Their blueprint for the future prevails, and if it "satisfies" their rules, it does not matter that it violates principles and philosophies that did not "fit."

I see in this a new order of determinism, more dangerous, perhaps, than any of its predecessors because it is swathed in the veil of self-fulfilling prophecy and terribly persuasive because of its technical trappings. Some time earlier in this paper, I deplored the trained incapacity of those atomic scientists who mind their own business too well. Now I must criticize the hubris and pretension of professional problem-solvers who presume to force all social problems into their Procrustean bed. Armed with the tools of their trade, they are the last word in efficient management of human affairs. But that which is technologically efficient may not be politically proper, humanly feasible, or socially desirable. If it is our Zeitgeist that dictates that we rely on technology to solve the problems of our present and our future, then our future may be technically "satisfying" but devoid of value. Those who are being invited by a technically-oriented society to invent its future will do this according to their own conceptions and with their own tools. The mechanical model will substitute for the human learning experience. Human and social values are not amenable to programming on a computer. If mankind continues to exhibit the same ability to adapt that in past eons assured his survival, there may emerge a new kind of Homo Sapiens, the one designed by the futurologists, and created in the image of the G-O-D Guarantor of Decisions, the god of technology, in the new C.E., that of Computer Efficiency.

Having traveled the path from history into the future, are we any better prepared to answer the question, "Can we control galloping technology?" I am not sure. But I am convinced that we must try and that there is good reason

for the attempt. The quality of life and all living is a sacred trust, from generation to generation. Keeping that trust is consistent with the highest ethical and religious ideals. An eminent historian gave beautiful expression to our everlasting obligation: "Every civilized society imposes sacrifices on the living generation for the sake of generations yet unborn. To justify these sacrifices in the name of a better world in the future is the secular counterpart of justifying them in the name of some divine purpose."[35]

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[35] Edward Hallett Carr, "What is History?" N. Y. Alfred A. Knopf, 1962, p. 158.