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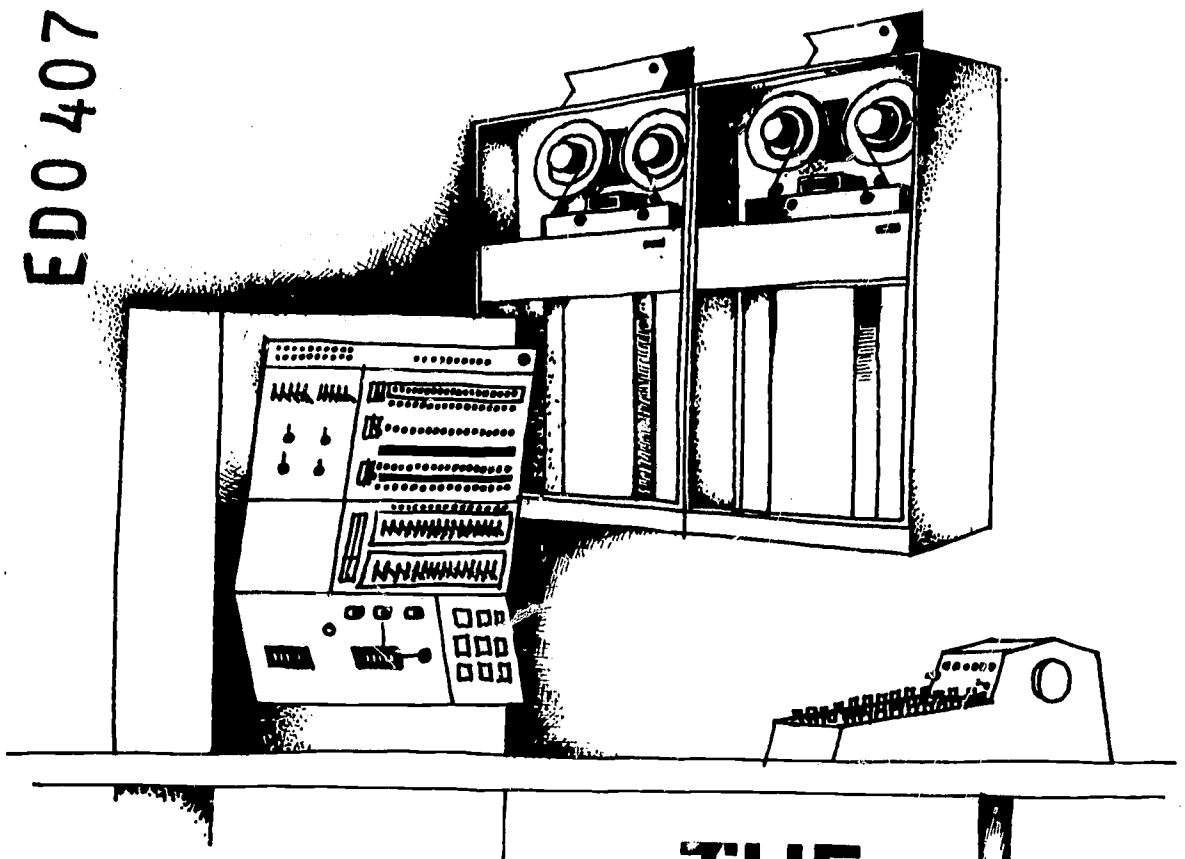
ABSTRACT

A special document, published separately from the complete proceedings of the eleventh meeting of the Panel on Science and Technology, is justified because the papers presented discuss the impact of the rapid development of the computer and the revolution in communication technology upon our society. This impact is critically examined by 10 eminent educators, sociologists, and scientists from the United States and from foreign countries, as well as by the distinguished keynote speakers and the panel moderator. The content of these proceedings are of interest to the Congress, the American public, and scientific and academic communities worldwide. (NH)



THE MANAGEMENT OF INFORMATION AND KNOWLEDGE

a compilation of papers prepared for the eleventh meeting of the panel on science and technology

Committee on Science and Astronautics
U.S. HOUSE OF REPRESENTATIVES

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1970

[COMMITTEE PRINT]

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CONTENTS

MEMBERS OF THE PANEL ON SCIENCE AND TECHNOLOGY

Dr. Ivan L. Bennett, Jr., New York University (medicine).
Dr. Harrison S. Brown, California Institute of Technology (geology).
Dr. A. Hunter Dupree, Brown University (history).
Mr. Martin Goland, Southwest Research Institute (applied mechanics).
Dr. Walter J. Hesse, Ling-Temco-Vought (aircraft and missile systems).
Dr. Thomas F. Malone, Travelers Insurance Cos. (meteorology).
Dr. W. Albert Noyes, Jr., University of Texas (chemistry).
Dr. William F. Pounds, Massachusetts Institute of Technology (management).
Dr. Roger Revelle, Harvard University (geophysics).
Dr. Richard J. Russell, Louisiana Coastal Studies Institute (physical geography).
Dr. Athelstan Spilhaus, Franklin Institute of Science (oceanography).
Dr. H. Guygford Stever, Carnegie-Mellon University (aeronautical engineering).
Dr. James A. Van Allen, State University of Iowa (physics).
Dr. Fred L. Whipple, Smithsonian Astrophysical Observatory (astronomy).
Dr. John T. Wilson, University of Chicago (psychology).
Dr. Maurice J. Zucrow, Purdue University, retired (jet propulsion).

INTRODUCTION

The annual meetings of the Committee on Science and Astronautics with the Panel on Science and Technology are intended to stimulate the mind—to encourage discourse and an exchange of ideas on subjects of current interest or contention. To that end, this year's 11th Panel, aimed at the broad theme of "the Management of Information and Knowledge," was triumphant. The 3-day fare of papers and discussion can be epitomized by Alexander Pope's phrase, "The sweeter banquet of the mind."

Rapid development of the computer and the revolution in communications technology are having an impact upon our society. This impact was examined critically in papers presented by 10 eminent educators, sociologists, and scientists from the United States and four foreign countries, as well as by the distinguished keynote speakers and the Panel moderator. Their thoughts are intellectual nutrition to be relished by the Congress, the American public, and scientific and academic communities worldwide.

For this reason we believe the papers merit wide distribution. That is the purpose of this special document, published separately from the complete proceedings. I commend these papers to all persons concerned with the relentless march of information and knowledge.

GEORGE P. MILLER,
Chairman.

FEBRUARY 1970.

THE MANAGEMENT OF INFORMATION AND KNOWLEDGE

KEYNOTE ADDRESS

MANAGING KNOWLEDGE TO SAVE THE ENVIRONMENT

McGeorge Bundy [1]

While I'm sure the motivation was pure, a group like this committee, concerned daily with the relationships of scientific knowledge to public policy, runs considerable risk in bidding a generalist operating most of the time in nonscientific areas to keynote your deliberations.

You run the risk of the visitor turning his mind for the first time to issues which you have worried hard and long;

You run the risk of the visitor having partial or obsolescent perceptions of the subject under scrutiny;

And you run the risk of the visitor pursuing a line of inquiry or personal "hobby-horse" tangential to the purposes which have brought his audience together.

These risks are surely accentuated when the visitor's experience with your subject—with receiving, managing, and acting—occasionally—on knowledge during the decade of the computer explosion has been in the executive branch of the Federal Government and in private philanthropy. While those worlds are clearly distinctive, they share one characteristic which this morning's assignment has sharply focused, at least for me. Both have a short memory, and a far greater preoccupation with the opportunities of tomorrow than with the evaluated inadequacies of yesterday. As a result, each has a strong tendency to base today's actions and tomorrow's plans at least as much upon the apparent lessons of personal testimony and experience as upon the systematic mobilization of impersonal, historic evidence. To state the reality is neither to condemn nor condone it, but simply to register it as a limitation on my feel for the issues which you have gathered to explore.

As I read it, the subject of your meeting, "The Management of Information and Knowledge," implies in its simple, declarative form a *problem*, a *capability*, and a *potential* if unrealized *benefit*.

The *problem* is that in most, if not all spheres of inquiry and choice, quantities of raw information overwhelm in magnitude the few comprehensive and trusted bodies or systems of knowledge that have been perceived and elaborated by man. I'm thinking, here, not only of knowledge systems with predictive value, but also of information systematically organized to yield the benefit of comprehensive description. Where, for example, does the novice urban mayor turn to comprehend the dynamic interrelationships between transportation, employment, technology, pollution, private investment, and the public

[1] President, the Ford Foundation.

budget; between housing, nutrition, health, and individual motivation and drive? Where does the concerned citizen or Congressman interested in educational change go for the best available understanding of the relationship between communications, including new technology, and learning? Whom does the modern woman consult when she seeks comprehensive and reliable information on the psychological and biological implications of using "the pill"?

Yet if streams of unassimilated, and often unmanageable, information inundate us even as we thirst for understanding, computer information systems seem to offer unprecedented *capability* of addressing the age-old problem of integration. They promise this *first*, because of their vast capacity to store and recall data; and *second*, because of their usefulness as a speedy tool in sorting out orders of relationship and dependency between many separately observed phenomena.

And the faith of the modern rationalist is that the family of man can reap important social *benefits* if it harnesses the capabilities of modern systems of information analysis and storage to convert data into knowledge, and then applies the product as widely as possible to issues of social and personal choice.

If I have correctly stated the elements of the faith framing this assembly and its deliberations, then I register as more, rather than less, of a believer. At the same time, my interest and allegiance is engaged more by the theory and the potential for good of modern information technology than by the present state of the art of application.

The results from employment of computer analysis in the service of policy choice in military affairs and private enterprise have clearly been erratic, and ought to induce caution in other potential users. Even in these areas, where systems have relatively clear boundaries, and objectives allegedly lend themselves to precise specification, experience with application underscores the limitations of this new technology:

—its susceptibility only to data which can be quantified, and the distortions in judgment which will occur when nonquantifiable aspects are badly misjudged, or worse still, omitted entirely from the calculus;

—the direct relationship between the *quality* of raw data elements or inputs and the *value* of knowledge output;

—the necessity that one's theory or explanatory hypothesis bear at least a first approximation to reality.

Indeed, in light of the findings of recent congressional investigations, one cannot avoid wondering whether it remains possible for even the most sophisticated and rigorous process of analysis to comprehend and master the complexities and uncertainties of modern weapons systems.

With these limitations in mind, however, I want to suggest this morning that the endangered environment offers a large and urgent opportunity for exercise of the faith of the contemporary rationalist. If the popular press is any guide, the necessity of preserving and restoring the environment seems finally to have approached the top of mankind's agenda. Fortunately, some sectors of our body politic were ahead of the current, nearly universal alarm. With important leadership from Congressman Daddario and his Subcommittee on Science, Research, and Development, Congressmen Saylor and Dingell, and in the upper chamber from Senators Muskie and Jackson, Congress has

led the way in suggesting the intellectual, managerial, and economic resources that America can and should offer to this worldwide awakening.

And while it seems indisputable, as President Nixon insisted last week, that we ought to *act* now to save ourselves from pollution and limit the psychological stress and physical degradation we know are associated with population density, we also have overwhelming need to *learn* more clearly how the myriad acts of man affect the stability of all of nature's systems.

As the Stanford study group on environmental problems of the National Academy of Sciences has noted in its recent appraisal of "the crisis," we cannot effectively manage the environment without knowing what it is, what it was, and what it can be. At present, we do not comprehensively or regularly *measure* environmental quality. We do not *know* how and to what extent it is changing and has already changed. Much of the information now gathered under the aegis of such environmentally oriented agencies as ESSA, the Geological Survey, the Bureau of Commercial Fisheries, the National Air Pollution Control Administration, and the Federal Water Pollution Control Administration is obtained for special purposes. Not surprisingly, but most unfortunately, no agency is either assigned or assumes responsibility for conducting an overall, ecological evaluation of the quality of the environment nor is any common, interchangeable, or comparable sampling method now being used, though the quality of the air, for example, quite clearly impinges upon the quality of water.

But if the first requirement is to conceive and install a systematic comprehensive system of ecological observation and data collection, there is also a large need for analysis; for manipulation of information on a grand scale to identify simple correlations between independently observed and measured phenomena, and for testing of intellectually ambitious models of ecological reality to improve our powers of prediction and spur our defensive, preventive actions. If, in short, it now seems urgent, perhaps even critical to take the largest view of our environment and its interrelating subsystems, and to address issues of strategic management and preservation, information technology fortunately makes it possible to do so for the first time.

Indeed, some scholars (often with Ford support) are now coming at environmental analysis from two sides: the economic and the ecological. Both approaches strive to understand the complex interrelationships of the parts of man-made or natural systems, and the causes of equilibrium or instability.

Each approach explores and seeks to identify relationships of dependency between independently observed phenomena. When considering a stream, for example, analysts attempt to define the relationship between discharge of specific amounts of organic materials at specific locations and need of the stream for oxygen at the same locations. Out of a series of such equations, they develop a mathematical model which at its best may represent a primitive skeleton of a complex system. Its formalized, quantitative relationships lend themselves to mathematical manipulation as verbal descriptions of reality cannot. With the goal, for example, of achieving a given standard of water purity in our stream, a good model should enable us to discern the range in cost of several alternative "cleanup" strategies combining elements of plant relocation and modified production methods.

Ecologists and economists have already demonstrated that model-building and analysis can yield more penetrating insights than might come exclusively from the logic of lay observation or commonsense, and can also have practical application.

Mathematical models of whale populations have predicted within a 2-percent error what the annual catch would be. These models could have been used to fix quotas at a level to protect whale populations and enable them to recover from the tragic overfishing of the past decades. That quotas have not resulted is a political, not a scientific outcome. Better, though still inadequate use has been made of models of the Pacific salmon industry, which show the most effective kinds of restrictions on fishing and which identify the occasions when their application will offer the most protection to salmon.

Economists at Resources for the Future recently challenged a plan by the Army Corps of Engineers to build a number of dams on the upper Potomac and its tributaries. The corps proposed, in part, to construct these dams to hold water that could subsequently be released in dry season to dilute wastes in the lower river and thereby sustain throughout the year a steady standard of water quality. The agency's critics in RFF constructed a mathematical model of the hydrology of the river basin and explored the costs of a number of alternative methods of assuring the given, as well as higher and lower water standards. They found that all alternatives, combining various treatment methods, were substantially cheaper than the proposed dams, and some would cost only one-tenth as much.

To be sure, all these models have or could have practical immediate utility in saving whales, saving money or insuring water quality. But more important for our purpose, they offer promising evidence that analysis of complexity can enhance the rationality of decision making. Even if one knows that a reservoir is a more expensive way of keeping the Potomac clean than advanced waste treatment, one may still prefer to keep it clean in this more expensive fashion. Similarly, it is conceivable that a decision to exterminate whales might be deliberately arrived at. It is *deliberation* that the models make possible and, indeed, in some sense enforce—which is not the least of their social value.

For its part, the Ford Foundation seeks to contribute its full share to the creation of the expanded, action-relevant knowledge about our environment and the threats to it that the time requires. Five years ago, the Ford Board of Trustees, upon the recommendation of my predecessor, authorized the development of a program in resources and environment. The experience of our increasing effort in recent years suggests to us the very high priority that should be attached to study and appraisal of environment on the broadest scale. We have recently intensified discussions with scholars and public officials on this matter. While we have no formal recommendations as to ways and means to proceed at this date, we are encouraged to believe that there is a vital, complementary role that philanthropic institutions can play along with Congress, the Executive, other educational and research institutions and indeed the family of nations acting in concert to facilitate the broadened intellectual attack these problems require.

The environmental dangers we face, the systems to be understood, and the remedies to be fashioned will frequently be international in character, an aspect properly recognized by the recent, relatively under-reported decision of Secretary of State Rogers to create an Office

of Environmental Affairs headed by Mr. Christian Herter, Jr., in his office. I personally am convinced that energy for both rigorous study and prompt action must derive from national governments, and not be remanded to or anticipated from supranational agencies or voluntary assemblies of motivated individuals sharing the same concerns or intellectual training across political boundaries. At the same time, I also see important possibilities for international cooperation and collaboration in these urgent environmental tasks.

There is not only the manifest fact of our national interdependencies relative to the environment; there is also no obvious ideological basis for disagreement over causes or relative responsibility, or political gain to be realized from a posture of isolation. Indeed, there is some reason to believe that even potential adversaries will welcome and be responsive to an initiative for communication and intellectual consultation on these complex scientific and technical questions. And there is certainly reason to hope that a fruitful intellectual consideration of our common stake in preserving the environment would facilitate discussion of even harder issues of common concern.

In addition to the political possibility for cooperation, there is the undeniable fact that we confront problems of awesome complexity. The intellectual talent which must be encouraged to address these problems is not only exceedingly scarce but also geographically and politically dispersed. Every experience that I have had in exploring issues of common concern with the intellectual and scientific leaders of other societies and states has confirmed what I have always felt in my bones to be true—that the best ideas or perceptions are likely to emerge from circles of intellectual competence deliberately made as inclusive as possible.

So as we launch this decade of attention to the environment, there is much to be said for activation and steady cultivation wherever possible of a workable process of international intellectual consultation and collaboration with nationals of countries that may be potential adversaries as well as traditional friends. This process will not happen automatically. It needs to be made someone's business. It necessarily requires a new order of collaboration between the State Department, the science agencies, and the nongovernmental academy, and ought to have congressional encouragement as well as executive direction.

One can conceive of three different levels of fruitful international exchange:

First, we should make every effort to insure that national systems for monitoring, collecting and storing environmental data are compatible. I believe early, serious effort across political boundaries to achieve intellectual consensus concerning the key phenomena to be observed, and the quality indices to be established will obviate dangers of poor or nonexistent linkages between mechanical national arrangements for collection, storage, retrieval and exchange.

Second, assuming as I do that each nation will independently pursue research and experimentation in remedial actions, information on work in progress, results and understandings, however tentative, must flow freely across political boundaries. There simply is too little time, brainpower, and public money available for nations to operate either in a chauvinistic or unconsciously

introverted fashion; for countries to run up blind alleys tread earlier by others, or remain ignorant of promising approaches under scrutiny elsewhere. The responsibility for insuring the necessary exchange of information in these matters rests with each nation and its interested intellectual community. The priority for public policy here, it seems to me, is the provision of resources for an expanded flow of personnel and information materials from points of national origin, rather than the creation of new, allegedly coordinative international agencies.

Third, when the necessary intellectual mobilization begins to yield operational applications, there will surely be opportunity for shared international effort. The developed countries will have their traditional obligations vis-a-vis the emerging countries, and new patterns of international law and management seem likely to be required with respect to our priceless, collective oceanic, inner and outer space assets.

The prospects for a successful defense of our natural environment, within our own political sphere as well as in cooperation with others, cannot be insured simply by a commitment to a deeper and broader intellectual inquiry, as fundamental as I believe that is. It will also depend upon at least two other factors which have historically been a concern of this annual gathering and which remain worthy of attention today. I refer:

First, to the health of our system of higher education; in particular, our system at the graduate level for the development of an adequate supply of professionals, skilled in many fields and motivated to tackle these vast, but imperative problems of public choice and policy;

Second, to the health of our political process, its responsiveness to the requirements of national welfare, its capacity for sober deliberation, wise choice and timely, effective action.

I, for one, share the anxiety that many feel today over the adequacy and well-being of each of these vital systems.

With respect to higher education, the problems are many and complex. There is, to begin with, the anxiety that many intellectuals feel at the seeming incapacity of American society to put first things first; the anguish they feel over their perception of a civilization seemingly awash in its own errors and excesses. It would be a serious error to blink at the increasing estrangement that many of the most gifted in the American Academy, and not just the young, feel toward the values that swirl and prevail in the larger culture and society that encompasses them and their work, and their inclination to withdraw from engagement with problems of that larger scene. At the same time, complementing this external criticism, there is a self-examination and search among many scholars for a fresh and vital definition of the tasks and role of academic men in modern life, an inquiry undoubtedly induced in part by the relentless probes of querulous students motivated to make a difference and not unrelated to the apparent obsolescence of many of the structural forms that have grown up in the contemporary university.

Yet if these enigmatic forces are easier to describe than to reconcile, my quick earlier survey of some of the dimensions of the intellectual challenges of environmental restoration may have suggested my personal conviction that no modern society is going to make it if it fails to

connect up its muscular actions to a discriminating intellect. The demand for guidance and understanding by that intellect has never been greater, and not only with respect to the environment, but in the voracious demands of modern society for increased scholarly attention and more powerful intellectual insight concerning the learning process, the aging process, the reproductive process, urbanization, and all the forces compelling human adaptation and institutional change in the technological era.

In my judgment, the ongoing, many-faceted debate over academic purposes and values will find its focus in the intersection of the important questions of intellectual freedom with forms of educational finance, an emerging problem on the horizon of everyone's consciousness if not yet at the top of anyone's formal agenda. We have finally faced up to the distortions and dangers of channeling disproportionate amounts of Federal aid for graduate training, research, and institutional development via the defense budget. We seem increasingly aware, as well, that grants of fragmented financial support for highly specialized, if appropriate educational objectives do not invariably coalesce a coherent or healthy community of scholars and students at point of destination.

But the broader national debate—in part, clearly, a political debate requiring initiation by responsible governmental leaders—which defines and affirms the goals of our system of higher education for both individuals and society, and the terms of national public support and accountability, has barely begun, and is increasingly urgent. In this necessary discussion, the Congress and the public have a right to expect the academic community to come forward in its turn with the professional, curricular, and organizational innovations and protections which an era of protracted engagement with issues of individual welfare and social policy will require.

Finally, I come to the knotty interaction of ideas and action—the capacity of the general and informed public no less than leadership in a democracy to make wise and effective commitments in policy and program when tested and reliable information is available.

I have argued earlier that the computer can help us achieve a more penetrating and encompassing understanding of the world's natural systems and how man impinges upon them. In the hands of men of powerful *and* scrupulous intellect, this modern tool can help us define the facts. But I have not asserted, nor do I believe that this intellectual process will define "an" answer or "the" remedies.

For action, we must look to politics as the arena where facts are assayed and values collide, where interests compete and policy or stalemate results. And when the needed observation and wider analysis of our threatened environment is further along, I am inclined to believe that the necessary remedies and assessment of damage costs will cut profoundly across many of man's basic values, especially the economic ethic and motor of our existence.

This new knowledge of where we are, and perhaps of how late it is, will also place great strain on our political process. There will be *no* obvious, consensual and painless technical panacea available to us. We will not be able to avoid a widened definition of the processes of industrial production which embraces the full costs of safely disposing of or recycling waste materials. There will be sharp political conflict

over the assignment of these additional cost burdens. There will be a clearer understanding of the price to the current generation of environmental damage unconscionably shunned by earlier eras; we may have indisputable evidence that further procrastination will lead to irreversible destruction.

In his recent State of the Union Message, President Nixon has suggested the possibility of a conscious and active national policy of redistribution of population, and he has also challenged the assumed identity between economic growth and individual well-being. He has thus identified two of the central topics of a far-reaching debate on the future quality of our life.

The values of our society and the quality of our politics will surely be tested sharply by these choices between adequate and insufficient action; by the assignment of the burden between producer and consumer, between private and public sectors, and between present and future generations.

In that great debate, we will be enormously dependent on the ability of men of scholarship and knowledge to communicate dangers, and the range of promising strategies and operational urgencies in terms that are understandable to the general public and to those with political responsibility for action.

We will also need a political process both open and coherent. On the legislative side, it must afford opportunity for representation of view by individuals with a human interest as well as by organized groups with a more tangible economic interest; by the unvoiced, but nonetheless real stake of future generations as well as that of participants in the next general election. And in execution of the generally approved programmatic course, legislation should be strong enough to avoid bureaucratic splitting of the difference of underlying disagreement by tolerating or encouraging several executive agencies to operate independently and inconsistently, undoing with today's directive or action on this side of town what was painfully resolved in someone else's office yesterday.

In the end, effective translation of the desire of man to preserve his environment will depend on the skill of the public man—the capacity of the individual legislator and of the executive decisionmaker to sift evidence, to discriminate between theories, to interrogate the scientist-scholar, to reach conclusions and to help create the public support for the needed action.

In the era of information explosion, societies can become paralyzed over a plethora of facts and the absence of obvious conclusions. Or they may freeze when the indisputable facts and necessities offend received values and conventional wisdom.

Neither form of paralysis is likely when the linkages between the arena where policy is forged and the relevant circle of informed and disinterested citizens and scholars are firm and easy. This audience and its predecessor gatherings happily embody that value and tradition at its best. The agenda of your common concern is important evidence for the proposition that the discoveries of science and the disciplined intellect intend to serve, rather than overwhelm man as he sets out in a new decade to tackle his unfinished agenda of pollution, pestilence, population, personal productivity, and poverty.

THE MANAGEMENT OF INFORMATION AND KNOWLEDGE

KEYNOTE ADDRESS

EARL WARREN [1]

It is a great privilege to participate in this conference for the purpose of discussing the rapid expansion and use of knowledge brought about by modern technology. No one could have had my experience on the Supreme Court in the last 16 years without realizing that scientific and technological advances have brought about vast changes in the life of the Nation—changes that carry with them implications of both good and evil which merit our most earnest consideration in gatherings of this kind.

However, until the passing of time compelled me to start thinking about what I would say on this occasion, in response to the invitation of my fellow townsman and longtime friend, Chairman George Miller, I never realized how audacious it was for me to assume that I had sufficient knowledge of these changes to justify my attempting to keynote a discussion by scientists, technologists, and scholars on the management of information and knowledge. Nor would I have been relieved of this anxiety by the fact that the particular subject on the day of my appearance would be "The individual, the Machine, and the State."

In addition to that, I was really shocked at my limitations in this field of knowledge a week ago when I read in the morning paper that a computerized and live nationally televisioned prize fight had been held the night before between two former world heavyweight champions, one of whom had been dead for many months and the other who was still alive. I was further amazed to learn that in theaters throughout the country boxing fans had paid $5.50 for seats to witness it. But I was truly shocked when I read that the live man was knocked out after 57 seconds of the 13th round.

I wonder if that might not presage a new era throughout the world of sports. In baseball, why could they not abolish the draft and use as replacements Babe Ruth, Ty Cobb, and Christy Mathewson, and in football Jim Thorpe, Red Grange, and Ernie Nevers? The games could be computerized before the season opens; the stadiums could be closed and everyone could see the game on closed circuit in his comfortable living room or in an air-conditioned theater. In this manner, all the players on all the teams could be of championship caliber and their plays could be predicted by the machine to an absolute certainty.

I do not know what implications such use of the machine would have upon the individual or the state, and I am sure it would be better for me not to speculate because that is not the role of a judge. Tradi-

[1] Chief Justice of the United States, retired.

tionally, judges are not in the vanguard of any movement; nor are they supposed to survey the future to determine what should be done in the face of possible advances in science, technology, or human reactions to either. They are tied to the words of the Constitution and the statutes as they were meant at the time of enactment, in addition to that, and largely to interpretations of the past.

But this does not mean that courts should be or are impervious to change. They, like all of our institutions, must be oriented to the times and conditions under review. In this regard, I am reminded of the agonizing the courts have experienced in defining and applying the word "commerce" as it is used in the Constitution. That document states in simple language: "Congress shall have the power to regulate commerce with foreign nations and among the several States and with the Indian tribes."

In the economy of those days, commerce was not a complicated activity, but was confined to traffic involving sailing vessels and animal-drawn vehicles. With the coming of the railroad, telegraph, telephone, aircraft, radio, television, and electronics, the courts have agonized for 182 years to find an accommodation between such advances and the word "commerce." The end is now no more in sight than is the limit of scientific or technological development which is no more known to us than were the present-day realities to Henry L. Ellsworth, our first Patent Commissioner, when he made his annual report to the Congress on January 31, 1840.

His words seem strange to us now, but this is what he said in part. He speaks of the discovery of the electromagnetic telegraph which he predicts "is destined to exercise a great and it is believed happy effect, in the transmission of intelligence from one section of the country to another. Experiments already made in England and on the Continent leave no doubt of its practicability; and this will ere long, be further tested on the railroad route between Washington and Baltimore." He reports also, "The experiment of illuminating the streets of Paris by means of the electric spark has, as communicated in the late scientific journals, been also most successful; and further developments of this application of electricity may be expected."

He then sums up these startling revelations with the conclusion that "The advancement of the arts, from year to year, taxes our credulity and seems to presage the arrival of that period when human improvement must end." He went still further and intimated rather pointedly that in a period of a few years there might be no need either for him or the Patent Office.

Much of what has transpired since then is commonplace in today's world. Increased knowledge and its use are advancing at an infinitely greater pace day by day. What will happen in the next 100 or even 50 years is little more in the comprehension of the average American than were our modern techniques in the vision of Commissioner Ellsworth.

These advances cannot be stopped, and we should not try to stop them even though some of them, as in the past, will be harbingers of evil as well as good. The job of every generation is to find an accommodation for them which will not dehumanize us or distort the ideals we have long held but not achieved for American life.

Today, in our judicial systems, both State and Federal, we have very serious problems which have more to do with the administration

of the courts than with the interpretation of the law. Like business and and industry, we, too, are paving the way for making use of electrical equipment to do much of the administrative work that has been done in the past by judges and their clerical staffs. The judges are presently overburdend with much paperwork and general administration which is not germane to the judging process. Much of it can be done by machines and, through our new Federal Judicial Center, we have made the studies to establish that the preparation of jury lists, selection of jury panels, the summoning of jurors, and the procedures for paying them can be done by a mechanical process with a minimum of both time and manpower. The bringing of cases to the trial stage and keeping the calendar in shape for more rapid disposition of cases can also be done with less manpower and far more effectively than it has been done in the past. Many hours of the judges' time can be saved by the use of computers, and the Congress has indicated such programs are desirable.

On the other hand, electronic equipment has caused the courts great concern because of the invasions of privacy. Electric wiretapping, which Mr. Justice Holmes a half century ago aptly described as "dirty business," still plagues the courts. Also, today there are even more modern and awesome electronics of sound and vision that invade the privacy of individuals in their homes and businesses and which, unless adequately curbed in their use, will cause grave danger to our way of life. They have unlimited potentials for disturbing both individuals and business organizations. The right of privacy is one of the great values in life, and was well expressed by Mr. Justice Brandeis in these words:

> "The makers of our Constitution undertook to secure conditions favorable to the pursuit of happiness. They recognized the significance of man's spiritual nature, of his feelings and of his intellect. They knew that only a part of the pain, pleasure and satisfactions of life are to be found in material things. They sought to protect Americans in their beliefs, their thoughts, their emotions and their sensations. They conferred, as against the Government, the right to be let alone—the most comprehensive of rights and the right most valued by civilized men. To protect that right, every unjustifiable intrusion by the Government upon the privacy of the individual, whatever the means employed, must be deemed a violation of the Fourth Amendment. And the use, as evidence in a criminal proceeding, of facts ascertained by such intrusion must be deemed a violation of the Fifth."[1]

In the McCarthy period and particularly in the 1950's the courts were plagued by cases involving the use of secret information banked and used to adversely affect the clearance rights of Government employees, consulting scientists, and scholars. Such data banks are now becoming more widespread in business and industry, and are becoming more respective in matters of credit, loyalty, and so forth. Granted that information of this kind can be assembled for good purposes, there are still uses to which it should not be put. The unwarranted use of such uncritical information often irreparably harms the standing of the affected individual in the community. It creates dissension between individuals and groups and makes for disunity. It is a matter of great

[1] 277 U.S. 455, 478, 479.

public interest and should challenge the State as well as the individual or group involved. It has recently become the official concern of other freedom-loving nations. Only last Saturday the following item concerning England appeared in the local press:

> "The British Government promised today to set up a broadly based committee to recommend legislation for establishing individual privacy as a legal right.
>
> "After a day-long debate in the House of Commons during which no member dissented on the need for a right-of-privacy law, Home Secretary James Callaghan said he was naming Kenneth Younger, a former Member of Parliament, as chairman of a group of representatives of parliament, press, the legal profession and the public to make an extensive inquiry.
>
> "That it will agree on the principle and produce draft legislation was taken as a near certainty.
>
> "* * * The principal target was the activity of 'private eyes,' credit snoopers and private investigation agencies which amass and sell to inquirers vast amounts of personal information on individuals applying for jobs, loans, installment purchases, or business connections."

It was argued that "laws against theft and trespass that once protected against invasion of privacy have been outmoded by modern technology with telescopic cameras, computers, parabolic antenna, phone taps, recording machines, and bugging devices. The author of the bill proposed forbidding, on pain of damage payments, employment of such devices for illegitimate purposes."

No discussion of the individual, the machine and the State would be complete unless we also touched upon the affect of the machine on the State insofar as it affects the environment in which we live—pollution of the air, the water, the very food we eat, and the destruction of our natural resources. These facets of destruction affect every individual. As much as the automobile, airplane and other manufacturing industries have contributed to the development of our Nation, they also carry a heavy load of responsibility to alleviate the conditions of smog, water pollution, and food contamination which they have brought into being. The atmospheric conditions which move smog from place to place do not stop at State lines nor do the interstate rivers stop at any border. They affect the lives of Americans wherever they course. They diminish to some extent the right of everyone to life, liberty, and the pursuit of happiness. It is a national problem which commands the attention of the Federal Government as well as that of the States and those responsible for the conditions.

Happily, the President and the Congress have both recently manifested not only a concern about these conditions but also the intention of eliminating them. Their problem is a hydra-headed one that calls for a national commitment equal to that which enabled us in a few years to go to the moon. In the solution of it, the participants need not be limited to scientists and technologists. There is a place for every citizen. In one way or another, we have all contributed to the conditions and, therefore, have partial responsibility for eliminating them.

It is to discuss such problems as well as the beneficence of scientific and technological advances that I assume this meeting is being held. It is a matter of the greatest importance.

THE MANAGEMENT OF INFORMATION AND KNOWLEDGE

REMARKS OF THE MODERATOR

DANIEL BELL[1]

This is a rather unique educational enterprise, even more so by the fact that it is initiated by the Congress. It brings together Members of the Congress, members of the scientific and academic community, and an interested public to discuss not a specific legislative issue, but a broad theme and to try therefrom to pool knowledge, provide some public understanding and perhaps some guidelines in identifying relevant problems.

The theme is the management of information and knowledge. As Mr. Fulton has suggested, there is one thing lacking in the topic, which is the role of wisdom. The problem is how do you apply wisdom to the management of information and knowledge?

A number of years ago Columbia University was sued by a student on the ground that the university did not provide him with wisdom. And he wanted his tuition back. The court denied his claim on the ground that a university does not provide wisdom; it only provides knowledge and information.

The question is, how do you apply the wisdom to information and knowledge? And to Mr. Fulton, therefore, I can give a bit of rabbinical wisdom, a story of a man who asked the rabbi about wisdom.

"Rabbi," he said, "You are a wise man. How do you become wise?"

The rabbi replied, "Well, you study, work hard, and gain knowledge."

The man said, "But, rabbi, a lot of people study and work hard and gain knowledge and are not wise."

The rabbi said, "You study, work hard, gain knowledge, and have experience."

The man said, "Rabbi, a lot of people work hard, study, gain knowledge, have experience, and are not wise."

Well, the rabbi said, "You work hard, study, gain knowledge, have experience and good judgment."

"Rabbi, how do you have good judgment?"

The rabbi said, "By having bad experience."

So, perhaps we can pool here our experiences, good and bad, in an effort to apply wisdom to the problem of information and knowledge.

I have been asked to do one further thing which is to try to set some context in which this discussion will take place. The context I want to set it is the next 30 years—not arbitrarily, but symbolically—and the proposition I wish to put forth is that the development in which

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[1] Professor of Sociology, Harvard University, and chairman, Commission of the Year 2000, Academy of Arts and Sciences.

all of our efforts are taking place is the emergence of what I have called a postindustrial society.

I am trying here to identify not the immediate political currents, but the deeper structural changes which are taking place in American society—structural in the sense of the basic social arrangements, the way in which the movement, for example, from an agrarian to an urban society is a structure change.

If one tries to identify the basic structure changes in American society, what is emerging is the idea of a "postindustrial society," and these problems are unique in human history.

We can think of society in terms of preindustrial, industrial, and postindustrial. Most of the world today is still essentially preindustrial, in the immediate sense that at least 60 percent of the labor force is engaged in extractive work: mining, fishing, timber, agriculture. About 65 to 70 percent of the labor force of Asia is still preindustrial. Sixty-five percent of the labor force of Africa is still preindustrial. Sixty percent of the labor force of Latin America is still preindustrial.

Industrial societies are essentially those few on the Atlantic littoral, plus the Soviet Union and Japan, societies in which the majority of the labor force is engaged primarily in industry and manufacturing.

The United States, to some extent, is the first postindustrial nation in that the majority of the labor force today is not engaged either in agriculture and extractive industries, or manufacturing industry, or a combination of both, but essentially in services—that is, trade, finance, real estate, education, research, administration, government.

But this is not just a change in sectors, a change only from extractive to industrial to services. It is a change equally in the character of the societies themselves.

A preindustrial society is essentially one based upon raw materials, as a game against nature, and in which there is diminishing returns. An industrial society is organized primarily around energy and the use of energy for the productivity of goods. A postindustrial society is organized around information and utilization of information in complex systems, and the use of that information as a way of guiding the society.

Without the organization of information, we can no longer know where we are going to be going, and as an old Talmudic aphorism puts it, "If you don't know where you are going, any road will take you there."

There is another and even more important fact about a postindustrial society. It is not just a service society in terms of where people work; it is not just an information society on the basis of organizing the flow of knowledge; it is also a society uniquely dependent upon the compilation of theoretical knowledge.

Now every society has always been dependent on knowledge in order to grow. But it is only in the last decades that we have become uniquely dependent on the codification of theoretical knowledge in order to know where we are.

This is preeminently the case in the relation between science and technology. If one takes a look at every major industry we have—steel, auto, aviation, electricity—these are all primarily 19th century industries in their pattern of innovation and in their origin, although steel

began in the 18th century and aviation in the 20th. But these were all created by talented tinkers who worked quite independently of the law of science; people like Darby in steel, Edison in electricity, the Wright brothers in aviation.

The first modern industry, so to speak, is chemistry insofar as one has to know the theoretical properties of the macromolecules which are manipulated in order to know what one is making. That is a unique relationship that is amplified by the atom bomb. It is implicated in the whole relationship to war which also creates a change of relationship of science to technology.

In effect, what this means, is those institutions primarily concerned with the codification of theoretical knowledge, become primary to society, because theory now, in effect, guides the way to practice. We have, in a postindustrial society, a reduction of empiricism and a growth of theory; theory, not only in the relation of science to technology, but also in the relation of economics to public policy. We have, for example, the extraordinary situation of a Labor government in England deliberately engineering a recession to redeploy resources in order, in effect, to create a sense of forward movement based upon economic theory. To that extent, one finds the codification of theory becoming central.

If that is the case, it means a number of things. It means that the health and strength of the intellectual community is not only a matter of a general concern to society, but a necessity in the organization of change. It means the sources of innovation in the society come from the intellectual institutions, the universities, the research institutes, the research corporations. It means moreover that the scarcest resource to the society is essentially talent (or human capital in the words of the economists) and the husbanding of human capital, the identification of talent is a much more different cycle than that of financial capital.

We know the principles of raising money capital, which is to restrict consumption and use the results of savings for investment, but the problem of identifying talent at an early stage, whether through headstart programs or several others, of husbanding it, monitoring it, enriching it, are essentially very difficult processes over a 20-, 25-year cycle.

The organization of human capital is also, therefore, a very real problem in a postindustrial society. To this extent, it seems to me that the kinds of problems we face are new and difficult. Every society always thinks its own problems are unique, but there are elements of interdependency and complexity in a postindustrial society which are genuinely novel in history. This makes our deliberations in the next 2 or 3 days more pregnant for the coming years in being able to guide our lives and the lives of our children.

THE "EMERGENT UNITED STATES" . . . POST-INDUSTRIAL SOCIETY

HERMAN KAHN [1]

The chart with which I begin attempts to give an encapsulated description of man's past economic history together with a look at his future. Basically it argues that man's primitive culture, presumably hunting or food gathering, lasted for the first million years or so of his existence. It is difficult to compute per capita income in this mode of existence but we can argue that, depending upon circumstances, it was something between $50 and $250 per capita, fully understanding that this is a rather misleading kind of estimate to make.

CHART I.—ONE WAY TO LOOK AT MAN'S ECONOMIC PROGRESS

Annual per capita product in 1965	Economic system	Leading sectors and most of development
$50 to $200	Preagricultural or primitive	1st 500,000 to 2,000,000 years.
	Preindustrial or agricultural	8th-1st millenium B.C.
$100 to $300	Industrial revolution	1760 to 1790.
$200 to $1,000	Industrialization	19th-21st centuries.
$500 to $2,000	Mature industrial	Mid 20th-21st century.
$1,000 to $10,000	Mass consumption	Mid 20th-21st century.
$5,000 to $20,000	Postindustrial	21st century.
$50,000 to ?	Almost posteconomic	22d century. (Assumes average annual increase in GNP/CAP of 2.3 percent or so).
?? to ?	?	23d century.

About 10,000 years there occurred the first of the three great events I'm going to talk about—the agricultural revolution. It started in the so-called Fertile Crescent of the Eastern Mediterranean and launched civilization. Civilization means civic culture, living in cities, and some but not all of the early agricultural societies created such a manner of living. For every 10, 20, or 30 people on the farm there was one man in the city. Very likely the average per capita income did not change, remaining something between $50 and $250 per year. What did change, of course, was the density of population and the way of life.

Indeed, as far as we know no culture ever went much over $250 per capital in individual income or ever dropped much below $50 until the industrial revolution in the 18th century. This was the second great event of history as we are looking at it, and it did, of course, change per capita income by a factor of 10 or so—that is eventually, when the industrial revolution had fully matured. We will as a matter of definition think of Europe in the 1950's as an instance of mature industrial culture. Southern Europe in the 1950's had about $500 per capita in-

[1] Director, Hudson Institute, Croton, N.Y.

come, northern Europe about $2,500. However, in some ways we are less interested in per capita income than in the general style of life, the culture and its capabilities.

It is now believed that the next 10, 20, or 30 years or so will bring as big a change in man's condition as these first two. There is a more or less tentative agreement to call this new transition the emergence of postindustrial culture. Income again is expected to go up by about another factor of 10 but once again we are less interested in income than in the style of life and other such issues. By the year 2000 about 20 percent of the world's population should be living in countries with an income at least within the post industrial range.

Two other entries on the chart are worth noting. The first is what I call the "almost posteconomic." This is by no means a ridiculous concept. If per capita income continues to rise by 2.3 percent or more a year (this is not a very startling rate of growth) then in a hundred years or so we should increase by another factor of 10 in per capita income. This would mean 50,000 to 250,000 per capita per year. It seems reasonable to call this posteconomic. As far as economic issues are concerned as we currently understand them, they are likely to be considered trivial or irrelevant. There will, of course, always be a problem of scarcity, and there will always be projects which people will be interested in doing which will have to be rejected because of their use of scarce resources, or at least in principle this should happen. But in so far as the standard economic issues which worry people today are concerned, one can call this a posteconomic society. It should probably be added that a good deal written today about the postindustrial culture would in my opinion apply more to this virtually posteconomic culture than to the kinds of conditions we expect to see in the late 20th and early 21st centuries. The differences which will develop during the next 30 years are simply not that big.

In principle at least, economic growth could continue indefinitely, and as we will mention later it gets more and more difficult to measure things like gross national product as we go into a "posteconomic economy;" but in any case the last line on the chart reminds us that growth may continue well into the 23rd and 24th centuries and beyond.

In the second chart we see a second version of economic history. We see as thin lines the three great changes, two which already have occurred, one of which we expect to occur soon. The thin line shown at 8000 B.C. is actually some 10,000 years or so wide. It took almost 8,000 years for agriculture to reach Spain and England, and there are some places it still has not yet quite reached. Thus that line indicates a very complicated process. It is easy to imagine that if somebody were to discuss these same issues some 3,000 or 4,000 years from now, they might collapse the period from 1750 to 2000 A.D. into a single line. My chart reflects our ethnocentricity, our own interest in recent and current events, rather than providing a real perspective on the whole process. If this were done we might have something like chart III, which shows in rather dramatic fashion one picture of human history—past, present, and future (we sometimes call this chart the big picture).

CHART II

TODAY WE TEND TO DIVIDE MAN'S ECONOMIC HISTORY INTO FOUR BASIC STAGES

HUNTING AND FOOD GATHERING
(PRE-AGRICULTURAL AND USUALLY PRIMITIVE)

8,000 B.C.

BASICALLY AGRICULTURAL
(PRE-INDUSTRIAL AND SOMETIMES CIVILIZED)

1,750 A.D.

INDUSTRIAL (OR MODERN AND/OR SCIENTIFIC)
- INDUSTRIAL REVOLUTION
- PARTIALLY INDUSTRIALIZED
- MATURE INDUSTRIAL
- MASS CONSUMPTION

2,000 A.D.

POST-INDUSTRIAL (OR POST-MODERN AND/OR POST-SCIENTIFIC)
- EMERGENT
- VISIBLE
- (MATURE)
- (LATE)

CHART III

FUTURE MAN MAY USE ONLY THREE STAGES

PRECIVILIZED

(2,000,000 years)

8000 B.C.

CIVILIZED

(10,000 years)

2000 A.D.

Postcivilized	(10 Years?
Posteconomic	100?
Truly Human	Eternity?
Posthuman	Until Fulfillment?)
Faustian	
Postfaustian	
Promethean	
Postpromethean	
Godlike	
Truly Religious (E.g. Neodeist)	

Chart III makes very dramatic the fact that we simply don't know what this postindustrial culture is. It may be postcivilized; it may be posteconomic; it may be what we can call "truly human"; or it may be posthuman. That is, there may be people, but people made in a laboratory, or people half human, half artificial as is considered in the so-called cyborg concept; or it might be that human beings will be replaced by the computer, as has been suggested in science fiction. I would distinguish very sharply between the Faustian and the Promethean in man. The Faustian man molds the environment to his liking; the Promethean understands but does not necessarily use his knowledge. It is even possible that in this world some of the central religious or philosophical questions of our times may be settled. Deists, for example, may understand better what they mean by a first cause and a final destination.

This uncertainty about what to call the postindustrial culture or its characteristics is fully reflected in the title of the next chart (IV). Each of the terms in quotes emphasizes that a problem exists here; we are speculating about a very basic change in culture on the inadequate but suggestive basis of current trends. But let me return to chart IV later in these remarks.

CHART IV

THE "EMERGENT" "U.S." "YEAR 2000" POSTINDUSTRIAL (OR POSTMASS CONSUMPTION) SOCIETY

1. Most "economic" activities are quaternary (largely self-serving, services to self-serving activities, or services to such services) rather than primary, secondary, or tertiary (production-oriented).
2. Per capita income $5,000 to $20,000/year (or about 10 times industrial and a hundred times preindustrial.
3. Narrow economic "efficiency" no longer primary.
4. Market may play diminished role compared to public sector and "social accounts."
5. Official floor on income and welfare for "deserving poor"—effective floor for others.
6. There may be more "consentive" and anarchic type organizations (vs. "Marketives" and "Command Systems").
7. Business firms may no longer be the major source of innovation or center of attention.
8. Widespread use of automation, computers, cybernation.
9. "Small world" (but "global metropolis" not "global village").
10. Typical "doctrinal life time" 2 to 20 years.
11. Learning society—Emphasis on late knowledge, imagination, courage, and innovation—deemphasis on experience, judgment, and caution.
12. Rapid improvement in institutions and techniques for training and teaching—"education" may lag.
13. Erosion (in some upper and upper middle classes) of work-oriented, achievement-oriented, advancement-oriented, deferred gratification values.
14. Likely erosion (at least in these same classes) of the other 11 "traditional levers."
15. Much apparent "late sensate chaos and polarization."
16. Sensate, secular, humanist, perhaps self-indulgent criteria may become central in important groups—at least during this transition period,
17. But the search for "meaning and purpose" will largely find at least an interim solution (or solutions).
18. This solution may contain important elements that are "against progress," against numbers 15 and 16 above, and/or against "western culture."

I want now to suggest to you what I call a surprise free projection of what the next 30 years ought to look like (chart V). The term "surprise free" simply means you put in all the theory you believe; if it occurs, you shouldn't be surprised. Of course, the most surprising thing you would have is no surprises. But I've been looking at a chart like this for about 5 years now and it looks pretty good to me now. So I'm beginning to think of it as a forecast rather than as a projection.

CHART V

RELATIVELY A-MILITARY, RELATIVELY A-POLITICAL, "SURPRISE-FREE PROJECTIONS" OF THE "MOST SIGNIFICANT" ASPECTS OF THE FINAL THIRD OF THE 20TH CENTURY

1. Continuation and/or topping out of multifold trend.
2. Onset of postindustrial culture in nations with 20 percent of world population and in enclaves elsewhere.
3. "Political settlement" of World War II—Including the rise of Japan to being the third superpower (or near superpower) and the reemergence of Germany.
4. With important exceptions, an erosion of the 12 traditional societal levers and a corresponding search for meaning and purpose.
5. The coming 1985 technological crisis—need for worldwide (but probably ad hoc) "zoning ordinances" and other controls—a possible forced topping out of No. 1 above.
6. Onset and impact of new political milieu.
7. Rise of a "humanist left-responsible center" confrontation—particularly in the high (visible) culture.
8. Increasingly "revisionist" communism, capitalism, and christianity in Europe and Western Hemisphere.
9. A general decrease in consensus and authority—a general increased diversity (and some increased polarization) in ideology, in value systems and in life styles.
10. Increasing problem of trained incapacity and/or illusioned or irrelevant argumentation.
11. Worldwide (foreign and domestic) law and order issues.
12. Populist and/or conservative backlash and revolts.
13. Better understanding of and new techniques for sustained economic development almost everywhere.
14. High (1–15 percent) annual growth in GNP/CAP almost everywhere.
15. Worldwide capability for industry and technology—recently a growth in multinational corporations and conglomerates.
16. Much turmoil in Afro-Asia and perhaps Latin America.
17. Nativist, Messianic, or other "irrationally emotional mass movements—general decrease in rational politics.
18. A relatively multipolar, relatively orderly, relatively unified world—that is, enormous growth in world trade, communications, and travel; limited development of international and multinational institutions; some relative decline in the power, influence, and prestige of U.S. and U.S.S.R.; new "intermediate powers" emerge: e.g., East Germany, Brazil, Mexico, Indonesia, Egypt, Argentina, etc.; a possible challenge by Japan for world leadership of some sort, China and Europe both rise and fall.

Those who have read "The Year 2000: A Framework for Speculation on the Next Thirty-Three Years" will remember an earlier form of this chart. (This earlier form was labeled somewhat more simply, but not very differently.)

Let me explain this chart by first commenting on the concept of a "projection." A projection is a more or less routine, mechanical, prescriptive, or other way of extending a past trend into the future.

There is no necessary implication that the projection is valid or even meaningful. It thus differs from a "forecast" or a "prediction." In a forecast we try to describe all the important likely events and give some idea of the relative probabilities. This is, of course, what one would like to have. Thus if one is tossing a fair coin, the forecast would be 50 percent chance of heads and 50 percent chance of tails. One would not feel that the forecast had been vitiated if one knew ahead of time it had as good a chance to come out heads as tails. Similarly, in a fair toss of dice there is one chance in 36 of getting two ones.

These odds are so low that one might therefore often be willing to predict that two ones will not come up on the next toss. But if such an event actually occurred in a toss, this would not be considered an overwhelmingly persuasive proof that the prediction had been foolish, incorrect, or inexpert. However one chance in 36 is so improbable that it would certainly arouse some questions if not outright skepticism. In any case it would not be taken as strengthening the general credibility of the forecaster and/or his methodology. Thus in the case of many predictions, we are usually arguing that a particular set of events has some combination of likelihood and importance so as to deserve serious consideration or that it is more probable than not that one of the set will actually occur. Of course, if one is absolutely certain about his prediction then one is probably in the "prophecy business" and not in futuribles or policy research occupations.

If we consider the concept of a "surprise free projection" we are considering something which resembles the naive projection of economics though it is a somewhat more sophisticated concept and, I believe, often more useful. In the so-called naive projection one keeps certain aspects of a situation constant and lets others continue or evolve in some prescribed manner—usually according to current trends. In the surprise-free projections we put in any theories which we happen to believe. Naturally if events evolve according to our theories we should not be surprised; hence the term "surprise free."

It is possible to have two or more contradictory surprise free projections because many times we may entertain two or more hypotheses or theories simultaneously, and if any one or more of these actually occurred, then once again "we would not be surprised." Unless there is further discussion of the "surprise free projection" there is no denotation or connotation to be derived from the name itself of just how deeply, firmly or emotionally committed to these theories or projections we are. They are often simply hypotheses, concepts or theoretical ideas which we are willing to entertain reasonably seriously but do not necessarily feel have been proved, documented, or otherwise possess a high degree of assurance of being correct.

It is common in discussing a set of issues as large as those indicated on the first chart to make the comment that the most surprising thing that could happen would be no important surprises. And indeed it would be most surprising in many periods of history if very important unexpected events did not occur which were important enough to change the other trends on the chart. Now it is, of course, possible to

have very big surprises and important events which, however, do not conflict significantly with the trends on the chart. These other events might be important enough so that if we had known about them we would have included them on the chart, but not including them does not necessarily vitiate the trends that are listed. In other words, even though surprising events occur they might still allow for "other things being more or less equal" as far as the trends and issues on the chart are concerned.

As I remarked earlier, I have been studying this basic surprise free projection for about 4 or 5 years in one form or another and have now more or less come to believe it. We all are familiar with various kinds of ego involvement mechanisms and therefore it is easy to jump to the conclusion that I am simply being trapped by this kind of psychological mechanism, and this may in fact be occurring. On the other hand, a rather persuasive case can be made that the last third of the century will be very different from the first two-thirds—and that one of the differences lies in the relatively apolitical and amilitary character of most of the important trends of the last third of the century. It is this possibility as much as anything that makes the surprise free projection relatively plausible—at least for the trends and issues with which it is concerned.

The relatively apolitical and amilitary character of the basic surprise free projection can easily be seen by comparing the projection with what happened in the first two-thirds of this century. There is nothing, for example, like World War I, the subsequent triumph of democracy over authoritarianism and monarchy, the rise of communism, the great depression of the first third of the century, or the subsequent rise of fascism. Nor is there anything much like World War II, the successes and fall of fascism, the expansion of communism, the decolonialization of Afro-Asia, and so on. What I am suggesting is that if one had bought a map of the world in 1967, it is probably going to be a pretty good map in the year 2000, and that this would not have been true for either the first or second third of the 20th century.[2]

A rather illuminating analogy can be made with the 19th century. Imagine that we showed up at the conference in Vienna in 1815, called to draw up a treaty to terminate the Napoleonic and revolutionary wars of the previous 25 years. We know from the diaries and other historical data that almost to a man the delegates were deeply concerned about having another 25 years or so of the same kind of revolutionary violence. Presumably if one had asked these people to predict the next quarter of the century they would have argued that it would be "much like the last quarter." What happened was quite different.

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[2] However, see the Great Discontinuity by Peter Drucker for an argument that actually the first two-thirds of the century exhibited a remarkable continuity in economic variables and that the last third of the century will see the real economic discontinuities. This view is not in as much contradiction with my own view as a superficial reading would indicate. I agree that the economic development proved, despite the political and military upheavals, to go remarkably smoothly and relatively predictably. I simply note here a likely relative absence of sharply discontinuous and relatively erratic political and military events in the last third of the 20th century while agreeing—at least to a degree—with the expectation of relative economic and cultural discontinuities.

There was almost 100 years of relatively evolutionary processes rather than revolutionary processes. It is true that there was 1830 and 1848, both of which had their revolutionary aspects. There was the Crimean War, the Austro-Prussian and Franco-Prussian wars, the unification of Italy and Germany, and many other military-political events. But given all this, by and large, one can argue that these next 100 years were, almost certainly as compared to expectations, evolutionary and quiescent rather than revolutionary and violent.

The most important things that happened in the 19th century were the industrial revolution (which in our formulation would simply be a continuation of the multifold trend), the achievement of a very high state of technological competence and relative affluence on the continent of Europe (which in our jargon would be the achievement of an early industrial culture), and finally, and in a way the most interesting to us at the moment, the unexpected rise of Prussia to a position of semidominance in Europe. This last was almost completely unexpected and presumably no one at the conference of Vienna would have predicted it. Yet this rise of Prussia dominated events in the last third of the 19th century and the first half of the 20th century.

I am going to argue that there will be a similar rise of Japan in the last third of the 20th century. A rise which is still largely not realized and whose significance has been large underemphasized.[3] The 21st century may well end up as the Japanese century.

CHART VI

1. High saving and investment rates.
2. Superior education and training.
3. "Adequately capitalized."
4. "Risk capital" readily available.
5. Technological capabilities competitive to west.
6. Economically and patriotically advancement-oriented, achievement-oriented, work-oriented, deferred-gratification, loyal, enthusiastic employees.
7. High morale and commitment to economic growth and to surpassing the west—by government, by management, by labor, and by general public.
8. Willingness to make necessary adjustments and/or sacrifices.
9. Excellent management of the economy—by government, by business, and, to some degree, by labor—this results in a controlled and, to some degree, collectivist but still competitive and market-oriented (but not market-dominated) capitalism.
10. Adequate access—on good and improving terms—to most world resources and markets.
11. Almost all future technological and economic and most cultural and political developments seem favorable.
12. Currently relatively few and/or weak pressures to divert major resources to uses with "low economic productivity."

[3] However in May 1969 while on a trip to Japan the author suggested that after the Osaka Exhibition of 1970 there would probably be a great tendency both in Japan and outside of Japan to understand this likely future role of Japan. This would in part be true because of the focus on the year 2000 that the exhibition forces, and also because the figures for Japanese growth are just too startling to be ignored much longer. This change will presumably prevent Japanese talking "poor mouth" (i.e., from pointing out they are 20th or so in per capita income). It will probably take a good deal longer for many of the implications to sink in. (Indeed I do not think of myself as necessarily having many or most of these thought through, though I certainly have been interested in the subject and have speculated extensively in a forthcoming book, the Second Rise of the Rising Sun, to be published by Prentice Hall in 1970.)

In chart VI, I have 12 reasons why the Japanese economy should probably continue to grow until the end of the century. As you may know, the economy grew by a factor of three in the fifties, from small to medium. It grew by another factor of three in the sixties, from medium to large. It's now the third largest in the world. It seems quite likely in the seventies, it will grow by more than a factor of three, from large to gigantic. Now, when you go from small to medium, it doesn't change much. When you go from medium to large it changes a lot. When you go from large to gigantic, people have got to make room for you. There are a lot of reasons why it's growing.

Let me just give you two of them because it illustrates what a different culture looks like. This country is the most prestige conscious in the world. It's only when they get the hierarchy straightened out, if they are older Japanese, that they even know what pronouns to use. If they are younger Japanese, they don't have that problem, but they still sort of have to know. These people are watching growth rates like we watch baseball scores and they are very elated about the whole thing.

Now it's more than that. I'd like to read this song:

For the building of a new Japan,
Let's put our strength and mind together,
Doing our best to promote production,
Sending our goods to the people of the world,
Endlessly and continuously,
Like water gushing from a fountain.
Grow, industry, grow, grow, grow!
Harmony and sincerity.
Matsushita Electric.

This kind of song is sung for 10 to 15 minutes every morning in Japanese factories. Management and labor just get together and sing it for fun. They like it.

It is not sung anywhere else in the world, including China, if you are interested.

The song is an accurate statement of fact if you notice. They do build a new Japan. Every 6 years they double the size of the country. They do put their strength and mind together. They do their best to promote production. Grow, grow, grow. Harmony and sincerity. What's wrong with it? The answer is, nothing. But no other culture can sing it.

Now an interesting point about the rise of Prussia in the last 19th and early 20th centuries is that the British were quite clear, or at least many of them were, that the Prussian economy was more dynamic than theirs and that the traditional British growth rates of 1 to 2 percent, which had made them the wonder of the world, in the late 18th and early 19th centuries were now in a sense disgraceful, since the Prussians were likely to do so much better. On the other hand, initially at least they did not have any great anxiety about Prussia passing them—indeed the two countries were very close. It was not until

the Germans decided to build a navy that they began to drift apart and that Britain made up with its 500-year old enemy, the French.

This decision on the part of the Germans to build a navy while based upon rational argumentation (Admiral Tirpitz' risk theory) was probably one of the most foolish decisions ever made by a great country and may have, in some reasonable sense, been the most important single cause of World War I and of the British entering that war against the Germans. One way to characterize a central issue of United States and Japanese foreign policy in the future is that neither country make a decision of that sort.

I will now turn back now to the first—and therefore by implication the most important—trend of my basic surprise free projection. We argued in "The Year 2000" that there was a long-term secular trend in western culture, which goes back about a thousand years, though the 16 aspects of it, which I show below, do not all go back that far. Some only go back a few hundred years, some go almost the full millenium.

CHART VII

THERE IS A BASIC, LONG-TERM, MULTIFOLD TREND TOWARD:

1. Increasingly sensate (empirical, this-worldly, secular, humanistic, pragmatic, manipulative, explicitly rational, utilitarian, contractual, epicurean, hedonistic, etc.) culture—recently an almost complete decline of the sacred and a relative erosion of "irrational" taboos, totems, and charismas.
2. Bourgeois, bureaucratic, and "meritocratic" elites.
3. Accumulation of scientific and technological knowledge.
4. Institutionalization of technological change, especially research, development, innovation, and diffusion—recently and increasingly a conscious emphasis on synergisms and serendipities.
5. Worldwide industrialization and modernization.
6. Increasing capability for mass destruction.
7. Increasing affluence and (recently) leisure
8. Population growth—now explosive but tapering off.
9. Urbanization and recently suburbanization and "Urban sprawl"—soon the growth of megalopolises.
10. Recently and increasingly—macroenvironmental issues (e.g., constraints set by finite size of earth and various local and global reservoirs).
11. Decreasing importance of primary and (recently) secondary and tertiary occupations.
12. Increasing literacy and education—recently the "knowledge industry" and increasing numbers and role of intellectuals.
13. Future-oriented thinking, discussion, and planning—recently some improvement in methodologies and tools—also some retrogression.
14. Innovative and manipulative rationality increasingly applied to social, political, cultural, and economic worlds as well as to shaping and exploiting the material world—increasing problem of ritualistic, incomplete, or pseudo-rationality.
15. Increasing universality of the multifold trend.
16. Increasing tempo of change in all the above.

We also argued, in "The Year 2000," that the observation that the above secular trends really existed was empirical rather than theoretical, and not very dependent upon any particular perspectives on—or theory of—history. Of course, the 10 or so important macrohistorians who have seriously discussed the rise and fall of cultures have all also noticed this trend, and have actually attributed to it enormous significance—even if they disagree about details and implications. I,

here, would like to use this concept of a long-term multifold trend as an important organizing concept which is also a very useful source of conjectures as well as a context and framework. Some of these conjectures will overlap with the speculations of the macrohistorians, but we will not here accept any particular theory of macrohistory as being proven.

First and foremost is the trend toward an increasingly sensate society. This is not just a question of an increasing role for science and/or technology, but a systematic erosion of the sacred, of the role of taboos and totems, and in some ways even an erosion of the very concept of authority and tradition. It is obvious that there are many ebbs and flows in this "erosion of the sacred." One thinks of the Reformation and the counter-Reformation, or on a much lower scale of the enlightenment and the later romanticist reaction. Further, many religious humanists, some secular humanists, and many "cultists" would deny any formulation that attributed a lesser religiosity or sacredness to their personal beliefs. Making reasonable concessions to all of the above points of view, nevertheless one can argue persuasively that ever since the 10th or 11th century there has been a general decrease in the role of the religious and the sacred perspectives and attitudes and an increase in the role of the mundane, the secular, the practical, and the humanist perspectives and attitudes. I personally would agree with many of the macrohistorians that this process may be the single most important aspect of the long-term multifold trend.

The second trend, the trend toward bourgeois, bureaucratic and meritocratic elites, has been almost universal in recent years. There has, of course, in the last 5 or 10 years come into being a rather spectacular revolt against middle-class bourgeois values—a revolt led by the youth of the bourgeois upper-middle-class. In many ways this revolt is a reactionary. How far this latest antibourgeois movement will get is, of course, still an open issue.

We need say little here about points three, four, and five except to note that it is exactly this increase in technological, economic, and military capability in the West—and some other important variables—which led to trend of expanding sphere of influence of the West and the current worldwide industrialization and modernization.

The following four maps illustrate how pervasive the West became from a low point in the middle of the 15th century (the fall of Constantinople). (There is supposed to be a letter in existence from the Pope to one of the Kings or Emperors in which he mentioned the low state to which Christianity had fallen and how unlikely the prospect looked for recovery.)

It seems quite likely that outside of the 20 percent of the world that is expected to live in postindustrial societies by the year 2000, the other 80 percent of humanity is likely to be deeply preoccupied with various kinds of reactions that resulted from the process of more or less forced Westernization and then withdrawal.

As far as the West itself is concerned, in the last two centuries or so, much of the increasing affluence has resulted in increased leisure and increased population growth. This population growth in the West, which until recently has been quite explosive, may now be tapering off.

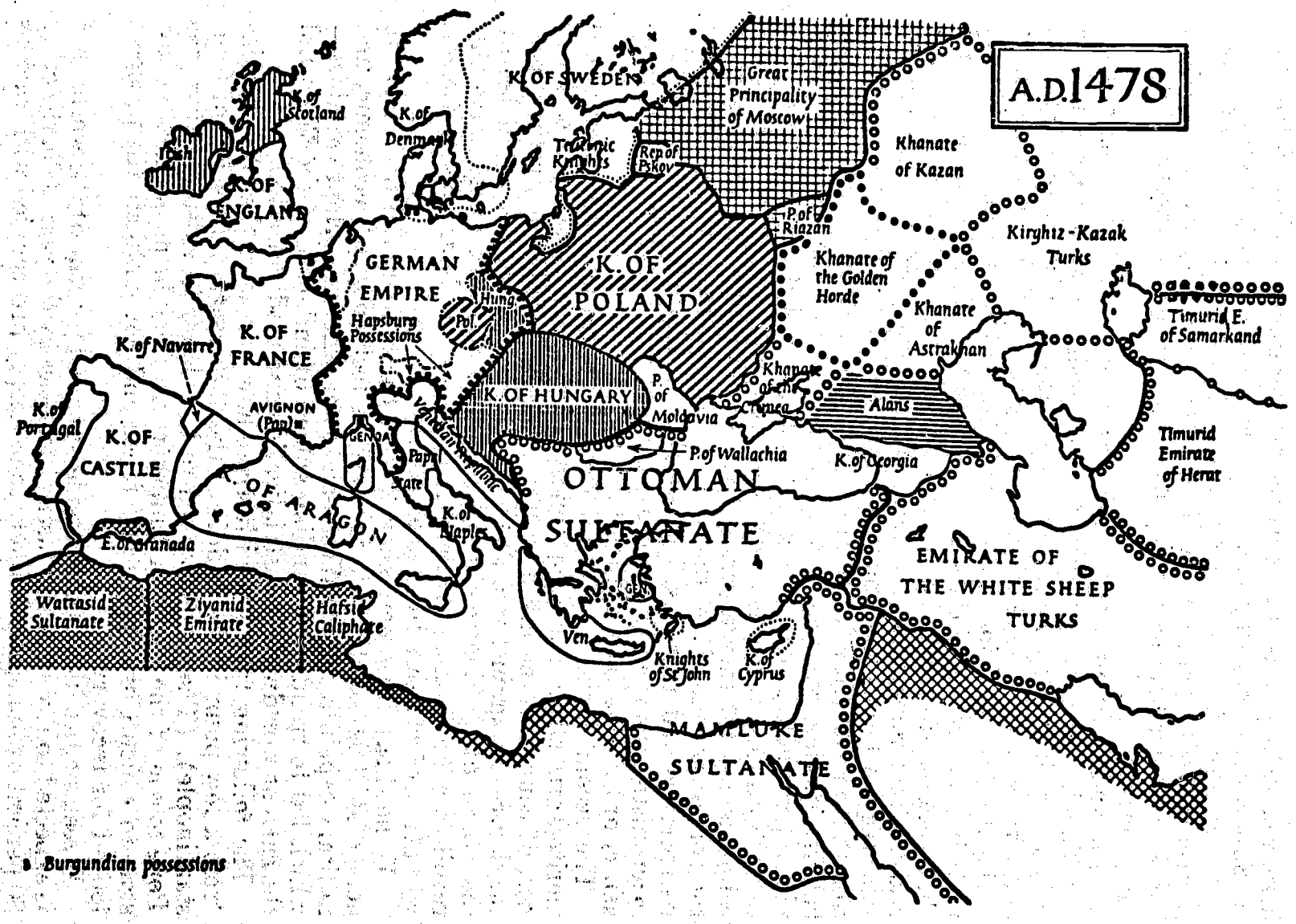
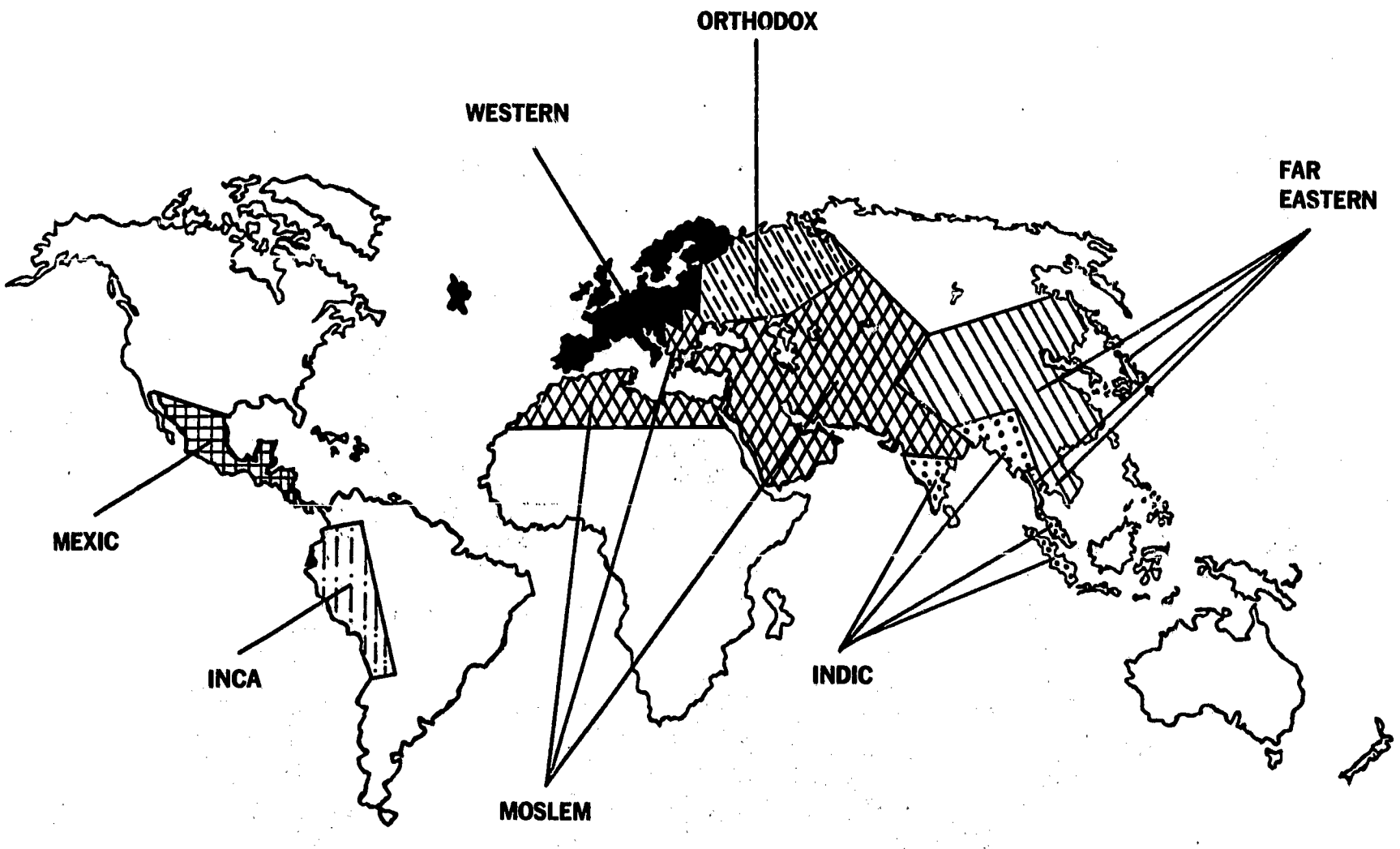


Chart VIII–A.—EUROPE IN 1478



HERMAN KAHN

Chart VIII–B.—THE WORLD IN 1500: MAJOR CULTURE AREAS

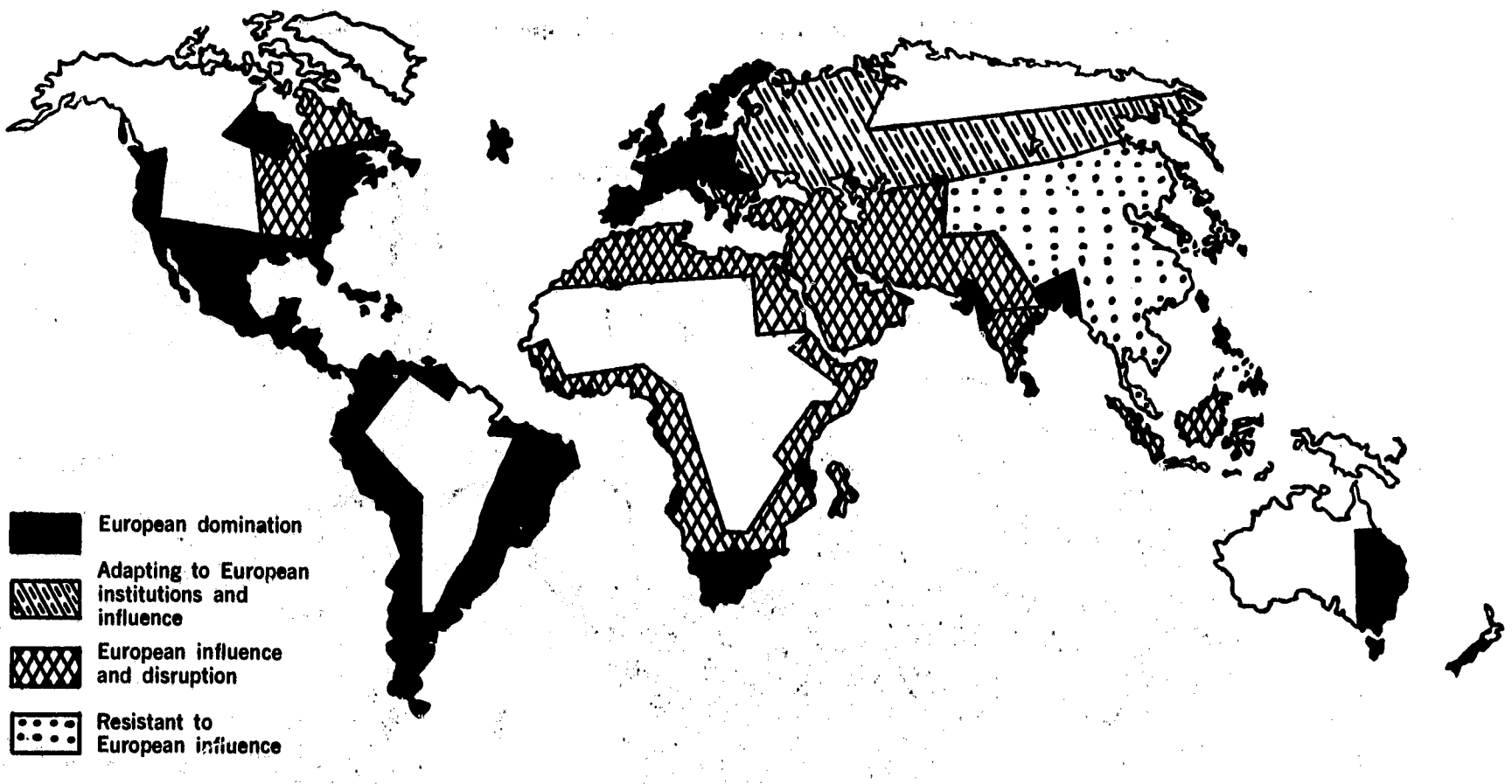


Chart VIII–C.—THE WORLD IN 1750: ZONES OF WESTERN CONTROL AND INFLUENCE

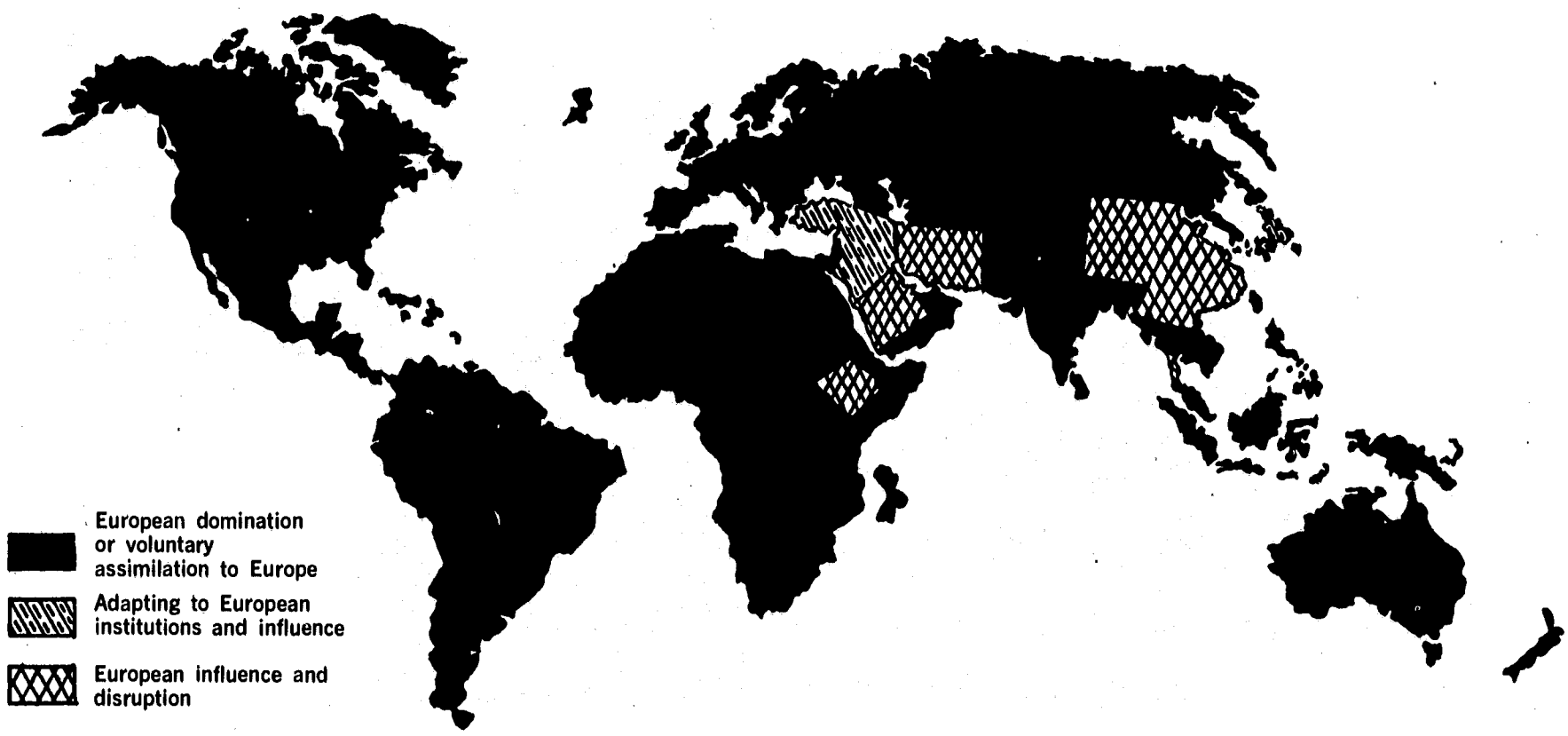


Chart VIII–D.—THE WORLD IN 1914: THE CLIMAX OF EUROPEAN EMPIRE

Trends 9 and 10 (urbanization and macroenvironmental issues) have only recently become serious problems. One can argue that one of the most important changes occurring in the human condition is the almost complete transformation in the 19th to 20th centuries of almost all societies from being mainly rural to being mainly or almost 100 percent urban. Many current problems and issues result directly from this concentration of human beings and activities.

Other issues are included in trend No. 10, the constraints set by the finite size of the earth and its various reservoirs includes the pollution issues, but we are also thinking here of overcrowding, of the ease with which one can procure rockets with a worldwide capability, and so on. To some degree, the commonly voiced and near apocalyptic view of the 1985 technological crisis is caused mainly by the finite size of the earth and its various local and global reservoirs. Many of these issues simply would not arise—or at least not so soon—if our civilization were located on a large planet such as Jupiter.

This issue of a coming 1985 technological crisis was raised in more or less this formulation in an article by John von Neumann in the June 1955 Fortune magazine, in which he discussed the likelihood that a number of technological trends seem to come to a crisis stage sometime around 1980, or soon afterwards. I myself feel that John von Neumann was basically right, even though I would tend to choose 1985 as the modal crisis year. We lump here issues going all the way from pollution and modern military technology to "better living through better chemistry" (e.g., drugs) and genetic engineering for the individual. Some of these issues, such as those associated with weapons of mass destruction have almost preoccupied the public debate for some years now. Others have just recently come into prominence. Indeed in some ways currently the center of attention has shifted to the pollution issue. Shifted to such a degree and with such an intensity that I recall somewhat ruefully a prediction I made about 3 years ago, that it would be very hard to exaggerate the importance of pollution but that many publicists and romanticizers would soon succeed in doing so.

The pollution issue has the remarkable character that almost all classes and political groups in the United States seem more or less willing to focus attention on it as a major issue. For the perspective of the Left this issue validates their long-held distrust, dislike and skepticism about affluence and technology. They can now say, "As we always thought, this modern technology and affluence is nothing but garbage, or at least produces a lot of it." Those on the right, particularly the hunters, outdoorsmen, and the like, tend to have an almost mystic interest in preserving historic America—including the woods, the streams, the beaches, unspoiled wilderness areas and the like. And almost everybody would like to breathe clean air, drink clear water, have easy, comfortable and good looking recreation areas readily available, as well as having living space, elbow room, and privacy in normal everyday life.

The 11th trend noted in chart VII, which of course reaches its limits in the postindustrial culture (in which the primary, secondary, and tertiary occupations become of almost trivial importance), is today of importance in all countries—even ones that are very distant from being

postindustrial. However, it is only those that are close to postindustrial in which the knowledge industry dwarfs all other industries. This does not mean that you may not have an excessive role for intellectuals in even relatively primitive countries. India, for example, has a serious problem of unemployed college graduates and of students who have had some college. But it is only in the postindustrial or near-postindustrial societies that the overwhelming majority of people make their living, in some form or another, from the knowledge industry. And the intellectuals (people who derive their experience of the world in a second-hand manner, deal mainly with ideas, and who often attempt to idealize or intellectualize issues) become a numerous or even dominant group as a result of their sheer numbers.

We include as part of trend No. 13 the idea of progress and the revolution of rising expectations. This has resulted, of course, in the 20th century in deliberate and planned economic development. We also note that in part because the modern intellectual tends to be educated mainly in relatively technical or technological fields and lacks a sense of history, and in part because he lacks certain kinds of practical experience, that there has been some retrogression in our ability to plan our future. In some real sense the quality of the people doing the planning today may not be as good as was available 20–200 years or so ago. In any case, this is the age of item 14—an age of innovative and manipulative rationality increasingly applied to social, political, cultural and economic worlds, as well as to shaping and exploiting the material world. This in turn seems to bring with it increasing problems of ritualistic, incomplete or pseudo rationality—e.g., a rationality whose job is less to give intelligent and useful guidance than to satisfy certain bureaucratic, morale, public relations or other ritualistic or psychological demands and needs.

The last two points, of course, are not only pretty obvious; many are now beginning to believe that these two at least must top out—that the multifold trend can no longer be increasingly worldwide and with an increasing tempo of change both within and outside of Western culture.

Let me suggest, then, what "postindustrial" culture might mean. It is summarized in chart IV, which we have already seen. I call it the "Year 2000" postindustrial culture because it is occurring in a certain milieu. If you changed the milieu, this postindustrial culture might look quite different. Let me discuss item 3. Economic efficiency is no longer a central issue. That isn't quite right and I'd like to describe what I mean by that.

If you look, say, at the average American applying for a job, he generally asked, before World War II, only two questions. What is the salary and what are the chances of advancement? Today he asks a number of questions. What's the neighborhood like? The schools? Impact for family? Fringe benefits? What do you make? It's much easier to hire a man for aerospace than for Post Toasties today. He still asks the same questions as before. But they are not dominating. So that has been a very big change, but the change has not been 100 percent. Now in some ways the change has been. If you ever want to know the true heart of a people, what they really think, it's a very good idea to look at the third-rate literature and the third-rate movies. I'm

referring to the confession magazines, the soap opera, the grade C movies, and so on. These are not confused by either genius or creativity. They speak right from the heart. Each country has its own pattern. The U.S. pattern is really quite interesting. Before 1930, if there was ever a conflict between job and family, between interpersonal relationships and advancement, job and advancement always won out or there was tragedy. Since 1960 that's been reversed. It is no longer considered ligitimate for an American to sacrifice his family for his career.

In 1930, an American who earned a million dollars and acquired an ulcer in the process was looked upon as a hero, wounded in the battle for success. In 1960 that same man is looked upon as a compulsive neurotic with twisted values. In other words, he looks sick rather than heroic. That's a really startling change in just a 30-year period and the change has continued since. And that I think is one of the main characteristics of this postindustrial culture. You remember about 50 years ago President Coolidge made a comment that the business of America is business. When he said that, it was an absolutely accurate statement. Some 30 years later Charles Wilson made the comment that what's good for General Motors isn't bad for the United States. When he said that, that wasn't a bad remark but a much criticized remark. Their economic interest largely overlapped. To a degree which was really startling he could defend his position. You could not do it today. I have been in an audience with Jim Roche and he admitted that he could not make that remark. Even today General Motors has become a rather small part of the United States. You know the book, "The New Industrial State," by J. K. Galbraith? What I am suggesting is almost the exact opposite thesis. In order to describe it, let me use an analogy. Imagine this was 1850 and I was giving you a talk on agriculture and I noticed that for the year 1970 less than 3 percent of the population would be producing about 98 percent of the food. I would call that the new agricultural State and point out that this 3 percent would have a stranglehold on everything and would run the country. You have noticed that it didn't happen. Agriculture is a fairly dull subject in the United States. That's a notion of postindustrial. Industry will be a small and relevantly uninteresting part of the United States.

It's not posteconomic. There are about 200 people who spend more or less full time or a lot of time in writing about the future and most of them seem to write as if there would be no economic problems any more. I do not believe that's correct. I do not believe that this will be a leisure society in which people fight over the right to work. And if they do, I'll watch them. I won't fight.

Now one issue immediately comes up. Will this society be postbusiness? That's an open issue. If industry stays in the same areas which it is today, it'll be postbusiness. If it moves heavily into new areas and it seems likely in the United States, but unlikely in Europe, then it may not be postbusiness and there may be a big difference here between Europe and the United States.

Point 4 in chart V, our projection of the "most significant" aspects of the final third of this century, gives you some of the reasons for this. The erosion of traditional values in the West and their partial replacement by new values and their partial non-replacement by any-

thing. This shows up most sharply in the upper middle-class youth and, by the way, it's cross cultural since it picks up most of Latin America, most of western Europe, and North America. Let's look at this upper middle-class kid for a second. He knows there's a new society coming up. Has no interest in history. Thinks it's bunk because somehow nothing before World War II is relevant. If he asks himself, who are the most successful nations in the world, say, economically, the answer comes very fast: West Germany and Japan. And, of course, they lost World War II. So rule number one, it's good to lose wars. Or at least it doesn't make much difference whether you win or lose it. What I am saying here is the world has changed in very important ways and he knows it. He may overstate it and I think he does, but he does notice it.

Now I want to paraphrase Freud. Freud once made the comment that for most people, their only touch with reality is the requirement to earn a living. Take that away and most people can and will live disillusioned lives. I want to argue that there are at least 12 levers which societies like ours have used to force people to, in a sense, reality test.

CHART IX

THE 12 TRADITIONAL SOCIETAL "LEVERS"

(I.e., traditional sources of "reality testing," social integration, and/or meaning and purpose)

1. Earning a living.
2. Defense of frontiers (territorially).
3. Defense of vital strategic and economic interests (or possibly vital political, moral, and morale interests).
4. Religion.
5. Tradition.
6. Other "irrational" and/or restricting taboos, rituals, totems, myths, customs, and charismas.
7. Biology and physics (e.g., other pressures and stresses of the physical environment, the more tragic aspects of the human condition, etc.).
8. The "martial" virtues such as duty, patriotism, honor, heroism, glory, courage, etc.
9. The manly emphasis—in adolescence: team sports, heroic figures, aggressive and competitive activities, rebellion against "female roles"; in adulthood: playing an adult male role.
10. The "puritan ethic" (deferred gratification, work orientation, achievement orientation, advancement orientation, sublimation of sexual desires, etc.).
11. A high degree (perhaps almost total) of loyalty, commitment and/or identification with nation, state, city, clan, village, extended family, secret society, and/or other large grouping.
12. Sublimation and/or repression of sexual and aggressive instincts.

Or at least to force certain points of views on them, if you will. I want to argue that all levers are and have disappeared for the upper middle-class kid. Not for the society as a whole. America is only about 15 percent progressive middle class or upper middle class. But it happens that the upper middle class sort of runs the society. So they are a very important group.

What happens when these levers disappear? Well, do you remember that I made the comment that the business of America was business. I said that's no longer true. Do you know what the business of America is today? Creating a new society. It's a very strange business and I wouldn't recommend it. It's a complicated business. Many people feel

excited about the enterprise. God bless them. I find it very hard to believe that people will do a good job. They have very little guidance, to me.

CHART X

THE CURRENT "TRANSITION" AND/OR SEARCH FOR MEANING AND PURPOSE SEEMS LIKELY TO ENCOURAGE THE FOLLOWING:

1. High consumption and/or conformist, materialist, bourgeois, and/or new middle class "good citizens."
2. Neo-cynicism.
3. Being a human being (neo-epicureanism, familial and altruistic motivations and/or emphasis on interpersonal interactions).
4. Fulfilling a sense of responsibility (neo-stoicism).
5. Neo-gentlemen (e.g., neo-athenians and/or Europeanization of U.S.).
6. Self-actualization.
7. Special projects or programs that create general or specific esprit, elan, pride, excitement, charisma and/or chauvinism.
8. "Bread and circuses" (including for example both welfare and "happenings").
9. Rise of new and old cults.
10. Protest, revolution, and violence as a kick or even a way of life—(e.g., a commitment to Nihilism, anarchism and/or neo-fascism as well as 'ordinary" protest movements resulting in continuing and continued demonstrations and riots).
11. Semipermanent adolescence.
12. Other kinds of "dropouts" and quasi-dropouts.

Now chart X is what I think the new society, at least in the transition state looks like. I think it is more likely to be the top of the column rather than the bottom. Notice line seven. That's of special interest. I think one of the ways we are going to turn people on in the future is by big exciting or small interesting projects. It's a little bit like Augustus and his attempt to convert Rome from brick into marble. The Lincoln Center type project in a way is very typical of this kind of a culture and our reaction to the problem. Lincoln Center is not great art; you hire it, you buy it.

CHART XI

SOME IMPORTANT HUMAN NEEDS AND/OR VALUES

1. Respect and recognition (competitive and mutual).
2. Proper mix of change, stability and/or continuity.
3. Rectitude, duty and responsibility (fulfilling ethical, moral and/or religious imperatives).
4. Daily activities and disciplines which are ends as well as means—which are judged to be, in themselves, fulfilling and meaningful.
5. Having status—a recognized position, role, identity.
6. Advancement orientation—enhancing one's status.
7. Achievement (gaining and using skills, meeting challenges, solving problems, creating and/or doing worthwhile or admirable things and projects).
8. Wealth (access to commercially available resources).
9. Physical well-being (safety, health and comfort).
10. Physical power (over things—territorially?).
11. Egoistic immortality (recognition).
12. Loyalty to or submergence in familial (shared fate, common commitment, ego-identification) structures.
13. Political representation (voting on and protection from community decisions).
14. Political power (over people and community decisions).
15. Praise, reassurance, attention, etc.

16. Justice to be done and/or morality to be made manifest—e.g., appropriate rewards and punishments for "good" and "bad" behavior.
17. Assurance and confidence about the important values.
18. Sensual satisfaction (food, sex, music, art, aesthetic and pleasant surroundings and experiences).
19. Adventure, excitement, danger.
20. Friendship, companionship, affection and love (to give and/or receive).
21. Enlightment and understanding.
22. Play, spontaneity and self-expression (being oneself).
23. Having and sharing spiritual, mystical and religious experiences, codes and/or fulfillment.
24. Satisfaction of feelings of anger, revenge, other hostile emotions—perhaps slightly sublimated or masked.
25. Mashochistic, sadistic, nihilistic, etc., motivations—perhaps somewhat sublimated or masked.
26. Other "perversions" (sexual, gustatory, drug, etc.).

Let me describe some of the ingredients that go into this transition. It will also give you a sense of the uncertainties. Here in chart XI is a pretty comprehensive list of human values which various societies have emphasized in the past. No society can emphasize all of these values. Some of them are contradictory. Many societies emphasize just a very small number. Some emphasize a rather large number. One way to characterize U.S. society in the past is to say that we have tended to emphasize almost all of the first group and deemphasize the bottom group. One of the transitions that is occurring, again in the upper middle-class kid and maybe in the society as a whole later, is a movement from one to the other and that change is a very big change. The want to make a living issue illustrates it.

Let me illustrate how easy it is to make a living in the United States today. If you ask yourself, what does it take to live like an upper middle-class kid, living very inexpensively, you are talking about a hippy. Hippies are, almost, in the United States, not in England, a hundred percent upper middle-class. The few who are not tend to be paranoid or schizoid or have other mental problems. This is not said in criticism, but the hippies do in fact furnish a very nurturing and protective environment for certain kinds of mentally disturbed people. I don't know what it costs today to live like a hippy. They've left the cities to a large degree. They are living out in the country. But I and others have made surveys in '67 and '68. We got the same answer in Haight-Ashbury, Cambridge Square, East Village, Los Angeles. Five hundred dollars a year, ten bucks a week. That includes the drugs. They live very inexpensively. Now it just happens that Uncle Sam pays five hundred a month for the graveyard shift in the Post Office for literate work. So this is 32½ hours work a week, 6½ hours work a night. In other words, if you are a hippy and upper middle-class, you are literate and you can pass the Civil Service exam with no trouble at all. It means you can live twelve to a pad, work one month on and eleven months off. And they do.

About one-third of the people working literate jobs in the graveyard shift at the Post Office are, in fact, hippy. I might make the point that those who are working 1 month on and 11 months off, all object to the interruption and all talk about guaranteed annual income. They are very upset. It's interesting to note that another third of the people in the graveyard shift are Negroes, young Negroes and you might ask,

what's a young Negro doing there if he's literate? And the answer is, he's got two jobs or he's going to school in the daytime. He's an upward mobile young Negro. The two groups dislike each other intensely and there is no communication problem. They communicate just fine. The more they communicate, the greater the dislike. What one group is throwing away, the other group is killing itself to get.

The point I am trying to make here is not only the shift in values, but how easy it is to live in the second group of values in the chart. You can do it. It's practical. You couldn't have done it 50 years ago. Let me make the same point a little more dramatically.

CHART XII.—SOCIAL AND POLITICAL IDOELOGIES MAY EMPHASIZE:

(1) Impulse	(2) Reason	(3) Conscience	(4) Transcendence	(5) God's will
Leading to, at best, a reasonable emphasis on:				
Freedom	Rationality	Loyalty	Spirituality	Revealed truth.
Spontaneity	Moderation	Dedication	Perspective	Absolutism.
Creativity	Thoughtfulness	Tradition	Pan-humanism	Salvation.
Perceptiveness	Meliorism	Organization	Idealism	Righteousness.
Participation	Flexibility	Order	Altruism	Eschatology.
Sensory awareness	Calculation	Obedience	Mysticism	Worship.
Self-actualization	Planning	Self-sacrifice	Detachment	Awe.
Joy and love	Prudence	Justice	Reverence	Submission.
But with a corresponding potential for pathological degree of:				
Permissiveness	Abstraction	Authoritarianism	Fatalism	Bigotry.
Impulsiveness	Theory	Rigidity	Passivity	Fanaticism.
Anarchy	Rationalism	Righteousness	Mysticism	Righteousness.
Lawlessness	Indecision	Despotism	Naivete	Dogmatism.
Chaos	Dehumanization	Sado-masochism	Unworldliness	Hypocrisy.
Nihilism	Scientism	Punitiveness	Superstition	Superstition.

In chart XII are a list of five ideologies which Western culture at various times has seemed to be friendly to. There is, so to speak, a reasonable form of each ideology—the upper half of the chart—and a pathological form—the bottom half of the chart. Now most people in this room were raised in column 3. If you are a typical American or European, you were raised in the upper half. If you were a Nazi, you were raised in the lower half. But you were raised in column 3. Your son today is almost certainly being raised in column 2. There's been an enormous shift in the upper-middle-class school systems in the United States and school systems generally. To some degree he may prefer column 1. Now the people in column 2 and 3 have never been against column 1 typically, but they never particularly thought it was great either. Just reasonable. Column 1 in fact reserves the bias of childhood and is very close to hippy culture.

To a remarkable degree, though, the hippies are also in column 4. In other words, they split between 4 and 1 and that is a fairly interesting thing. From the viewpoint of a political scientist I find the utmost significance in this.

Each of the various metahistorians—Sorokin, Spengler, and Toynbee, and others, Schubart, and Berdyaev—has the same description, roughly, of the way society goes through stages. I want to use Sorokin's terminology (ideational, idealistic, sensate) simply because it's neutral. I can use these terms to talk about any area in a society.

CHART XIII.—4 CULTURAL STAGES IN THE FINE ARTS

Ideational art	Idealistic or integrated art	Sensate art	Late sensate art
Transcendental	Mixed style	Worldly	Underworldly.
Supersensory	Heroic	Naturalistic	Protest.
Religious	Noble	Realistic	Revolt.
Symbolic	Uplifting	Visual	Overripe.
Allegoric	Sublime	Illusionistic	Extreme.
Static	Patriotic	Everyday	Sensation seeking.
Worshipful	Moralistic	Amusing	Titillating.
Anonymous	Beautiful	Interesting	Depraved.
Traditional	Flattering	Erotic	Faddish.
Immanent	Educational	Satirical	Violently novel.
		Novel	Exhibitionistic.
		Eclectic	Debased.
		Syncretic	Vulgar.
		Fashionable	Ugly.
		Superb technique	Debunking.
		Impresstonistic	Nihilistic.
		Materialistic	Pornographic.
		Commercial	Sarcastic.
		Professional	Sadistic.

Let me use the fine arts (chart XIII). Think of eighth century to sixth century Greece or Europe between the sixth and 10th centuries. Now if you look at the paintings of this period you find that there is no perspective on them. This has nothing to do with lack of skill of the artist, he is simply making the painting as an act of worship to God and God's eye is everywhere, so how would you have perspective. You cannot recognize the features because he hasn't bothered, who cares about people. And God can recognize his own. There's no reference to the term human happiness that has come down to us from the sixth to the 10th century. It was not a thing that was of interest to people at that time, or at least the people who wrote. You can argue that there were projects (this is slightly controversial but not very) that they carried through which are beyond our technological ability today. It took 100 years to finish the typical cathedral. Anybody here willing to start a 100-year project? Now it's only a moment of time to God but quite a distance to an American.

The next period is the idealistic period, where the art is never about normal ordinary people or the countryside, it's uplifting and ennobling. You can think if you will of the early middle Renaissance, Shakespearean England, Hitlerian Germany, Socialist realism in Russia—you know, 50-foot tractors with 10-foot workers. Any Strategic Air Command base. What do these groups have in common? A belief that they are engaged in a project which is bigger than ordinary human beings. Something important and well worth sacrifice for.

Sensate art is art for art's own sake. For decoration, for amusement, for interest—it's like a good Hollywood movie.

The first kind of art is for God's sake, the second kind of art is art to ennoble, to uplift, to make you more than yourself. The third kind of art is art for art's own sake and the last kind of art is art for protest sake or art as a happening with no esthetic sense in it.

The hippies are very conscious of this. Their position is not that they're Jesus Christ with a new message but that they're John the Baptist. They come first and get rid of all this crud, then the man with the message comes. No point asking them what the message is,

they don't know. John the Baptist didn't know either. All he knew was that there was a message coming. What they don't understand is that this whole process can touch off ideological conflicts, which have provided the bloodiest periods of mankind.

And that raises my final question. Does it make any difference that modern art is largely late sensate? To a man the metahistorians feel, as the art goes, so goes the rest of the culture. It may be right, it may be wrong, we just don't know.

MANAGING MODERN COMPLEXITY

STAFFORD BEER [1]

I. THREAT SYSTEMS

I speak to you today against a background of seemingly ungovernable crisis which it is impossible to ignore. We are met to discuss the future, but we must know the context from which we begin.

The business of forecasting is fraught with many traps; it often seems ascientific. But the perspicuous detection of inexorable trends can be a matter of good science. There is a reality to observe and to measure, a reality in which a dead man is a corpse and not a statistic. There is a reality, too, with which to experiment; a reality that does not come in parcels labelled for the attention of appropriate officials. The very stuff of this reality is *complexity*. The elements of our society ever more richly interact: the more this happens, the more participation is invoked, the more the streams of data flow . . . the more complex does society become.

Handling complexity seems to be the major problem of the age, in the way that handling material substance offered challenge to our forefathers. Computers are the tools we have to use, and their effective use must be directed by a science competent to handle the organization of large, complex, probabilistic systems. This is the science of cybernetics, the science of communications and control.

The central thesis of cybernetics might be expressed thus: that there are natural laws governing the behaviour of large interactive systems—in the flesh, in the metal, in the social and economic fabric. These laws have to do with self-regulation and self-organization. They constitute the "management principle" by which systems grow and are stable, learn and adjust, adapt and evolve. These seemingly diverse systems are one, in cybernetic eyes, because they manifest viable behaviour—which is to say behaviour conducive to survival.

In my opinion, the most important fact which a quarter of a century's worth of cybernetics has revealed is that this behaviour is governed by the dynamic structure of the system, rather than by special events occurring within it or by the particular values taken up by even its major variables. "Structure" means the way in which the parts of a whole are inter-related; and here it includes both the feedback loops by which systems regulate themselves and also the conditional probability mechanisms by which systems learn and organize themselves. "Dynamic" relates to the speeds at which communication is effected within the system, and especially to the relative lags with which messages are promulgated, overtake each other, and combine to form new patterns. Dynamic structure generates outcomes.

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Therefore I say that what will happen to mankind in its battle with complexity will be determined neither by particular innovation nor by isolated achievement at some unknown future date. Hence the attempted prediction of such things is not to the point. Outcomes are latent in the dynamic structure of the systems we have or may adopt: they will inexorably emerge.

At present, the most obtrusive outcome of the system we have is a gross instability of institutional relationships and of the economy. This cannot last. The society we have known will either collapse, or it will be overthrown. In either case a new kind of society will emerge, with new modes of control; and the risk is that it will be a society which no one actually chose, and which we probably will not like. I shall argue that we must use our science to detect the latent outcomes which will one day characterize the future of mankind. And let us so engineer our systems that their latent outcomes suit our social purpose. It is true that the outcomes cannot be fully determined, because there is noise (or shall we call it free will?) in the system. But a systemic design taking due account of cybernetic laws may be expected to produce behaviour which is predictable in terms of the overriding social need for stability.

Thanks to the growth of complexity, which is very much a function of the growth in data-handling capacity and of the information explosion, society has outgrown the dynamic regulating capacity of its own hallowed structure. History did not design that structure to cope with such complexity, and a cybernetically grotesque machinery is a result. It is from this standpoint that I ask you to look again at the environmental crises from which our view of the future must necessarily start.

The thermonuclear threat is a computable threat, and one which computably grows—although we act as if we were inured to it. The various pollution threats—by pesticides, by noise, by sewage, by carcinogenic urban air—were and remain systemically predictable. None of these things happened by chance, by accident, or by the wrath of God. We have run ourselves into these problems by failing to calculate the predictable consequences of the systems civilization has underwritten. The same seems to me to be true, though less obviously so, of the various forms of societary crisis which run alongside the environmental crises. Problems of race, problems of poverty, problems of overpopulation: all these are quantifiable aspects of computable systems. It has taken social upheaval and threatening violence to draw them to our proper attention; it has taken a major revolt of the young to motivate any kind of rethinking.

The risk which faces us today is the probability that society will yet refuse to study the systemic generators of human doom, and will disregard the cybernetic capability which already exists competent to bring these many but inter-related forms of crisis under governance.

There are two reasons for this fear. First of all, our culture does not take kindly to the notion that it nurtures the seeds of its own destruction. Instead of studying the systemic reality in which outcomes are latent, it prefers the technique of prognostication. Small wonder: by using such wholly non-systemic devices as the Delphi technique, we may predict a possible millennium for our comfort. But the Delphi technique is aptly named: its pronouncements are shrouded in ambiguity—because they take no account of the systemic context. Meanwhile, the systems we have already started, which we nourish and

foster, are grinding society to powder. It might sound macabre to suggest that computers will finish the job of turning this planet into a paradise after human life has been extinguished. But that vision is little more macabre than the situation we already have, when we sit in the comfort of affluent homes and cause satellites to transmit to us live pictures of children starving to death and human beings being blown to pieces.

The second reason for my pessimism is that technology now seems to be leading humanity by the nose. We appear to have no sense of priorities where our problems are concerned; we do what is technologically easy—and we do it regardless of cost. For example, the problem people have of transporting themselves from one remote place to another really exists between homes or offices and international airports. But the problem we continuously solve is the non-existent problem of moving between those airports. It is easier to go from Mach 1 to Mach 2 than to tackle the genuine problem. Perhaps it was also easier to go to the moon than to face up to what is happening in the street outside.

Thus I direct myself and you to the claim that cybernation is about the regulation of society, and that this is what computers are for. Perhaps this opening is a surprise. Would it not have been *easier* for all of us to plunge into the technology of computation, to prattle on happily about nanoseconds and massive data banks, to wonder at the explosion of knowledge and the impending marvels of data storage and retrieval by holograms and photochromic tubes, rather than to tell the truth about cybernation? What did you really expect? The fact is that most of the problems we stand ready to consider are bogus problems. They are generated by theories about technological progress, and theories about the way society works. Theory is often the only reality countenanced by our culture.

The reality is that we are elements in a vast and almost ungovernable social system generating outcomes that happen to us. We come sprightly to conference, dragging lead-heavy bones, to talk about machines that matter only if they can help us men. Our fat is suffused with insecticide, but we are avid to decide what it will be like to take our newspaper out of the back of the television set. The expansion of knowledge will yet save the world, shall I not tell you, coughing through the carcinogens—and assuming that my plane was not hijacked and that I was not "mugged" on the way * * *.

I am fighting for a way through to your real ears. That is exactly to say that I am trying to differentiate, in you, between data and information. Data are a whole lot of meaningful patterns. We can generate data indefinitely; we can exchange data forever; we can store data, retrieve data, and file them away. All this is great fun, maybe useful, maybe lucrative. But we have to ask why. The purpose is regulation. And that means translating data into information. *Information is what changes us.* My purpose too is to effect change—to impart information, not data.

Data, I want to say to you, are an excrescence. Data are the very latest kind of pollution. We are not going to do anything at all about the management of information and knowledge towards the regulation of society as long as we think in data-processing terms. That is technologically easy. It is what the computer companies and the telecommunication interests would like us to do. Data are assuredly the

great new marketable commodities of the nineteen-seventies. But, let me repeat, data of themselves have no value.

What has value is the machinery to transform data into information, and the machinery by which that information may be used to innervate society. Society has become a complex organism, and it needs a nervous system. Managing the development of informational science and technology is all about this task. There is no other message than this.

2. Bases of Argument

The technological capabilities on the availability of which my arguments will be based already exist. There is not really a significant element of prognosis about them. There is however one proviso to this: it derives from a logical trap to which I will shortly draw attention. But first, here are some fundamental propositions.

First Proposition.—We can now automate whatever we can exactly specify.

Second Proposition.—Most (possibly all) ostensibly human prerogatives for inferential, judgmental, learned and adaptive behaviour can be exactly specified—at least with respect to finite contexts.

To extend the second proposition to intuitional and creative behaviour poses grave difficulties of definition, and invariably invites emotional uproar. But we may at least stand by this weaker statement.

Third Proposition.—Within specified frameworks, much ostensibly intuitional and creative human behaviour can be indistinguishably imitated by machine.

Fourth Proposition.—Distance is technically irrelevant.

All this means that purposive systems can now be created to undertake any kind of purpose at all. We know how to design those systems, and how to innervate them with data streams. And so society would appear to be confronted by a problem of choice: what activities should actually be automated? But I shall argue that this question is largely illusory.

First of all, there is the logical trap. This is of the sort called by logicians a fallacy of addition. We may do *any* of the things we can do; it does not follow that we may do *all* the things we can do. In the present state of the art, that is to say, we shall rapidly exhaust our reserves of skill. So here is the proviso about technological capability. My own belief is that we shall have to embody a great deal of basic software in special purpose hardware, and that we shall need to automate the creation of special software itself. I think that computer science will break through the barrier of human programing, and move to an era when programs are written by machines under general human surveillance. This will in turn lead to programs which modify themselves in the light of experience. Then we shall be near the realization of the machine being more intelligent than its designer, which von Neumann envisaged and showed mathematically possible more than twenty years ago. There is no need for more than this one paragraph of such modest guesswork—because after *that* it may well be too late to do what ought to be done right now. At any rate, this is the only technological barrier which I can identify.

Then we revert to the spurious problem of choice. Why should not responsible authorities choose between desirable and undesirable sys-

tems for handling knowledge and information? The answer is that in neither the private nor the public sector of a free society is there a sufficient concentration of power to do so. If, for example, mammoth publishing interests decide (as they may) not to mobilize the resources of electronics adequately in the dissemination of knowledge, then it is open to electronic interests to become the publishers of the future. It is also open to the information handling community itself to embark on entrepreneurial activity at the expense of both these industries. In the public sector, it is certainly open to central government, through its grant-awarding agencies in particular, to encourage or discourage particular applications of cybernation. But it will be very difficult to inhibit developments which are of themselves economically viable in the way that (for example) space exploration would be inhibited without central funding.

And here we perhaps identify the basic nature of the problem which cybernetic systems set out to solve. Throughout history until this time the problem was to acquire sufficient information to generate effective change. The individual wishing to become expert in some field of knowledge had to buy information expensively; the government wishing to understand even the rudiments of the structure of its society had to buy information through the census. And so we have gone on, paying more and more money for data acquisition—on the assumption that data constitute information. But we have already said that data become information only at the point when we ourselves are changed. It is self-evident that our capacity to be changed, whether we are an individual seeking private knowledge or a government seeking understanding of society, is strictly finite. In conditions of data paucity, almost all data acquired can be transformed into information—and used to procure effective change. But in conditions when the supply of data far outruns this metabolic capability, most data are literally worthless. Yet we pay more and more for these worthless data because that is the established order of things.

The fact is that quite recently the sign of the informational problem changed from plus to minus. The problem is no longer about acquiring data, which are generated as a by-product of every modern undertaking. The problem is about informational overload. The private citizen seeking knowledge is inundated by information which is virtually free. Yet the publishing industry responds in the old mode—by selling him yet more. The firm continues to buy expensive market research, because that is what it has always done, oblivious of the fact that transactions of every kind can now be electronically monitored, so that data are in glut. Its problem too is one of procuring adaptive behaviour, and no longer at all one of "finding the facts". As for government, there is really no dearth of societary information either; there is instead a problem of organizing information—across departmental boundaries and in time.

Institutions, firms and (thanks to television) private citizens today receive critical information very quickly indeed; the aggregate picture at federal level is slow by comparison to materialize. To put the point the other way round, then, the body politic has wildly overactive reflexes. In the body physiologic this is the condition of *clonus*—it is a symptom of spasticity. If we live, as I suspect, in a spastic society it is because of clonic response. And by the expectations of these arguments, the clonus will get worse.

Thus I argue that the problem of information management is now a problem of filtering and refining a massive overload—for all of us, whether citizens, firms, institutions or governments. We might well say that it is a problem not so much of data acquisition as of right storage; not so much of storage as of fast retrieval; not so much of retrieval as of proper selection; not so much of selection as of identifying wants; not so much of knowing wants as of recognizing needs—and the needs are precisely the requirements of systemic equilibria.

This almost tabular account of the matter ostensively defines another cybernetic truth. In any controlled system, there must be an hierarchic array of sub-systems, in which both the values and the structure of any one sub-system are set by a logically superior system. That is to say that one cannot discuss the purposive nature of a system in its own language, but only in a higher order language. There are potent reasons for this in theoretical logic, just as there are potent practical issues in terms of the need systematically to reduce the informational overload by a system of filters. These filters are necessarily arranged hierarchically, in a way which matches the hierarchy of logical systems.

Thus I introduce the concept of *meta*system: a system which stands over and beyond a logically inferior system, and one which is competent to handle that lower system's logic. Please note that metasystems are logically superior, and not necessarily more senior or more highly endowed with status or privilege. Please note also that in an hierarchy of systems there will be several orders of "metal". Let us take a moment of time to illustrate these points, since the concept of metasystem plays an important role in what I have to say.

Consider for example a school, in which each of a hundred teachers adequately controls and instructs a roomful of pupils. The roomful is in each case made up of several sets of pupils. Now each set of pupils is in fact pursuing a course of instruction which takes it from one room, one association of sets, and one teacher, to another room, another set of sets, and another teacher. If we consider the totality of rooms, holding their pupils and teachers, as sub-systems of the school (for this is indeed the organizational format we observe on a visit) there is no way of knowing or discussing *in such terms* the educative process as it affects all the pupils. To do this we shall need to find the metasystem which organizes all the groupings and ensures that they mesh together. This metasystem is the timetable, in terms of which the course followed by a particular pupil stands revealed. This is a logically superior system; but we do not expect the teacher in his room to treat the timetable as some kind of ju-ju. On the contrary; but if he wishes the timetable altered, he will perforce raise the issue in metasystemic terms. It is simply no good to say "this is my class, and I will take it at another time."

Furthermore: if the state wished to discuss the total process of education for all its high schools in relation to nursery schooling on the one hand and to university education on the other, then a new metasystem logically beyond the first metasystem would be required. And in this case the question whether the second metasystem is not only logically but also constitutionally superior would arise. It would be discussed in those familiar terms about autonomy, about professional integrity, about bureaucratic interference, about sub-optimization, about synergy. . . . Such discussions would be less boring if we could get the logic right first.

The Esoteric Box

Let us now retrieve the argument that the development of purposive automated systems involves a spurious problem of choice. For, we argued, there is no method in a free society whereby such choice could be implemented. I would like to examine this argument in more detail, with a view to uncovering certain mechanisms which are germane to the issue before us. The objective now is to try, like good scientists, to determine the basic parameters of the problem at some level of abstraction which facilitates understanding. Were we to fail in this endeavour to stand back and to generalize, we should conclude with long lists of possible systems, in hundreds of possible contexts, with long lists of possible dangers attaching to each. Then we should achieve no useful insights at all.

Firstly, what is the entity which will in practice develop systems of knowledge and information? It is some kind of social institution: perhaps a firm, perhaps a profession, perhaps a social service * * *. Whatever it is, it is surely an identifiable entity, with certain recognizable characteristics. I call it an *esoteric box*. What is going on inside this box is an established order of things: things accepted as mores of the box, things professional, things historical, and so on. There is a complex arrangement of sub-systems, a strange set of relationships between people of standing inside the box, and a recondite way of behaving. These features—their complexity and unintelligibility to the outsider—justify the box's adjective "esoteric". Admission to the box's activity cannot be gained without the appropriate passport. But the box is not a closed system, it is part of society; it certainly has inputs and outputs. Even so it is internally and autonomously self-organizing and self-regulating. And although the box *processes* whatever it exists to affect (and this is often people), that which is processed does not change the box at all. The box goes on; it is very powerfully organized to maintain its own internal stability, and therefore its survival as an integral institution.

I have elsewhere sought to show that the esoteric box, the identifiable social institution, is a strongly robust system in equilibrium. If we try to influence its behaviour by changing variables which apparently affect it, it responds neither by collapsing nor by a violent reaction. It simply shifts the internal position of equilibrium very slightly, thereby offsetting the environmental change that has occurred. (In the model from physical chemistry that I have used to study these boxes, this behaviour would be an instance of the operation of Le Chatelier's principle.)

Now if it is an esoteric box which is going to develop an information system directed to cybernetic ends, its primary objective will be to enhance its own performance and chance of survival—it will not attend first to the performance and survival of society at large. Equally, the box will be highly resistant to efforts made to constrain its freedom to do so. There seem to be only two mechanisms available to a free society seeking to influence an autonomous institution in any case. The first is to facilitate some modes of development and to inhibit others by the provision of incentives and inhibitors from outside. I mean by this the awarding or withholding of grants, tax concessions, public campaigns, and so on. Every esoteric box has its own feedback mechanisms; what the state can do is to change the gain on the relevant amplifiers. But

because of the high internal stability of the box, we must expect this kind of control device to operate in a cumbersome and generally inefficient way. The other device available is legislative. The main trouble here lies in the identification of what is antisocial. Most advances in human welfare have paid a price in the infringement of personal liberty: whether that price is seen as reasonable or as a fundamental deprivation of human rights will often be a matter of interpretation. But I shall in any case assume that wise government will interact with the authorities in any esoteric box to achieve acceptable codes of behaviour. What really concerns us in this situation is what happens at the metasystemic level.

The fact is that esoteric boxes interact. Any major facet of public policy, such as health, education, the manipulation of credit, security, and balance of payments and so forth, involves at least a string and possibly a complex network of interacting esoteric boxes. Now just as the esoteric box itself is seen as something extremely stable and survival-worthy, so the system which links the boxes is typically tenuous and unstable. It is not itself an institution, not itself a higher order esoteric box. It is simply an assemblage of esoteric boxes, and it does not constitute a proper metasystem at all. It is in this fact that the threat to society really lies; it is here that we shall seek the important scientific generalizations.

Consider education, for example. There are, to speak arbitrarily, four major esoteric boxes involved in this facet of society. There is the system of compulsory schooling; there is the university system; there is the post-experience career-oriented system sponsored by industry; there is the free market in adult education. All four of these esoteric boxes may be sub-divided, almost endlessly; but we are seeking to move our thoughts in the opposite direction—to identify the commonality of these systems and to examine their interactions. If we take health as our example, we shall find a similar situation. There is an esoteric box labelled general medical practice, and another called hospitals; there is a public health box labelled sanitation; there is a market-oriented box dealing in pharmaceuticals; there is a market-place for medical information which belongs to publishing.

In short, we may take any facet of social policy and find the strings and networks of highly stable esoteric boxes which between them make a composite but not integrated impact on the individual citizen. We may do this for security, discovering esoteric boxes for the police, esoteric boxes for fire protection, and esoteric boxes for insurance—not to mention the esoteric boxes which are the armed services themselves. We may do the same thing for the movement of goods, discovering esoteric boxes for every method of transport. We may do it for the movement of money, detecting esoteric boxes for emolument and social benefit, for taxation, for credit * * *.

Then the question arises, why are those strings and networks as unstable as they appear to be? If there is no genuine metasystem, why has one not grown up? Was there never a stabilizing structure of any kind? I think that there was a metasystemic structure of a very remarkable kind, but that it has been abandoned. We have thereby lost the meta-controls which made the composite systems of esoteric boxes viable. If this be true, no wonder we need assiduously to design replacements.

First, there was the structure of society's "external skeleton": the religious, legal and moral framework. Into this hooked the structure of the "internal skeleton": there were indeed formal bonds linking social institutions themselves. Younger people seem to be systematically abandoning the values of the external system, so that it ceases to be relevant to any control process dependent on negative feedback. Given that almost fifty percent of the population of the United States is now under twenty-five years of age, the revolt of youth is destroying metasystems whose stabilizing value they do not understand is a serious matter indeed. The young have more power in society than ever before: purchasing power, and the power that derives from not being afraid of inherited norms. Most of them are not taking technology for granted. Many of them are questioning established values in terms which their elders do not understand. Some have already begun smashing up computer installations. As to the internal system, changes in technology are moving the interfaces between the esoteric boxes representing established institutions—and they are not responding. Instead of evolving by adaptation, these boxes are putting up the shutters and seeking to maintain themselves as integral systems while the context changes around them. This will not work.

Thus the strings and networks are unstable, and the metasystems are missing. Rather than attempt the exhaustive enumeration of these composite systems let us try to state the features they share in terms of knowledge, information and control. They seem to me to be the following:

Characteristics of Strings and Networks of Esoteric Boxes

(i) In all cases some esoteric boxes in the system are part of the public sector and some part of the private sector.

(ii) In all cases the esoteric boxes are generating, and (inefficiently) passing between themselves, knowledge about the world in which they operate.

(iii) In all cases they are also generating, either as primary or as spin-off data, knowledge about the individual citizen which they rarely interchange.

(iv) In all cases the very forces which produce stability within the esoteric boxes themselves conduce to instability between the boxes.

(v) In all cases, what constitutes the improved management of knowledge *within* the esoteric box has to do with the rapid matching of sets of possible courses to sets of actual conditions, and the rapid correction of mismatches by feedback governors.

(vi) In all cases what would count as an improvement in the management of information *between* esoteric boxes, and therefore an embodiment of the metasystem concerned, would be an integral information network and a mutual trade-off in knowledge—both of the world and of the citizen.

If this list of six points correctly states the position, it behooves us to elucidate them further.

3. Elucidation of Systemic Characteristics

We begin this elucidation by developing a generalization about the management of information within the esoteric box. This is an explanation of point (v) in the foregoing *List*.

Whatever we are looking at at any given moment in time will be found to represent a complex state of affairs. Call this total situation the *initial condition*. For example, a patient entering a health system has an initial condition; so has a pupil in any educational situation. The first step taken by a professional in reviewing this initial condition is to try and characterize it with a name. In the case of health, this name is the diagnosis (*diabetis*="he needs more insulin than he has got"). In the case of the educational condition, we may name a state of ignorance relative to some need (*advanced physics*="he needs more physics than he has got"). This naming process may be very inefficient, as for instance when we name the complicated economic status of a citizen within the economy as: *credit*=$100. And even in medical diagnosis, for instance in psychiatric medicine or in prophylactic medicine, the name may not be very much help. Then why do we go through the naming process?

The answer to this is surely that the brain is a coding device. We are not cerebrally organized to hold in our heads large wedges of information about complicated states of affairs. Having examined the complexity of the initial condition, we seek to encapsulate it in a name—which can later be used to retrieve at least the critical attributes of the situation so named. Next, we use this name in our search of courses of action from which to select a treatment of the initial condition. Thus the very mention of a medical diagnosis selects in the mind of the physician a subset of the whole set of human therapies which relates to the name, and from this subset one therapy will be selected and applied. Similarly, "advanced physics" selects a subset of courses from all possible education courses, and from that subset one course will be recommended. The credit rating simply selects one figure from a small number of possible figures to be applied as a ceiling on purchasing power.

Depending on the seriousness of the situation, as measured perhaps by its "professional" content, this naming filter is a more or less elaborate tool for making the system work. A higher professional content can be injected into the process by a more elaborate taxonomy of names, and also by iterating the process of selection. Thus, having made a diagnosis and selected a possible therapy, the physician will go back through the name filter to the actual initial condition, and verify the treatment in every particular. In most social situations, however, this iteration is far too expensive to undertake. And for that reason, many of the responses which social systems make to the initial condition are crude indeed.

The first general capability of automation within such a system is to abandon the naming filter. For computers *can* hold large wedges of information. The computer is faced with the problem of matching one complex profile (the initial condition) with another—probably less complex—profile of possible courses of action. Far from simply automating the human professional component in the system, then, the automatic system should much improve upon it, especially if it is organized to interrogate the subject in order to fill out details of the initial condition which it perceives to be relevant. Moreover, as its model of the system it handles is enriched and improved by experience, it becomes possible in principle for a preliminary choice of action to be iteratively simulated. Then the likely effects of choosing this action,

and in particular the vulnerability of this strategy to unknown factors or a range of possible futures, may rapidly be estimated before any indication of choice is given at all. Next again, if the automated system is geared to invigilate the actual process of applying the course to the initial condition, so that the subject's response is continuously monitored, then corrective action against any mismatching or systemic oscillation may be continuously taken. And of course it will be taken on the basis of the total richness of possible interaction between the two sets (states of the subject and possible treatments) rather than through the exiguous filtering channels of the naming which have hitherto been used with so little finesse.

In all of this we find key applications of another fundamental cybernetic principle: Ashby's Law of Requisite Variety. Variety is the cybernetic measure of complexity. It is explicitly the possible number of states of a system. The Law says that the variety of a given situation can be managed adequately only by control mechanisms having at least as great a capacity to generate variety themselves. Names typically do not do this: they are archetypes of variety reducers. Indeed, in most socio-economic situations of our age, we seek to obey Ashby's law by *reducing* the variety of the real world, necessarily in a somewhat artificial way, as with naming. As I said earlier, this leads us to manage low-variety theories about the economy, because we can handle those, rather than to manage the high-variety economy itself. A much more satisfactory method of handling the problem is to *increase* the variety of the system doing the judging, managing or controlling—by automating the "professional" component. The second method is now technologically open as we saw in the last section. Allied to fast feedback, whether through simulations of the total system or through the invigilation of actual results, the whole mechanism permits a much more refined and much speedier convergence on a stable outcome.

By looking at this mechanism in its relevant detail, we simultaneously lay bare the major threat to privacy of which everyone who has ever contemplated these matters is already aware. As we seek better control of situations by confronting variety with variety within the system, we lose the anonymity which used to cloak the identity of an individual by the use of a name. This is quite clearly seen in the simplest case of all—the name of the citizen as normally understood. My name identifies me from among the rest of us here; but it undertakes to disclose no more information than this primary selection. Yet the more effectively any esoteric box handles my case, then the higher the variety it disposes as a measure of my own variety; therefore the more risky to my personal integrity does the whole process become. Here is the person rawly exposed. Because in higher variety, within the professional system appropriate to any esoteric box, I am saying that the better the system, both from the point of view of the social institu tion concerned and therefore from my own as its patient or pupil or client in any other way, *ipso facto* the more potentially damaging to me is that system. Am I psychologically ill? The medical system will know. Am I educationally inadequate to my job? The educational system will know. Where was I at the time the murder was committed? The credit system knows when and where I bought petrol that night * * *.

This analysis successfully generalizes the problem of privacy, and also says a great deal about the reasons why esoteric boxes are under

such pressure to withdraw into themselves—instead of collaborating in metasystemic management systems (see Point (vi) in the *List*).

As to privacy: It is all too possible that the computer will sweep forward to destroy privacy and freedom of choice without our really knowing that this is happening—much as the motor car has swept forward, poisoning us and inexorably changing the quality of life. Consider two major mechanisms which might bring this about.

First, there is the question of a man's credibility as a citizen. When a man is too well documented, electronically buttoned-up, in what sense can he make a new start? How can he restore his credit, once it is lost? How will he persuade the machine to emulate his own God-given capability to *forget*? A man is to himself as to others a complex package of information. In behavioural terms at least, his vital statistics, his knowledge, his actions and his emotional response as well—all may be catalogued and stored. By the criteria of information theory, then, my electronic image in the machine may be more real than I am. It is rounded and retrievable. Above all, it is a high-variety image—higher very likely than the image of me in the minds of my own friends. The behaviour of the image is predictable in statistical terms. Probably I am not. But the strength of the machine image is its pragmatic validity. There is no confusion here, no ambiguity, no loss of history, no rationalization. I am a mess; and I don't know what to do. The machine knows better—in statistical terms. Thus is my reality less real than my mirror image in the store. That fact diminishes me.

Second of the threats to my reality, there is the likelihood of my manipulation on a scale which is also frightening. Overt advertising has already taken us to the brink of what seems to be tolerable in this respect. But at least we are conscious of the risk—we may note the Freudian images of the ad-man cult, and the importunity of slogans which are akin to physiological conditioning. We may thus protect our personalities. But the computer's machinations are covert. A long-term record of my purchases should enable a computer to devise a mailing shot at me which is virtually irresistible.

As to involution: We earlier made the assumption that esoteric boxes themselves will engage in dialogue with their own clients and with governments to protect the citizen in this threatening situation. The important thing is not so much that this ought to happen as that it will certainly happen. For if it is vital to the social institution to remain integral, and if it is the proclivity of that esoteric box to be highly stable, then integrity and stability will be supported and reinforced by the highest ethical codes where professions are concerned, and by commercial self-interest where they are not. Each esoteric box will identify its own vested interest in solving these problems; and in solving them it will increase its own stability and survival power. Then these systems will become more involuted, and yet more esoteric; they will become more stable, and more resistant to change; in many cases it will be literally impossible to assess the information they contain without a special electronic key.

As the solutions begin to emerge from the studies which institutions are already making, it can be expected that legislative force will be asked for the implementation of any provisions which repeatedly occur as proposing matters of principle. For example, it already looks likely that legislation will be sought to permit the citizen access to his own

computer files, or at least to permit him the knowledge that an entry has been made therein. Even so, there will be many difficulties for legislators, and especially difficulties of definition, After all, many records have been kept in the past, records made up with quill pens, of which the citizen had no intimate knowledge—and in cases of national security, or even of high-grade employment, perhaps no knowledge at all.

But the point for which we are reaching here really concerns the missing metasystems for the regulation and stabilization of strings and networks of esoteric boxes. If the inexorable trend is toward involution, and toward the isolation of information within the box, then the interchange of information between esoteric boxes becomes less and less likely (see Point (iii) in the *List*). Institutions will not dare to move towards the creation of metasystems, because this would breach confidentiality. As for the legislators, how can they possibly launch bills at one parliamentary sitting intending to keep information inside the box (for the reasons adduced), and then launch bills at the next sitting aimed at better management on the strings-and-network level? For the requirements of the second legislation would be to assemble information more economically for metasystemic purposes, to enrich the understanding of social needs by synthesizing information within higher-order models of the economy, and in general to seek modes of control which would necessarily diminish participation at lower societary levels to the point of total incomprehension as to what was going on.

This is a king-size dilemma. It has already been encountered in a relatively mild form by government bureaus of statistics, all of whom operate under legislation which guarantees the privacy of the individual firm by statistical aggregation. But in situations where large firms dominate sparsely populated localities, real skill may be needed to avoid betrayal of this rule by sheer accident. And perhaps in avoiding such risks the efficacy of the network will be sensibly reduced. The extension of the problem down to the rights of the individual, and up to meta-metasystems, and across to include the whole gamut of socio-economic behaviour, is a daunting prospect. But the difficulty is real; it will not go away.

So here is the meaning of Point (iv) in the *List of Characteristics* we set out to elucidate. Strings and networks of esoteric boxes will become less and less cohesive; and the metasystems they represent will become more and more unstable. These are the inexorable trends, and this is the basic reason why (I unhappily suggest) society is falling apart.

The Blurring of Interfaces

We have been seeking to elucidate the meaning of the four final points of the six statements made in the *List* which ended Section 2. It is time to revert to the first two of those six points. For in our recent discussion we have concerned ourselves primarily with information about the citizen as a product of either public or professional social institutions. But the argument of Points (i) and (ii) was that every facet of social control shared in the public and private sector, shared too in knowledge of the world as well as in knowledge of the citizen. Then let us begin a fresh analysis, beginning with the missing pieces of the puzzle, and see where that leads.

2.

We want to talk in the first place, then, about knowledge of the world, and its dissemination as an entrepreneurial activity to anyone needing knowledge. This whole process began and continued historically in a very distinctive way. There were people—individuals by name—in the time of the ancient Greeks in whom reposed such knowledge as there was. Those wishing to acquire knowledge did so on a personal basis and at great expense. This often meant journeying to sit at the feet of an Aristotle and to learn from him. We might call the process *custom-built publishing*. We should note that it was a very high-variety process (the cybernetic analysis of a dialogue demonstrates to perfection Ashby's Law of Requisite Variety). And we should note finally that the effectiveness of the process relied on a relative paucity of knowledge compared with the capacity of the human brain and the calls on its time. For nearly two thousand years this situation prevailed. Although writing and its tools were developed, any piece of writing was still custom-built. One's copy of any text was a personal copy, bearing unique imperfections, omissions and additions. Then, five hundred years ago, came printing—a process which remains almost unchanged to this day as the accepted principle of permanent imaging.

It was the invention of printing that procured the first qualitative change in the management of information and knowledge for mankind. In achieving the massive dissemination of knowledge Gutenberg and Caxton also destroyed its custom-built character. In mitigation, the publishing industry (as it has become) developed an activity called editing. This critical occupation fulfills almost exactly the same function as naming or diagnosis in our earlier model. It constitutes a crossover point between a high-variety set of information on the one hand and a high-variety set of clients on the other; it selects subsets from each, and attempts to match them. Insofar as the matching succeeds, there is a marketable product. This may be defined as an edited publication, identifying a sufficient number of clients satisfied with the editorial process as between them to pay for the cost of publishing and printing (with of course a profit margin for all concerned).

The steady development of this whole marketing operation has led, like all other recent developments in the dissemination of human knowledge, to the informational overload mentioned before. Publishers continue to issue more and more printed material, relying specifically on their editorial skill in identifying market subsets willing to pay the price. But increasingly the process depends on mythology. It is easy enough to demonstrate that in fact the overload threshold has already been passed, and that (as we said) the sign has now changed on the stream of data input. No professional man can possibly read more than a fraction of what he would like to read or feels he should read. In some professions, current trends when extrapolated show that the whole population of professionals will shortly be employed in preparing abstracts of papers—whereupon no authors will be left to write them. This shows that insofar as people continue to purchase new publications they are not driven to do so by any residual capacity to convert data into information (meaning: what changes us). One may entertain various theories about the motives which do drive them. Such theories range from feelings of guilt and a sense of threat at one end of the spectrum to a pious belief that the editing process is (hopefully) con-

verging on *my* special interests at the other. However this may be, no professional man can now cope effectively with the material he is expected to buy; and most would agree that they buy more than they can cope with.

Various mechanisms may operate to put an end to this situation, perhaps quite suddenly and dramatically. Which mechanisms will operate depends on which motives turn out to be most significant. For example, insofar as many publications depend on their advertising revenue for survival, then when the advertisers become aware that their advertisements are not even seen (because the journals are not opened) they may suddenly and disastrously withdraw support en masse. But the more profound threat to the established mores of the whole industry derives from the likelihood that someone will give convincing entrepreneurial effect to the unrecognized but inexorable trends of the situation. These are quite simply that professional people have a need for less and not more information, and therefore—in the long run—are going to *pay* for less and less, and to refuse to pay for more and more. The publishing industry and government itself continue to regard data as equivalent to information. The metasystem in which this issue can alone be sensibly contemplated, will shortly recognize that any one client is overloaded by any one editor who provides for the needs of a coterie, however small, intended to cover his costs.

There is then an inexorable requirement for a return to custom-built publishing directed at individuals, whether private citizens or cabinet ministers. This service must be economically viable, once the necessity for it is generally recognized, because it meets a need which cannot much longer be ignored. Moreover, the new technology is able to supply it. We shall use the power of computers to undertake an editing process on behalf of the only editor who any longer counts—the client himself. It matters not whether the information reaches that client on a computer terminal, or in a custom-built personalized print. Economics and personal preference will decide that issue. What does matter is the inevitable reversion to the age-old principle of publishing based on the finite capacity of the brain to assimilate data, and to convert them to the information which changes the brain's condition. And in all of this we may note the mechanisms already uncovered in this paper: especially obedience to the Law of Requisite Variety, and the vitality of the principle of adaptive feedback.

I here repeat that this kind of prognosis is not to my mind a matter of forecasting, but the detection of an inexorable requirement. There is no need to extend the argument to publication in the field of leisure, important though this is, because the considerations are much more difficult—and I think longer term. But the field of professional publishing, which includes knowledge about the whole of science and technology, and includes knowledge about everything that government may do, is sufficiently significant in itself. Both areas may be treated as their own esoteric boxes. In both cases there has to be a high variety of exposure of the client to the system, and there has to be fast adaptive feedback. If you will allow that this is possible, then we reach a new dimension of concern in the field of socio-economic management.

We know by now, as a matter of principle, that the increased effectiveness of the service provided inside an esoteric box increases the vulnerability of its clients to intimate relevations—because of Ashby's

Law. The case of both commercial and governmental publishing to professional individuals offers no exception. In exactly the same degree, and by exactly the same mechanisms, that custom-built publishing becomes effective at all, so does the increasingly well-served client become a target of exploitation. Insofar, that is, as a particular product of either commercial or governmental publishing is especially meant for me, valuable to me, valued by me * * *. So far is it irresistible to me. We encountered this point before.

There is no problem here so long as we continue to speak of professional publishing by reputable publishers (and governments) itself. The matter for concern is of course that if such a system works for this purpose it will work for other and nefarious purposes too. If we can encode an individual's interests and susceptibilities on the basis of feedback which he supplies, if we can converge on a model of the individual of higher variety than the model he has of himself, then we have exactly the situation inside the automated system which was observed to be such a threat in more protected contexts. I think that marketing people will come to use this technique to increase the relatively tiny response to a mailing shot which exists today to a response in the order of ninety percent. All this is to say that the conditioning loop exercised upon the individual will be closed. Then we have provided a perfect physiological system for the marketing of anything we like—not then just genuine knowledge, but perhaps "political truth" or "the ineluctable necessity to act against the elected government". Here indeed is a serious threat to society.

Now we can see how the first three points in the *List of Characteristics* about the behaviour of esoteric boxes are indivisible from the last three points. Knowledge of the world and knowledge of the citizen are indissolubly united in systems of the kind we must expect; private and public interests moreover are inseparably involved in each. Then the interfaces between these four major components of information systems become hopelessly blurred. We shall not be able to legislate to keep what is indivisible divided. These arguments are based on realities manifested by situations which cannot be controlled at their own level without interference on a totalitarian scale in the rights and autonomy of our social institutions, the esoteric boxes.

4. Metasystem Management

The jigsaw puzzle is complete. We have looked closely at the emergent picture of interacting social institutions, exemplified as esoteric boxes. They are stable, involuted, resistant to change. Their interaction is embodied in strings and networks of complex connectivity, exemplified as metasystems. These are unstable, mercurial, existing more in concept than reality. The problems of information management that assail the boxes will be solved, if with the greatest difficulty. These solutions will themselves inexorably increase the metasystemic instability, threatening to blow society apart.

If all this offers an effective generalization of the problem of data pollution, and if we are to see any possibility of its solution in terms of good cybernetics, practice is needed in applying the model here envisaged. Let us then look at two levels of application, as widely separated as possible, to see how readily the systems concerned map

onto each other, and what may be the commonalities of acceptable metasystemic controls.

First Example: at Hearth and Home

One plausible development of existing capabilities in informational science looks like this.

It is already possible to transmit textual material and the instructions for printing it into a television receiver—during a normal broadcast, and without interfering in any way with the broadcast itself. This is done by utilizing some of the enormous channel capacity available and not used by the flying spot defining the picture. For example, the spot has a "flyback" period, when it returns from the end of one scan to the beginning of the next. One line of scanning on a TV screen contains approximately six hundred bits of information. The flyback takes five lines to return, and is thus capable of carrying three thousand bits of information. If sixty frames are scanned every second (this would be fifty in Great Britain) there is spare capacity to transmit 180,000 bits a second of other information while the broadcast itself is going on. We know how to produce hard copy from the television set, using this input information. If we wish to produce a column of print six inches wide, with excellent resolution at a hundred lines per inch, we need 600 x 100 bits of information to produce an inch of text. It follows from all this that we have a capacity to produce three inches of text every second without interfering with the television broadcast.

Newspapers can be produced in the home like this, as is well known, and experiments continue. But newspapers are not custom-built; they belong to the informational overload. This overload is due to be met by custom-built publishing. Then apply the existing technology to the new publishing concept and see what happens.

Suppose that there are twenty buttons on the side of the television set which can be pressed by the viewer. The broadcaster invites the viewer to participate in a "personal response program". He shows the viewer two pictures, and asks him to press the first button if he prefers the first picture to the second—otherwise not. He then asks a question, and says that the second button should be pressed if the answer is yes—otherwise not. And so on. By the time the viewer has pressed or not pressed all twenty buttons he has identified himself in a high-variety way. For there are 2^{20} ways in which the set of buttons may be pressed, and that means enough patterns to distinguish between more than a million individuals (where each offers a separate pattern). As to privacy, the viewer is at home and alone with his set. So no one knows which buttons he presses (or do they?).

Having completed this exercise, the broadcaster suggests that the viewer should press his "print" button. The television set will then print out, from the vast amount of information being carried on the flyback, a piece of print which is determined by the particular pattern set on the twenty buttons. After all, if the sponsor hires one minute of flyback time at the end of his advertisement, he may *transmit* no less than a hundred and eighty inches of text. The "computer program" set up on the twenty buttons *selects* (say) six inches of this available text, and the apparatus prints it. This means that the individual concerned receives a very highly directed message. By the arguments used earlier, the viewer is likely to find this message irresistible. For example, the

old lady sitting in one house reads "this product is especially suitable for old ladies", while the young man next door reads "this product is especially suitable for young men". (One needs little knowledge of the advertising world to recognize this example as remarkably naive.) Moreover, because the TV set is in a particular location, and can be pre-programed with that information, the custom-built message and advertisement could well include instructions as to which local supplier will make what special reduction for immediate compliance with the suggestion to purchase. Again, this example is offered for display purposes only: the opportunities are hair-raising. Suppose for instance that the apparatus is able to store previous sets of responses * * *.

The viewer lifts the telephone in order to place his order—or perhaps he simply presses a new button on his set labelled "yes". The supplier now has an order, and his system (for he is his own esoteric box) must immediately check the credit-worthiness of the customer. If by this time we have reached the cashless society, it could well be that the whole transaction is finalized and the viewer's bank account debited within the millisecond.

This is all entertaining, and something like it will very likely happen. Now consider the esoteric boxes on whose integrity and security he relies, but which he may by now himself have violated. The information he betrays might well include—

his medical status,
his educational status,
his intimate psychological situation,
the family context (i.e. someone else's privacy is breached),
the employment context (i.e. commercial security may be breached),
the economy's view of his credit,
the state of his bank balance,
his religious outlook.
his political outlook,
his social attitudes at large * * *.

Twenty bits, a variety of a million, every time: here is an inexhaustible source of metasystemic information available to anyone who sets out to acquire it. And from this information could be synthesized a new account of society and of the economy, orders of magnitude more powerful and valuable *and* threatening than any we have hitherto known or countenanced. With this unthinking violation of privacy goes the betrayal of all the mechanisms for protection and security to both the individual and the state which the esoteric boxes themselves have sought to guarantee. And with it go also the distinctions between public and private information, knowledge of the citizen and knowledge of the world.

Second Example: in World Economics

Undertaking now the largest possible change in the scale of this thinking, and leaping over a staggering array of other plausible examples large and small, we turn to the future of mankind itself and the stability of world economics.

A consensus of opinion might define an economy as the observable, quantifiable aspect of the social metasystem. The metric of economics appears to offer the only *lingua franca* which enables us to talk in fig-

ures about strings and networks of esoteric boxes—for typically these have no other commensurable denominator. But it seems to me most important to observe that this circumstance has let us into jejune descriptions of the social weal—which are obsessionally treated as *merely* economic. Surely no-one can believe that the total state of the world with all its pressures, ethnic, religious, liebensraum-oriented, power-geared, and all its problems of military, societary and environmental crisis, can adequately be discussed in terms of econometric models. Input-output analysis tells us something about the connectivity of esoteric boxes; cash flows say a little about their dynamic interrelationships; but we may discuss fiscal and monetary policy until we are purple without touching on the major causes of even economic disequilibria, still less of social dysfunction. This contention is relevant at both the national and the international level.

Having criticized the metric that is used and the models that are adopted, I may readily claim that the networks linking social institutions at this level are the most tenuous yet discussed. This underlines the fact that major political entities—states and nations—are the ultimately complete exemplifications of the esoteric box. They answer both to the definition of this term and to the behaviourial analysis of its operation. I shall risk as your foreign guest a remark about this which I hope will not be regarded as a solecism. We have just entered the decade in which the founding bicentenary of a remarkable interactive network will be celebrated in your country, the metasystem for which is perfectly exemplified in a federal constitution and its law. Is it not fair to say that there are esoteric boxes within this system, some of which are whole States while others are social institutions of other kinds, which maintain to this day those characteristics of the integral, stable, change-resistant box which we have taken much trouble to elucidate? And if there is cause for alarm about national instability, then surely it is metasystemic in nature. Correctives are hard to apply, for reasons we have also uncovered: they lead to involution and oven exacerbate the problems.

At the level of world affairs, the case is far more strong. The sovereign nation is the ultimately esoteric box; the interconnective networks between nations are like so much spun silk. All the mechanisms described here clearly operate, and they too are clearly involutionary. The problems and threats are the same, but they are writ large. Just as we may identify spurious metasystems purporting to link the esoteric boxes of our own social institutions, so there are spurious international metasystems. All approaches to world government, from the League of Nations onwards, and including market-oriented consortia, *speak* metalinguistically but do not *operate* metasystemically. This is why I call them spurious. Hence it is in the network of world economies that we find the ultimately inadequate description and the ultimately incompetent management of the ultimately unstable metasystem.

Perhaps the nearest approach to genuinely stable organizations of this kind are the multinational companies. They represent linkages of esoteric boxes, beyond doubt; they certainly have identifiable metasystems. Even so, the cohesive forces required to make them survival-worthy barely emerge—given a potentially hostile environment. Do we have adequate management mores and philosophy, company lore, or international law, to underwrite their responsible self-regulation? It is

a serious question, bearing in mind that these companies are in a sense the emergent *nations* of the next few decades. I mean by this that the gross product of some mushrooming companies already exceeds the gross national product of the smaller historic nations—for whom tradition, constitution, legal precedent and other long-standing regulators provide the cybernetic grounds of stability.

The vision of a small but historic nation in revolt is bad enough. The explosion of knowledge among people whose intellectual horizons are thereby expended and burst, the extension of personal vulnerability and loss of security through the uncontrolled spread of informational networks, and the political threats let loose by all of this, could turn such revolt into a societary crisis for that nation of unexampled magnitude. It would have to rely very heavily on the propensity to stability of the esoteric box to contain the situation. But what if instability such as this were to assail a multi-national company of greater size than this nation, a company that is not itself truly an esoteric box but a network existing at the metasystemic level without a metasystem. This would be a leviatha greatly to be feared, a leviathan obscenely polluted by its own data which it found itself powerless to metabolize.

Outcomes for Action

Action is required. The form of this action is a matter for you rather than for me. My endeavour has been to penetrate the immense complexity of the information management problem, in search of a scientific generalization. This I have tried to define in fairly plain English, to describe and to exemplify. The objective was to aid your endeavour to decide right action.

I suggested before that the problem is to manage complexity itself, complexity considered as the very stuff and substance of modern society. In the end, when all the computers have crushed their numbers to the last intransigent bit, the unquenched spirit of man takes final responsibility for life or death. Even so, this spirit necessarily operates—for ordinary folk and senators alike—through the medium of the human brain. This is one computer among many larger and faster (if so far less flexible) computers.

The cerebral computer is no more than a three-pound electrochemical device, slightly alkaline, which runs ten thousand million logical elements on the power of glucose at twenty-five watts. Its ability to discriminate is somewhat less than people imagine when they think of the human being in mystical terms as suffused by the divine afflatus. We can in general discriminate on a variety-scale of about nine. To understand an average is our métier. If we then judge that something is slightly, considerably, much or hugely better or worse than the mean, we have done as much discriminatory computing as we can normally manage. That scale of nine points is an output of roughly 3.2 bits of information.

Improvement in requisite variety is possible, since we enrich the dimensions of our comprehension by inter-relating several scales of discrimination. Even so, our human capability is geared at this general level. So when data processing systems offer us millions of bits of data, we dare not believe in a mythical metabolic process which could convert these data into information within our personal ken. There are ineluctable limits to the assimilation of knowledge, set by the finite

size of the sugar-furnace in our heads. These facts to my mind determine the sorts of action which count as both feasible and effective. I have refined my ideas about this to offer a final set of specific postulates.

1. We may reasonably assume that esoteric boxes can take care of themselves, since that is what they are for.

2. They can be aided: their actions can be facilitated or inhibited by government. Any intervention, however, interferes with autonomy, denies participation, and may prove ineffectual (by Le Chatelier's principle).

3. Then legislation directed *into* particular boxes is unlikely to be much help. In any case, there is probably no time to tackle the problem at this level.

4. Then the *focus of attention* should always be at metasystemic level. This is the locale of societary instability; here then reside the massive threats.

5. First, the relevant metasystem must be identified, and in some sense institutionalized. Otherwise, who is to act or who can be held accountable? This primary task can be undertaken only by those holding the constitutional mandate.

6. The purpose of a metasystemic social institution is precisely, and only, to embody the *nerve-centre* for metasystemic affairs. Its function is precisely, and only, to identify situations of dangerous and therefore explosive instability, and to identify trajectories leading to stability.

7. The recommended methodology is the construction of metamodels, continuously innervated by data effectively filtered through a cybernetically designed hierarchy of systems.

8. The implementation of conclusions might be vested in the metasystemic social institution; if it is, however, there will be problems about autonomy (see 2).

9. Insofar as legislation may be needed, the need can be pinpointed by these means. Directing either legislation or central executive action at strings and networks in the absence of metamodels is likely to increase instability rather than reduce it.

10. The kinds of model needed operate necessarily at a high level of abstraction: this makes almost everyone impatient. Consciously identify, then, the barrier to progress as anti-intellectualism.

Some metasystemic institutions already exist. The World Health Organization and the Food and Agriculture Organization are examples at international level, as are several international economic bodies; government departments handling whole sets of esoteric boxes are examples at national level. The questions I leave with you are these: Have such institutions been correctly identified? Do they at all map onto the *dynamic structure* of viable systems as understood by cybernetics? What other such institutions would be required in a stable society?

As to the warning in Point 10 about anti-intellectualism, it seems that the arguments used here would themselves predict this self-defeating syndrome in a society newly faced with the need to manage overwhelming complexity. If the brain is eclipsed in terms of variety by the computer milieu, it may itself revolt. Then panic-stricken attempts at the highest and most responsible level to quell forces that are not understood are as dangerous as the irresponsible cavorting of hooligans.

One may already detect at either end of the scale of social responsibility a response equivalent to laying about with the jawbone of an ass.

The alternative is to *design* a stable society, and to treat our complexity-control capability through computers as offering a nervous system for the body politic. This involves the deployment of a political science to new ends, in the recognition that our difficulties have gone beyond anything that can be grasped by a slogan. We should recognize a cybernetic issue for what it is. But when the unthinkable is already happening it is indeed difficult to think about, and we are robbed of our semantic strength.

SELF-LIQUIDATING IDEALS

DANIEL J. BOORSTIN [1]

Every society has its own kind of values, its own way of measuring what is good or bad, its own way of deciding whether it has succeeded or failed. The first, and probably the most conspicuous feature of the American attitude toward values is dramatized by the very fact that we are meeting here this morning. Whatever we may think about American values today—whether we think they are good or bad, strong or weak, static or changing—we can hardly fail to agree on one feature of our American attitude. More perhaps than any other people, and perhaps more than at any other time, we Americans are talking and thinking or (perhaps more precisely) worrying about our values.

Worrying about our values is more than a characteristic headache of our time. It is a byproduct of long and potent forces in our history and of many peculiarities of American life. In our own time it is peculiarly a byproduct of the American concept of a standard of living, of the American attitude to technology and of American success in technology.

We Americans have been led to the pursuit of some self-liquidating ideals. Myriad circumstances of our history have led us in this direction. I have explored some of them in my study of American civilization—"The Americans" (vol. I, "The Colonial Experience"; vol. II, "The National Experience"). And the notions I offer here are among the themes I will explore in the third and final volume ("The Americans: The World Experience").

A self-liquidating ideal is an ideal which is dissolved in the very act of fulfillment. Many of our most prominent and dominant ideals have had just this quality.

I. SOME EARLIER EXAMPLES: NEWNESS AND PLURALISM

The earliest example is in the very first appeal of America—as a New World. The first charm of the continent was its newness. The Great Seal of the United States, still found on our dollar bills, bears the motto "Novus Ordo Seclorum" ("A New Order of the Centuries"). But when the new Nation in a New World flourished and endured, it became old. By the later 20th century we were among the oldest of the new nations of modern times. Our Federal Constitution, which in 1787 seemed so uncertain an experiment, is now the oldest written Constitution in working order.

How to stay young? This problem plagues nations as well as individuals. But it plagues us more than other nations.

How can we keep alive the experimental spirit, the verve and vitality, the adventure lovingness of youth? Nations which glory in their

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antiquity—an Italy which traces its founding fathers back and into the heavens to Romulus and Remus, the twin sons of Mars, and to a semimythic Aeneas; a France which reaches back to a Saint Louis and Saint Joan; a Britain whose genealogy includes a legendary King Arthur—those nations have other special problems. Despite occasional revolutions and pretended revolutions, in modern times these nations, even when they have gloried in newness, have tried to sanctify it with the aura of antiquity. They have aimed to historicize their myths.

Our Nation, founded in the glaring light of history, from the beginning set itself a task of renewal. Our Pilgrim Fathers and Founding Fathers hoped to give the men of older worlds a second chance. But could any world—even this brave New World—stay forever new?

It is not only this first and most obvious of American ideals which has seemed to be self-liquidating.

The newness of our Nation would come, we were told, from the fact that the United States would be as varied and as multiplex as mankind. We would be (in Whitman's phrase) "A Nation of Nations." It became a tenet of American faith, restated by Lincoln, that we were "the last, best hope of earth." Our Nation was to be (as Emma Lazarus proclaimed in her inscription on the base of the Statue of Liberty):

> Mother of Exiles. From her beacon-hand
> Glows world-wide welcome * * *

The whole earth would be our womb. Our wealth and strength would be in our variety.

Of course there were other regions of the world—the Balkans, the Middle East, South Asia—which also were a mélange of peoples and languages and religions. What would distinguish the United States was that we would give our varied peoples the opportunity to become one. As they were dissolved in the American melting pot they would become part of a single community.

But suppose we actually succeeded. Suppose we brought all the immigrant-world into one great new nation. Suppose we managed to Americanize and assimilate the varied peoples of the world. What then?

Inevitably—and ironically—success would mean a new homogeneity. If the Nation really succeeded in drawing together all these peoples, giving them a chance to discover their common humanity and to forget the feuds and ancient hatreds that had held them apart, how could it fail to dissolve much of that rich variety, that pungency which itself justified building a Nation of Nations?

This danger was not purely theoretical. The 19th century, which brought us tens of millions of varied immigrants—from Ireland, Italy, Poland, the Balkans, the Middle East, and elsewhere—concluded in a paroxysm of fear and puzzlement. Immigrant Americans, almost as soon as they had established residence here, began to fear that the Nation might not be homogenous enough. They took for their own the slogan "Americanize the Immigrant." The Immigration Restriction League, in the 1890's, included many of the Nation's most respectable political leaders, industrialists, labor leaders, educators, scholars, and authors. And Congress published 40-odd volumes of hearings on the evils of immigration. The new immigration policy of the 1920's then proclaimed the dissolving of the adventurously pluralist ideal.

The pluralist ideal was being abandoned, not merely because some people believed it was wrong, or could never succeed. A better explanation of what was happening was that the effort to build a strong, nationalistic, community-conscious people from this international miscellany had substantially succeeded. Or at least it had succeeded to such an extent that millions, whose immigrant parents had arrived only a little earlier, came to believe in a newly consolidated Americanism, which left no place for later immigrants—or for others who were conspicuously, if superficially unlike themselves. The organized labor movement, which included and was led by immigrants and the children of immigrants, had joined with New England bluebloods to restrict immigration.

The years from about 1880 to about 1930 witnessed the greatest confusion in the shaping of an American ideal of nationhood. First- and second-generation immigrants collaborated with the descendants of earlier, more respectable and more prosperous immigrants, to define 100-percent Americanism. At the same time a new American sociology, which was substantially a science of the minorities, arose to give respectability and aggressiveness to pluralism.

Many Americans moved from the older ideal of assimilation ("Americanize the immigrant") to the newer ideal of integration (allowing each group to remain integral, and to glory in its distinctness), without themselves being clear about how all these ideals would fit together. That was the first heyday of the balanced ticket. It was the age of the second Ku Klux Klan, with its white racism and anti-semitism and anticatholicism. And, in response, it became an age of aggressive ethnicity. The grandchildren of immigrants, in search of their roots, fabricated a newly assertive and chauvinistic sense of separateness. Many otherwise respectable Americans were surprisingly tolerant of the racism of the Ku Klux Klan. This confusion survives into our own age, and helps explain the aggressive ethnicity and racism of groups like the Black Panthers, and the shocking toleration of destructive and illegal acts committed under the cover of racial separatism.

The battle over immigration left scars among minorities not unlike the sectional scars left by the Civil War. On the whole, and perhaps inevitably, the battle was won by the assimilationists—who thereby had helped fulfill (and liquidate) the American ideal of pluralism, without being clear about what should take its place.

Perhaps we are now living through another of our American cycles of self-scrutiny and conflict. Perhaps ours is another painful age when one of our self-liquidating ideals begins to be liquidated. And perhaps, in our age, the liquidation is tied to technology.

II. Technology and Self-Liquidating Ideals

Some of the current problems I now suggest arise from our efforts to bring the best material things to everybody. When before had a society set itself the ideal of bringing to every citizen the delights and satisfactions of the best products of its technology?

"Every man a King"—Huey Long's slogan—was not far from the extravagant American hope.

I will offer two examples of how we have tended to be frustrated by our successes.

(I) A WILDERNESS HOLIDAY FOR EVERYBODY: THE PROBLEM OF OUR NATIONAL PARKS

There is no more distinctive or more successful American institution than our national parks. The National Park Service, within the Department of Interior, and under the admirable leadership of George Hartzog, has demonstrated an efficiency, an imagination, and a democratic largeness of spirit to inspire all of us. Yet, despite their best efforts, and even because of their brilliant success, we face here again the paradox of a self-liquidating ideal.

A purpose of our national parks, beginning with the establishment of Yellowstone National Park in 1872, has been to preserve our wilderness areas for the benefit of all the American people. Rocky Mountain National Park, Grand Teton National Park, Glacier National Park, Yellowstone, and Yosemite, among others, aim to make accessible to all Americans the delights of the pristine continent. Our national parks now comprise over 25 million acres and receive some 40 million visitors each year. Their reach to the American public would have been impossible, of course, without the American standard of living, which includes the improvement and diffusion of the automobile, an unexcelled national network of highways, and a high standard of leisure, with regular and extensive paid vacations.

The national parks, themselves part of the American standard of living, have made it possible to democratize the wilderness. An American, then, does not need to be wealthy, to own a large estate, or to afford a retinue of servants to reach and enjoy thousands of acres of the most remote, most unspoiled, and most spectacular landscapes in the Nation.

But—"Will success spoil the national parks?" This is the question asked by Mr. Robert Cahn in his important articles recently published in the Christian Science Monitor (and republished in a helpful booklet with introduction by George Hartzog). Our wilderness acres, simply because they are so attractive and so accessible, have begun to become traffic jams. Living conditions in the campsites of Yosemite Valley and around Lake Yellowstone—with laundry lines hanging from tent to tent and one camper unwittingly putting his elbow in his neighbor's soup—begin to resemble the congested cities from which these people fled. In 1967 serious crimes in national parks rose 67 percent compared with a 16-percent crime rise in American cities.

The democratization of the automobile and the democratization of the wilderness countryside threaten to destroy the very landscapes that we want everybody to have access to. Is a wilderness holiday for all Americans a self-liquidating ideal?

(II) THE DEMOCRACY OF THINGS: FROM MODEL T TO THE ANNUAL MODEL

Henry Ford's dream was to make a new and better kind of family horse—a car which everybody could afford and which would last forever. Essential to his plan, of course, was perfecting his model T. Although he was experimental in developing his car, he believed that once the design was fixed, the object was simply to find ways to make it by the millions.

It was essential to his ideal that all the cars should be alike. As he saw it, mass production (what he called "the democratization of the automobile") required standardization, and standardization meant

turning out a single uniform product by the millions. "The way to make automobiles," Henry Ford explained in 1903, "is to make one automobile like another automobile, to make them all alike, to make them come through the factory just alike; just as one pin is like another pin when it comes from a pin factory, or one match is like another when it comes from a match factory."

To Ford this meant finding ways to turn out millions of model T's. He was confident that he could succeed. In 1909 a friend warned Ford that the automobile would create a "social problem" by frightening all the horses on the highway. "No, my friend," Ford replied, "you're mistaken. I'm not creating a social problem at all. I am going to democratize the automobile. When I'm through everybody will be able to afford one, and about everyone will have one. The horse will have disappeared from our highways, the automobile will be taken for granted, and there won't be any problem."

Toward this end Ford focused his efforts on making his car as cheap as possible, making repairs inexpensive and easy. He continued to believe it was his mission to turn out millions of copies of the same durable product. In 1922 he still insisted:

> We cannot conceive how to serve the consumer unless we make for him something that, as far as we can provide, will last forever. We want to construct some kind of machine that will last forever. It does not please us to have a buyer's car wear out or become obsolete. We want the man who buys one of our products never to have to buy another. We never make an improvement that renders any previous model obsolete. The parts of a specific model are not only interchangeable with similar parts on all other cars of that model, but they are interchangeable with similar parts on all the cars that we have turned out.

He meant what he said, and he had the power to make his dream come true.

Ford had begun producing his model T in 1908. On May 27, 1927, the 15 millionth model T was produced. And in that year, the number of model T's still registered (and therefore still presumably on the road) came to 11,325,521. But the model T was in trouble.

By 1920, Henry Ford's success in democratizing the automobile, in building an inexpensive car that would last almost forever, had produced a vast second-hand car market. Dealers faced a new kind of competition—no longer from the horse, but from the millions of still-usable used Fords. And, at the same time, the American buying public was stirred by a rising standard of living, by rising expectations (encouraged, incidentally, by Ford's $5-day wage which he hoped would make it possible for still more workers to buy Fords), and by a love of speed and a love of newness. They demanded something new.

But Henry Ford's spectacular success was in producing a static model. The problems of style and consumer taste had hardly occurred to him. He was a genius at production. And with the help of his own brilliant staff, aided by the pioneer factory designer Albert Kahn and others, he had developed the assembly line and so had taken a giant step forward in elaborating the mass production which Eli Whitney had pioneered a century before.

Ironically, his faith in the model T was an Old World faith. His belief in the perfectible product rather than the novel product, his insistence on craftmanship and function rather than on consumer appeal eventually left him behind. His genius had heralded a new age beyond his imaginings—and not at all to his taste.

This spirit of the new age was expressed in what Charles F. Kettering and Allan Orth in 1932 called the "new necessity."

"We cannot reasonably expect to continue to make the same thing over and over," they predicted. "The simplest way to assure safe production is to keep changing the product—the market for new things is indefinitely elastic. One of the fundamental purposes of research is to foster a healthy dissatisfaction." The leader toward the new ideal was Alfred P. Sloan, Jr., who shifted the point of view from the maker to the buyer. After Sloan went to General Motors, he developed a new and characteristically American institution. It is so familiar now that we hardly think of it as an institution. This was the annual model.

The spirit and purpose of the annual model were, of course, quite the opposite of those of Ford and his model T. "The great problem of the future," Sloan wrote to Lawrence P. Fisher (of Fisher Body) on September 9, 1927, "is to have our cars different from each other and different from year to year." The annual model, then, was part of a purposeful, planned program. And it was based on creating expectations of marvelous, if usually vague, novelties always to come.

Sloan and his able collaborators at General Motors set up a special new styling department which soon employed over 1,400 people. General Motors showed a new concern for color, and even invented enticing, aphrodisiac names for old colors. Now for the first time the automobile designers included women. "It is not too much to say," Sloan explained, "that the 'laws' of the Paris dressmakers have come to be a factor in the automobile industry—and woe to the company which ignores them."

The invention of the annual model did, of course, create a host of new problems of planning and of production. How much novelty would the consumer tolerate? How to titillate and attract the buyer without frightening him by too much novelty too soon? The bulgy Buick of 1929 (nicknamed "the pregnant Buick"), which was an admirably functioning car but a disaster on the market, according to Sloan was the result of a design mistake of not over 1¼ inches in excess body curve.

The effort to democratize the automobile proved self-defeating—and illustrated the problem of self-liquidating ideals—in at least two other ways.

The ladder of consumption.—When the model T became cheap and reliable and almost universal, cheapness and reliability were no longer enough. To keep the automobile industry, and General Motors flourishing, Sloan then devised what I would call a ladder of consumption.

When Alfred P. Sloan went to General Motors, the company was manufacturing numerous makes of cars. The makes had confused and overlapping markets. Sloan aimed to clarify the appeal of each General Motors make—so that, for example, a Buick would plainly be a more desired car than a Chevrolet. He aimed to design a car for every purse, and to create a clear price gap between different makes. The gap, however, was not to be so great that many Chevrolet owners might not hope some day to be in the Buick class, or so that many Buick owners might not hope some day to be in the Cadillac class.

This ladder of consumption began to dominate production plans. Starting with a price schedule, Sloan then had automobiles designed to fit the prices. This required a vast and unprecedented feat of

coordination. Sloan aimed at what he called the mass-class market. And Sloan's annual model (with the accompanying ladder of consumption) came closer than any earlier American institution to creating a visible and universal scheme of class distinction in the democratic United States of America.

The attenuation of novelty.—By the later 20th century the newness of new models had begun to consist in dubious minutiae such as concealed windshield wipers and concealed headlights. To devise every year an automobile (or rather a host of automobiles) so spectacularly different from their annual predecessors that buyers would rush to the latest model—this taxed the ingenuity of style-conscious designers and imaginative production engineers. They wracked their brains. They ran the gamut of human and diabolical ingenuity. As a result, some Chevrolets looked more impressive than some Cadillacs. The economy luxury car and the luxurious economy car were beginning to be confused. The few manufacturers—mostly foreign makers like Volkswagen and Mercedes-Benz—who did not visibly change their annual product found that they had a new sales appeal.

We cannot help recalling Henry Ford's plaint: "Change is not always progress * * * A fever of newness has been everywhere confused with the spirit of progress." Ford himself had not imagined that the frenetic quest for annual novelty might make novelty itself pall. The success of the static model (the model T) had itself created a demand for an annual model. The annual model ideal was itself being dissolved by success. What next?

III. A Renovating Culture: Problems and Opportunities

These are only parables of what seems to me to be a peculiarly interesting feature of the relation of our American society to our values. (I prefer the commoner word, "ideals.") Perhaps there are many other comparable stories. For example, we pursue the ideal of universalizing the opportunity to travel (which makes all places more alike, and hence less worth the trouble of going to) or the ideal of indefinitely increasing leisure (which leads people to try to keep life interesting by making leisure into work), or the increase in the means and modes of communication (which leads people to communicate more and more of what is not worth communicating).

Perhaps the explanation for self-liquidating ideals is inherent in the ideal of increase (which inevitably becomes excess), which has been so popular here. Perhaps it is even inherent in the ideal of democracy itself which aims at the very same time to fulfill each unique individual and to abolish distinctions among individuals. Perhaps it is only another example of the universal tendency of love to destroy its object.

But whatever the deeper, cosmic causes, the phenomenon is, I think, obvious enough. The fact of self-liquidating ideals may help us understand some of the peculiar recurrent strains, and some of the peculiar challenges, of life in the United States today.

Old World cultures have tended to be cumulative—and to think of themselves as cumulative. Aristocratic cultures tended to appeal to ancient orthodoxies. To believe in the glories of France is to believe in the possibility of adding up all the disparate, conflicting achievements

of different epochs of French history. Their glory is to widen the spectrum of their achievements. This requires the adding up of opposites—adding the achievements of a Revolutionary Republic to those of an Ancient Regime.

Old World revolutions have tended to produce explicit orthodoxies, which aim to define the Good Society for all time to come.

But, starting in a New World, as a new Nation, we remain a renovating culture. The Federal experimental ideal was to make it possible to try new objectives. One of the most remarkable, and least heralded, features of our Federal Constitution was its explicit provision for amendments.

Our recurrent need for renewal gives us some peculiarly American headaches and opportunities. For in our history there seem to be natural cycles of self-flagellation. We are now suffering through one of these. Perhaps such recurring cycles do not come from the total failure which the self-flagellants insist upon. Perhaps they mark another age when ideals which have been substantially achieved have begun to be liquidated.

Perhaps we are witnessing an age of the self-liquidation of the ideal of the American democracy of things. Perhaps more and more Americans, surfeited by objects, many of which actually remove the pungency of experience, now begin to see the ideal—the ideal of everybody having the newest things—being liquidated before their very eyes. Perhaps the annual model has begun to lose its charm. People who are so frequently and so insistently reminded of the supposedly desirable differences between indistinguishable products, who hear the blaring of trumpets to herald a revolutionary new cold water detergent—these people begin to be cynical about all novelty.

When the getting of more and more comes to mean less and less, when more and more Americans begin to worry over the comparative merits of their increasingly elaborate automatic appliances performing ever more-trivial functions, is it any wonder that more and more Americans become skeptical of the salvation that lies in wealth? Is it any wonder that more Americans should begin to rediscover the basic uses of American wealth at the lowest levels of consumption? Who can doubt the satisfactions of having things or giving things when they relieve starvation or undernourishment? The poverty-Americans (who in recent years have been given the new dignity of a recognized "minority group") are perhaps the only Americans for whom the American consumption ideal has not been self-liquidating. They have not participated either in its benefits or its frustrations. Is it surprising then that Americans nowadays show so striking and sometimes even so militant a concern for poverty in America?

A second characteristic and growing concern of our age is the focus on environment. The word has suddenly become so popular that people act as if the very concept of environment were a creature of the mid-20th century, as if there were no "Environment" before the age of smog. May not our new concern for the environment perhaps be another symptom of our discovery that the ideal of everything for everybody is somehow self-liquidating? By concern for environment these days we mean, of course, a concern over pollution of water and air, over congestion and crime and urban disorder—in other words for the unpredicted and uncalculated costs of building a democracy of

things. So we concern ourselves less with the exhilarating prospect of making more things for everybody than with an effort (in President Nixon's phrase) to "restore nature." And we aim to cancel out some of the consequences of making so many things for everybody.

In the perspective of our history it is not surprising that we should find ourselves seeking to redefine ideals for the American Nation. Perhaps it would be more comfortable to live in an age when the dominant purposes were in full flood, when the hope for fulfillment had not been overshadowed by the frustrations of fulfillment.

But may not much of the peculiar greatness of our Nation consist in its uncanny and versatile powers of renewal? Again and again our Nation has shown an astonishing capacity for setting itself hitherto-unimagined ideals, and then proving that these ideals can be fulfilled. And then setting still others. The burden and the challenge of being an American consist in these recurrent tests of our power of renewal. Paradoxically, this is our most distinctive and most potent tradition.

THE INDIVIDUAL: HIS PRIVACY, SELF-IMAGE, AND OBSOLESCENCE

PAUL ARMER [1]

COMPUTER AND COMMUNICATIONS TECHNOLOGY

We are engaged in this conference in the process of technological assessment. Consequently, I should first like to talk about the technology of computers and communications. I'm more comfortable talking about that topic since I am a computer technologist and not a lawyer, nor a political scientist nor a psychiatrist nor a psychologist nor a sociologist nor an economist, nor an educator. Of course, the list of things I'm not is endless, but the disciplines I have just enumerated will all be impinged upon in what I have to say today.

The first observation that I want to make is that the distinction between computers and communications is becoming very fuzzy. Professor Anthony G. Oettinger of Harvard has proposed that we recognize this by combining the two words into "compunications". I have trouble pronouncing it but I agree entirely with the idea. It used to be the case that all computers were physically confined to one room and serviced one user at a time. Today a computer system may have several hundred or even several thousand terminals, spread over thousands of miles, connected to it over communication lines. The various users may wish to send messages to one another via the computer system—in fact, the major purpose may be the interchange of messages. An airline reservation system is an example of this. Approaching this fuzzy distinction between computers and communications from the communications side, we observe that modern sophisticated communication systems are, in reality, computers.

To make my next point, I'd like to use an analogy originally put forward by Richard Hamming of Bell Labs. (1). When things are changing rapidly, we find that the concept of "an order of magnitude" or a "factor of ten" is a convenient measure of that change. For example, we can travel by foot at about 4 miles per hour, by auto at 40 miles per hour, and by jet aircraft at something more than 400 miles per hour. Each mode differs from its predecessor by an order of magnitude—a factor of ten. The capability of getting around at 40 miles per hour has profoundly affected our way of life, and jet travel has shrunk our world immeasurably.

Contrast the pace of these changes with what has been occurring in the computer field. The last order of magnitude change in transportation speed for the jet set took about 50 years for us to achieve, and while another factor of ten may be but 10–15 years in the making, another order of magnitude beyond that, at least for earthbound travel, is probably infeasible. On its trip to and from the moon, Apollo 11 averaged less than 4000 miles per hour. But the speed of the electronic portions

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of computers (not the mechanical portions) has been increasing by an order of magnitude about every four years, and it looks like that pace will continue at nearly that rate of change for awhile, despite the limitations of the speed of light. The speeds of the mechanical computers of the 1940's were measured in seconds whereas the internal speeds of today's computers are measured in nanoseconds, where a nanosecond is one-billionth of a second. One differs from the other by nine orders of magnitude. Light travels 186,000 miles per second but only about one foot per nanosecond. A nanosecond is to one second as a second is to thirty years.

Size (again I'm talking about the electronic portion of the computer) decreased by an order of magnitude in the last ten years, and will probably decline by three orders of magnitude during the next decade. The details of today's computers are not visible to the naked eye—the details of the computer of the future will not be visible in an optical microscope, since electron microscope techniques will have been used in their fabrication.

Most important, the cost of raw computing power has declined by an order of magnitude every four years, and this trend looks like it will hold for awhile. The amount of computing power in the U.S. has been expanding by an order of magnitude in something less than four years.

And there is another most important trend taking place in the computer field; namely, the introduction of time sharing where many small remote terminals, in the form of a typewriter or teletypewriter, are connected to a single large computer over communication lines. Because of the high ratio of computer speed to terminal speed, it appears to the user at the terminal that he has the complete attention of the computer. Thus computing power is being distributed in much the same way as electrical power and telephone service.

A moment ago I talked about the way the cost of raw computing power was declining. Many other costs are associated with using a computer—the costs of the mechanical devices for getting information in and out of the computer for one thing. Taking a larger view of what's happening to costs, an SRI report(2) prepared for the FCC recently predicted the cost of doing a fixed computer task would decline at about 25% per year for the next decade.

It's a common occurrence in the computer field for newly announced products to be at least twice as cost effective as their predecessors. For example, a recent CalComp ad stated "Our disk drives work twice as fast. For about half as much."(3) Suppose that the cost of automobiles or housing dropped by half this year? There would obviously be a considerable impact on society as a result. But this sort of change in economics is taking place in the computer field. It would be very surprising if such rapid changes were not profoundly affecting society.

Let me now turn from computers to communications technology. I stated earlier that the distinction between computers and communications is becoming blurred so one might suspect that similar changes were taking place in communications as have taken place in computers. Not so. The previously cited SRI report projects only a 2% per year decrease in cost for communications in the next decade while saying that the costs have been relatively constant in the past. I would conjecture that the reason for this discrepancy is that the forces of the marketplace just don't apply to the field of communications. The computers of the 1950's were built of vacuum tubes. If I were to say that

none of those tube machines are in use today, someone might find one or two or half a dozen still working and prove me wrong—but the number is very small. In fact, the field is now entering the third generation based on transistor technology. (Counting the tube generation, this makes it the fourth generation in 20 years.) Yet the telephone industry in some localities still uses equipment installed in the 1920's and doesn't plan on completing the changeover to electronic switching systems until nearly the turn of the century.

There are some encouraging signs, especially the recent rulings of the FCC which tend to introduce a little competition into the communications marketplace. From my somewhat biased point of view, these rulings come very late and don't go nearly far enough. But I applaud the direction of movement and hope that future appointments to the FCC don't reverse it.

On the technological front, communications satellites hold great promise for cost reductions. And cable TV is apt to have a profound impact on communications, in the broadest meaning of that word, with a concomitant impact on society. The television aspects are trivial compared to the communications aspects.

Privacy

Let me now turn from the technology to the assessment. I could spend all my allotted time talking to you about the positive things that can be said about the impact of computers on society; how they have contributed to a rising standard of living, enabled us to get to the moon, helped to cope with the problem of increasing complexity in our social organizations, contributed to better health and education, etc. But those areas do not represent problems for which some actions need to be taken. So I'll be talking about the negative aspects of the impact of computers on society. But please don't forget all the important positive affects.

My focus will be on the individual, his privacy, obsolescence and self-image. I will not address the issue of the impact of computers and automation on employment in the usual way that topic is thought of, since it has been covered by previous speakers. My discussion of obsolescence is, however, a variation on that theme.

I'd like to first take up the privacy question—I'll be discussing it in the context of the computer and not with respect to wire-tapping, psychological testing, private investigators, etc.

As we go through life we generate a fantastic stream of information about ourselves and our activities. Most of that information is never recorded; e.g., most of our cash financial transactions, what we ate for dinner last night or what time we went to bed. If you get an electrocardiogram even once a year, the sampling rate is like four out of a million. What information that is recorded and collected is widely dispersed and somewhat difficult and expensive to assemble. Information exists in small, widely dispersed puddles. But the advent of computer utilities and rapid changes in related technology are making it feasible to draw these puddles together into large pools of information. To put it another way, present systems give the individual a measure of privacy that he may lose in the computer utility era. Further, the rapidly changing economics are making it economically feasible to record in machine readable form much more information about our actions.

These pools of information are springing up all around us. The biggest one of all, the National Data Bank, is still in the discussion stage, thanks to concern about its impact on privacy. But many other pools are already in existence or, close at hand, on the Federal level, and also at State and local government levels. In the private sector, the trend towards computerization and centralization of credit bureaus is viewed by many as a greater threat to privacy than the National Data Bank.

Most of the people who discuss privacy talk about it as though it were inviolable. Unfortunately, it isn't. Like motherhood, there are some problems associated with it. The trouble arises out of conflicts between the individual's right to privacy and society's right of discovery. By the latter I mean the belief that society has the right to know anything that may be known or discovered about any part of the universe—and man is part of the universe. Society aspires to know the universe.

Society has raised its level of aspirations in many ways—we look for improved efficiency in government, better law enforcement, and more rational programs in general. To do this, government needs more and better information about what is going on—information about people and organizations. Government also feels that it must have information to protect society from disorder and subversion. Thus, today, we read of proposals to consolidate government files and to establish national data banks of various types.

The common good cannot be realized in a society consisting only of private entities—it requires some renunciations of the rights of personal and corporate privacy.

There is also a conflict between the individual's right to privacy and his pocketbook. Some of the proposals being made with respect to the regulation of credit bureaus may double or triple the costs of such operations. The proposers of such regulations often seem to assume that the added costs will be borne by the credit bureaus, presumably out of their profits. That is nonsense. If the credit bureaus are to stay in business, the added costs must be passed along to the consumer—credit will become more expensive. I'm not saying that I'm against such regulations or that I worship efficiency. Rather, I want to make the point that privacy will cost money and a choice will have to be made between these two conflicting goals.

You may also have gotten the impression, from my comments about the telephone system, that I also worship the forces of the marketplace. I don't. At least not blindly, for they just don't work in many areas. Pollution is a prime example of a problem which arises because the costs to society of pollution do not enter into the market mechanism. Pollution is an example of so-called "externalities" or "third-party" effects; an individual cannot exercise a choice in the marketplace as to the cleanliness of his air or water. Only government regulation, or the fear of it, can impose some measure of control on the problem.

This holds true for privacy as well. In credit bureaus, for example, the individual is a third party not involved in the market aspects at all. The seller of the information is the credit bureau; the buyer is the grantor of the credit.

I want to point out that the problem of privacy has been with us for a long time and has not been brought about by the computer. But the computer, by introducing orders of magnitude change into the eco-

nomics of the situation, is bringing about significant qualitative changes. We might consider one aspect of this change as positive: the computer is focusing light on a situation of long standing, where reality is undoubtedly much worse than most people realize. As a result of the examination going on, some aspects of the problem may be improved.

What can be done about assuring individuals and organizations an appropriate level of privacy in the era of computer utilities? One of the problems with doing something about privacy is that it lacks, as do pollution and other social problems, an organized constituency. Things happen in this political world of ours because of pressures. But these pressures or forces must be focused to be effective. For this reason, there exist all kinds of trade associations, labor unions, etc. The force most difficult to focus, even though large, is that of the man on the street. Look at the difficulties associated with passage of laws related to consumer protection, automobile safety, meat inspection, truth in lending and gun control. The power of the populace, compared to that of the groups lobbying against such laws, has not been very great in the past.

All the forces of the marketplace are pushing us towards the cashless and checkless society—towards the computerization and centralization of data banks. In the cashless and checkless society, much of the information about our actions which goes unrecorded today, will be captured by the system and remain available in the system. Orders of magnitude changes in the economics of recording, collecting and processing of information about individuals are taking place. Counterbalancing political and social pressures are not effectively focused.

In general, we find only a few congressmen and senators, plus a few isolated scholars and writers and the ACLU pleading the cause of privacy. Most of their presentations tend to be philosophical in nature, as this one is, rather than in-depth studies. One reason is that scholars and organizations interested in the problem are limited in the places to which they can look for financial support. If one is interested in doing research on the problems of health or education in our country, he can look to the Department of Health, Education, and Welfare; but if he is interested in privacy, he can look only to private foundations. The most respected study on privacy which resulted in Alan F. Westin's book entitled "Privacy and Freedom"(4), was supported by a grant from the Carnegie Foundation.

The work that was done at the Rand Corporation (my former employer) resulted either from related work on military security or was supported by Rand Corporation funds, which can generically be thought of as similar in nature to foundation support. Very few studies of the problems of privacy have been explicitly supported by the executive branch of U.S. government.

In accepting the invitation to give this speech, I agreed with the staff of the committee that I would discuss what I felt to be appropriate legislation with respect to privacy. In an attempt to do so I reviewed my own thoughts, a large number of papers and all the proposed legislation I could get my hands on, not only U.S. originated but from the United Kingdom, Canada and several states. I began to list general provisions (e.g. requiring that all data banks be registered or that the individual have access to his own files and be told anytime the information is revealed to another party, etc.). Then I asked myself "which of these are good?" In general, they are all good. But the problem is that each has a cost associated with it. And I don't know those costs, so how

can I make a judgment as to what is worth what it costs and what is not. I further believe that some of those costs are not really known by anyone since some of those costs will be obtained only by experimentation.

Consequently, I abandoned the idea of trying to give you my recommendations as what regulations should be written into legislation.

If what I say is true, then the immediate problem is how to organize ourselves in order to determine what regulations should be adopted. I believe I know at least the form of the answer as to how to organize ourselves. This answer has also been proposed by others. (For example, A. R. Miller.) (5)

It is my belief that some organization in the executive branch of the government should be charged with concern for the problem of privacy, just as the Department of Defense is charged with providing for the common defense and as HEW is charged with the problems of health and education. Don't misunderstand, I'm not proposing a cabinet level organization. Locating such an organization within an existing agency which is a major collector and user of data on people or corporations is "like asking the goat to guard the cabbage patch". For this reason, Miller suggests either the FCC or a new independent agency.

Another notion seems pertinent. Just as there are committees in the Congress concerned with defense, health and education, there should be a committee or subcommittee whose purview is privacy.

What might such a "privacy bureau" do? At a minimum, it might turn out an annual report on the state of privacy in the country, which would provide some illumination. But, more important, it should have staff to study the problem, to estimate costs and benefits and to draft legislation, just as HEW may draft legislation in the health area. And like the Public Health Service, it should have money for research grants and contracts and money for experimentation. Industry (e.g. the credit bureaus) might bear some of the experimentation costs. The privacy bureau should be charged with developing a register of data banks, both private and public. And possibly after some future date, no data banks should be permitted to exist without the privacy bureau's approval of their operations. It should attempt to assess the value of public data banks, including the National Data Bank and modifications thereof, while developing methods, procedures and technology to safeguard the information stored in such banks. The only way we can go about defining a balance between the individual's right to privacy and the common good is through the political process. It is important to realize that there is no right or proper or correct balance. The privacy bureau is needed to do the staff work for the political process.

Before going on to another topic, I want to be sure that I don't leave you with the impression that I feel that no regulations should be passed while the problem is studied further. For example, the Associated Credit Bureaus, Inc., has endorsed Senator Proxmire's Fair Credit Reporting Act. Presumably they have evaluated the costs associated with implementing its regulations and feel that they are not excessive. I believe that piece of legislation should be passed. The only danger I see in its passage would be complacency that the problem had been taken care of. The bill doesn't go far enough in providing protection, but on the other hand, the costs of extending it need to be studied.

Neither do I wish to give you the impression that little research has been done so far. Two years ago my research assistant at Rand turned out an annotated bibliography containing some 320 entries.(6) Much has been done since, both in this country and abroad, especially in Canada. But the many excellent ideas advanced need to be evaluated in greater depth than they have been so far.

I haven't paraded before you a number of horror stories citing invasions of privacy. I believe we've all heard enough of them and are convinced that there does exist a substantial threat to privacy resulting from the unprecedented changes taking place in computer and communications technology—which I have paraded before you.

I should like to end the privacy portion of my talk with a quotation from the previously cited article by Miller:

> Perhaps the most imperative need at this point in time is a substantial input of human resources to help solve the many privacy problems posed by the new technologies.

Technological Obsolescence

When we think of the impact of computers on employment, we usually think of the situation where the introduction of a computer or some technological change results in the fact that a given job no longer exists. This impact of technological change on employment is quite visible. But there is another form of impact, more subtle and much less visible. And one which, I believe, has very serious implications for individuals, organizations and society.

A recent magazine article(7) cited a number of unpleasant incidents in which middle managers in mid- or late-career suddenly found themselves fired or demoted. The article concluded that a middle-management union was the obvious answer to providing protection against the economic disaster for the individual inherent in such incidents.

To me, the union approach focuses on the symptoms rather than on the disease itself. What then is the disease? I would argue that there are three possible explanations for such incidents. The first is that the position disappears due to a merger or reorganization and is not related to the competence of the individual. The second possible explanation is the "Peter Principle"(8) which states that individuals will rise in an organization until they reach their level of incompetence. The third explanation is one which I have immodestly dubbed the "Paul Principle", since it goes hand in hand with the "Peter Principle". The Paul Principle states that "individuals often become, over time, uneducated and therefore incompetent at a level at which they once performed quite adequately."

Perhaps an example will help explain what I have in mind. Let me take it from the computer field, since its technology is changing very rapidly. Suppose an individual has risen in a company to where he is responsible for all computer and data processing activities in the company. The demands of his management duties leave little time for actually working with the technology of computers and data processing. Over time, his proficiency in the technology becomes less and less current—he becomes technologically obsolete and less and less able to perform his job. Eventually, he may be demoted, pressured to resign or even fired. He becomes one of the horror stories of the previously cited magazine article. To have a middle management union force a

company to keep him in that position is similar to legislating against the amputation of cancerous legs. It is a disservice to the health of the organization and also to the individual who can not help but feel less and less adequate to the demands of his job as time goes on.

The occasion of this individual's problem wasn't a discrete event like the installation of a computer, automation equipment, or the introduction of a new technology. Rather, the problem developed slowly over time as the technology changed while the individual failed to keep his knowledge current. I've seen many examples of this, not only in the computer field but in all areas of human endeavor which involve significant amounts of science and technology. And I include the businessman, because there is a large component of science in management these days. And the problem isn't confined to middle-management—it's just as prevalent at the top and at the lower echelons.

I've seen a number of executives who were psychologically in a bad way because they were aware that they were technologically obsolete and were no longer in control of the organizations they managed. These individuals had climbed to responsible positions in large companies; they didn't lack native ability. Rather, they had become "uneducated" for the job they held.

Let me put this another way. It used to be that an individual could go to school, take a job, learn through experience and do well until retirement—drawing in his later years, so to speak, on the intellectual capital he coined in school and on the job. This is now very difficult in many positions. Now the pace of things is such that significant changes take place in a period of time which is short compared to the life span of man. Today we find companies terminating men of a given specialty, while hiring young men fresh out of school in that same specialty. We find companies restricting the percentage of older men among new hires; we find companies in trouble because their managers are obsolete. And as I mentioned a minute ago, we find individuals psychologically disturbed because they feel that they are obsolete.

H. Bentley Glass, President of the American Association for the Advancement of Science, recently said, "A scientist must constantly renew, extend and reorganize his knowledge, or in approximately eight years he will be beyond hope as teacher or practitioner."(9)

We might think of two levels of continuing education. The lower level consists of evening classes, reading, or attending short intensive courses while continuing to hold a job. At the higher level, one would not attempt to hold down a job but would devote full time to education for a significant period of time (say six months to two years).

It seems to me that for many positions, the part time level is becoming less and less adequate—the individual uses up his intellectual capital faster than he can replenish it. If we were to suggest to a man in mid-career that he should consider taking (say) a year off to attend school full time, he would probably reply that he couldn't afford that—he'd have a serious capital problem—one measured in dollars.

If part-time continuing education is going to be inadequate for many positions (and I believe it will), then society has a problem. How is full-time continuing education to be financed? The tuition costs are a small part of the total—the major problem is that individuals will have to forgo income while they are not working.

Last year the Prime Minister of Sweden, Olaf Palme, described a related idea of continuing education which he calls "recurrent education":

> I think the best way for me to illustrate the question at issue is to assume . . . that all post secondary education is organised on a recurring basis, that all people, after completing upper secondary education, go out into a job, that after some time at work they take another period of education, then return to a job again, pass through another period of education, and so on . . . For the individual, recurrent education ought to have several advantages. We all have a need for variety, whatever our occupation is. The student with educational neurosis and the person in working life with symptoms of stress would both perhaps get to grips with their problems if they were given the opportunity of a change of activity for a time. Leisure time would be used by many in a more valuable way than now and the individual would have a better opportunity to get to know his aptitudes. Absolute individual failures would be less common, as everybody would have a repeated second chance. (10)

The academic world has had a sabbatical leave system for a long time—it's part of the academic culture and employers accept the expense as part of the cost of doing business. The academic world also has its equivalent of the middle management union called tenure, but that's another topic. Can we transfer the sabbatical mechanisms to other industries? I suspect not, though a few large firms do support some activity along these lines. But it's infinitesimal compared to the need I foresee. The private sector is very competitive compared to the academic world and I just don't see industry incorporating sabbatics into their culture—it would just be too easy for some firms to avoid the costs of sabbatics and hire, at a small premium, the newly refurbished employees of their competitors. Thus, I see the need for a broadly based mechanism, somewhat in the nature of the social security system. There are problems other than financing such a system—the mechanics aren't at all obvious to me and motivation will be a major problem.

What might be the costs of such a continuing education program? Since I haven't and can't describe it precisely, a precise cost is impossible. But we can, I think, come up with an approximate cost. Let us assume that 5% of the labor force is involved in continuing education at any one time and therefore not working. Let us further assume that the cost per person in terms of both the forgone income and the cost of providing the education, is $8,000 per person involved per year. Assuming a labor force of seventy million, we get an annual cost of about thirty billion. That looks expensive. Can we afford it? We can if we want to. That's about 3% of our Gross National Product. It's less than half our defense budget. And it's about the same as the annual increase in productivity. Further, in time it would undoubtedly cause productivity to increase more rapidly. And ironically, it would also increase the pace of change—the very thing which makes such a program necessary in the first place. In that sense, such a program is somewhat self-defeating—we'll have to run even faster just to stay even.

An assumption in what I've been saying is that the pace of change is actually accelerating. Is that really true? Actually, not everyone agrees that it is. In particular, economists look at such metrics as the growth of productivity and conclude that it isn't speeding up at all. Sociologists

tend to disagree with them violently—I'm with the sociologists. Considering the steadily increasing effort going into research and development, one would expect the pace to be increasing. Not too long ago, most of mankind was desperately engaged in producing enough food to keep alive—even today, in the underdeveloped countries of the world, most of the labor force is engaged in food production. In a highly organized industrial country like the U.S., a few percent of the labor force produces more food than our country can consume. This, plus our high level of per capita income, permits us to devote a significant portion of our large Gross National Product to research and development—thus generating more change. It has been pointed out that something like 90% of the scientists and engineers who ever lived are alive today. Considering all these factors, it would be surprising if the pace of change were not accelerating.

The computer is a major agent of such change. There is hardly an area of science, technology or human intellectual endeavor where the computer doesn't have a large impact on the pace of research and development.

Thus I believe that the most significant social implication of the computer is its role as an agent of change and the consequent fact that significant changes now take place in a period of time which is short compared to the life span of man. I've already told you of the problems I see flowing from this as they relate to individuals and a need for continuing education. To put my point another way, man must learn to adapt in a rapidly changing world. And society must provide mechanisms which help him to adapt.

Institutional Adaptation

Individual adaptation isn't the only problem since institutional adaptation is very much geared to the life span of man—the old guard frequently stays on until retirement—especially in our public institutions. There are other hindrances to institutional adaptation in that they often have a great deal of built-in inertia. Large organizations can not be moved rapidly. Our forefathers deliberately built a lot of inertia into our systems of government.

Society can afford to lose, through lack of adaptation, a few institutions in the private sector where there are many similar organizations. But in the public sector we have little redundancy; each country has but a single national government.

John W. Gardner in "How 20th Century Man Let His Institutions Go to Pieces"(11) stated, "The true task . . . was to design a society (and institutions) capable of continuous change, continuous renewal, continuous responsiveness." At times I can be rather pessimistic about the possibility of that happening. Individuals don't adapt very well and institutional adaptation (at least today) is tied to individual adaptation. To put the problem in the form of a pessimistic analogy—not only is the patient (society) ill but so is the doctor and the doctor's education and experience are not appropriate to the illness at hand.

Let me bring the matter a bit closer to home. The computer industry now claims to be the third largest industry in our economy, starting from a dead start less than 30 years ago. Some industry prophets predict that it will pass the automotive industry and become "#1" as early as 1980; others aren't as optimistic as to when but are just as

positive that it will become "#1". I have argued that computers and communications are having and will have a fantastic impact on our society. If this is indeed the case, then one would hope that one would find expertise in computer and information science well represented in the "establishment". Yet as I scan the distinguished roster of the Panel on Science and Technology, I do not find a single person representative of the computer and information sciences. And I would be most pleasantly surprised if any members of the Committee on Science and Astronautics had more than a passing acquaintance with computers and information science. Some of the panelists may have considerable experience using computers in their own disciplines, but from my point of view, that's like the difference between being a pilot and an aeronautical engineer. The National Academy of Science does have a computer scientist, Professor Anthony Oettinger of Harvard, as Chairman of its Computer Science and Engineering Board, but he isn't a member of the Academy. I presume the reason he isn't is that he's too young.

I hope I'm not being too parochial, and I certainly don't mean to condemn you for not being computer scientists. Rather, I'm trying to make the point that institutional adaptation is geared to the life span of man. And since so much change now takes place in a period of time which is short compared to that life span, institutions are having trouble adapting. Unless you've been to school in the last ten or twenty years, you're unlikely to have any formal education in computer science. But that means you're probably young, which means that it is unlikely that you are a member of the establishment.

I would like to point out that my own formal education was in Meteorology, not Computer Science.

Man's Self-Image

Computers, communications, and rapid technological change in general are all striking serious blows at individual psyches. Certainly the individuals who epitomize either the Peter Principle or the Paul Principle feel most insecure and lack a feeling of accomplishment and worthiness. The computer might be thought of as just one more step which began with Copernicus telling us that we are not the center of the universe, Darwin raising doubts about divine creation and Freud saying that we are not completely rational. The concept of an all powerful, infinitely fast computer is a real threat to man's self-image. It appears to him as something which competes in an area of human endeavor (intelligence) which he associates most closely with his own humanity.

I believe that most men do not have too much trouble in making the intellectual leap from the Fourth of July rocket to Apollo 11's trip to the moon. They are fantastically impressed, but they have a feeling that they understand the process. But the leap from the adding machine or desk calculator to the computer which can carry on a conversation with the user is one which is totally beyond most men's comprehension.

There are many computer specialists who believe that it takes at least a week of intensive instruction to teach "computer concepts" to executives—men who are way above average in intelligence and education. No wonder many lesser individuals feel that it is impossible

to learn what computers are all about. And if he doesn't believe he can do it, he can not.

Several years back, an IBM psychologist did an interesting study which showed that a significant percentage of the population tended to think of computers as "the fearsome thinking machine".(12) As might be expected, this view was held less by the well-educated (24% of those with a college degree did hold this view) than by the less educated (44% of those who had not completed high school). This view was highly correlated with feelings of alienation, suspicion, bitterness and with intolerance of uncertainties and ambiguities. In fact, once it is known where a person stands in terms of alienation and intolerance of uncertainties, variations in education make no significant difference at all in predicting whether or not an individual will hold the "fearsome thinking machine" attitude toward computers. Alienation is certainly on the increase in today's urban society, so we shouldn't be too surprised if the percentage of the population who fear computers is also increasing.

Men feel that they just can't cope with the rapidly changing environment in which they live. Or they may just decide not to try to cope, as some of the younger generation are doing when they head for the rural areas to form their communes. This fear of a world that is changing so rapidly that one is unable to function well in his job, or in his role as a citizen of the world, is not confined just to the less educated. I believe the Paul Principle is operant at the highest levels of industry, science and government. I wish I were able to take a secret poll of the individuals in this room as to whether or not they felt they were an example to some extent of the Paul Principle. I'd bet that at least a third—possibly a half—of you would secretly admit to it. I know I would.

References

1. R. W. Hamming, "Intellectual Implications of the Computer Revolution," Amer. Math. Monthly, vol. 70, No. 7, Jan. 1963.
2. H. M. Zeidler et al., Patterns of Technology in Data Processing and Data Communications, SRI Report No. 7379B–4.
3. Business Week, Jan. 10, 1970.
4. A. F. Westin, Privacy and Freedom, Atheneum, New York, 1967.
5. A. R. Miller, "Personal Privacy in the Computer Age: The Challenge of a New Technology in an Information-Oriented Society," Michigan Law Review, vol. 67, No. 6, April 1969.
6. A. Harrison, "The Problem of Privacy in the Computer Age: An Annotated Bibliography," Doc. RM–5495–PR/RC, Rand Corporation, Santa Monica, Calif., Dec. 1967.
7. The Man In The Middle—The Case for a Middle Management Union, News Front, Nov. 1969.
8. L. J. Peter and R. Hull, The Peter Principle, William Murrow and Co., Inc., New York, 1969.
9. H. B. Glass, Letter from the President, AAAS Bulletin, Sept. 1969.
10. Olaf Palme, Speech given at the Sixth Conference of European Ministers of Education, Versailles, May 1969.
11. J. W. Gardner, "How 20th Century Man Let His Institutions Go To Pieces," The Futurist, vol. II, No. 6, Dec. 1968.
12. R. S. Lee, "Social Attitudes and the Technological Revolution," unpublished manuscript.

TECHNOLOGY, MASS COMMUNICATIONS AND VALUES

Osmo A. Wiio[1]

Technology is rapidly changing human life throughout the whole world—directly or indirectly. However, for the large majority of mankind technological change is a remote thing: it does not touch upon everyday life. This is very much true in the developing countries, but even in the most advanced industrial societies millions of families live in conditions which are not much different from what they were some hundred years ago. When people initially come into contact with modern technology, the technology usually takes one or all of the following forms; communications, industrialized work methods and military technology.

At present, perhaps, the real vanguards of modern technology are mass media and communications systems. In underdeveloped regions a radio or television receiver literally opens a window into a new world and can start change in a society which has been stable for centuries. There are many studies which confirm this, one a study about the coming of television into the arctic Lapland of Finland. The study showed that the new medium made it possible for the Lapps to compare their living with conditions in other parts of the country: the comparison caused dissatisfaction and pressure for change.

The somewhat blind and naive belief in the great power of the mass media has been replaced by a more sophisticated opinion based on communications research. The effects of mass media are gradual and generally small: in a modern society the audience has developed an automatic protection against an overload of information. However, the effects of the mass media may be significantly greater in a primitive society where there is little psychological protection against persuasion and propaganda through mass media. It may seem paradoxical but the more an individual is exposed to mass media messages the more difficult it may be to use persuasion to change his attitudes and behavior.

In recent years there has been talk about direct radio and television transmissions from satellites orbiting above foreign countries. This innovation would mean, for example, that an American television show or a Russian film could be seen in India and the Indian authorities could not do anything about it. As a result, many representatives from small or developing countries have expressed concern about these programs. Some of their concern is political, some commercial. They fear that the system would be used for political propaganda or commercial advertisement in a society which would be vulnerable to such persuasion. The fear is at least partly justified because even non-persuasive daily television programs from a more advanced society would bring with them value systems which may not fit less developed

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societies. There have already been student revolts against mass-consumption ideology in pre-industrial countries—at least 50 years too early. On the other hand new values through communications might start changes towards the improvement of stagnant societies.

My guess is that any attempt on the part of one country to unilaterally decide the program content of direct broadcast transmissions would poison relations between the transmitting and receiving country. Therefore, I would recommend that an international agreement be worked out to handle this new problem.

Mass communcation are also of major importance in advanced industrial societies. Omitting work and sleep they consume the largest part of our daily life—anywhere from one to five hours. Although the direct effects of the mass media in a modern society are smaller than usually suspected, prolonged exposure to them has an effect in the formation of values, attitudes, opinion, and behavior. Communications in the broad sense of the word—communication of ideas and people—have changed the daily life of modern man perhaps more than any other technological change.

Marshall McLuhan has coined the phrase "the medium is the message". Much of our communication consumption is really consumption for its own sake regardless of the content of the message. Communication is the exchange of information and information is supposed—by definition—to decrease uncertainty. Very often there is very little information passed through the mass media—especially television. Communication through the media developed by technology has become a value in itself: people enjoy vicarious experiences instead of taking part—or participating, as the modern phrase goes. We are also mostly worried about how the messages reach the audiences but we seldom worry—or study—how the messages are understood and what kind of information should be communicated.

In many ways technology has lost its function as a tool and has become a value in itself: industry produces things that nobody really needs, gadgets are bought that serve no useful purpose, and technological achievements are worshipped regardless of their practicality. This has in some cases led to what I call the "black box fallacy". The black box is one of the most useful inventions of all time, it can be anything from a newsstand to a world government. You can take a black box, write NASA on it, feed in 26 billion dollars and out comes a trip to the moon. This is all fine and useful but the employment of black boxes can be carried too far. You can have, for example, one box symbolizing a computer and another a factory. If you are able to simulate the operation of the factory with the computer so that the inputs and outputs of both boxes are the same you may think that the boxes operate similarly or that the contents have to be similar as well. That may or may not be the case. You really cannot tell because in an open system such as human organizations there are many ways to reach the same goal. This is, of course, a very simple example but it is quite common to draw far-reaching conclusions about black boxes and to try to mold social or individual human behavior to fit the "behavior" of the black box. The map is never the original landscape, the word is not the object, the blueprint is not the machine. *Norbert Wiener* was one of the first to construct cybernetic models of human behavior and human society, but

he was also one of the first to warn of the dangers of drawing such analogies between computers and men.

It is interesting to note that technology has been widely attacked by the youthful dissenters both in the United States and Europe. It is no coincidence that automobiles have been the main targets in street fights and that computers have been damaged. Even here technology has lost its value as a tool and become a value in itself: not only a symbol.

It is almost an axiom now that technology is the main cause of change in the modern world. However, much of the change is haphazard and beyond the control of political decision makers. An innocent-looking device is invented and in the space of ten to twenty years it brings about more change in the world than any event short of a nuclear war. By inventing the transistor *Shockley*, *Brattain* and *Bardeen* may have shaped the future more than any statesman and by inventing penicillin, *Fleming* saved more lives that were lost in the two world wars combined. Often the invention is stumbled upon accidentally or it is developed as a solution for a minor problem: *Gabor* invented holography to make sharper pictures in electronic microscopes and now the system seems to have made a major contribution and to have many future applications in such fields as communications and data retrieval. So unless we forbid new inventions there is not much we can do about these "random" discoveries which change our lives. We can plan the future but at best we can only devise a "surprise-free" projection, as *Herman Kahn* writes.

If one listens to the critics of technology, then technology is to blame for everything bad and dangerous, from pollution to the atom bomb. Some of the criticism is justified but one should also remember that the modern standard of living is only possible in an industrial or post-industrial society. We, who enjoy this living standard, take for granted items like medical care, housing, an adequate diet, old age protection and so on, all benefits which we owe, in large part, to technological developments. But even then one should realize that technology and the resultant economic growth are only tools to make a better living for us—human beings. You cannot have eternal economic growth nor is it necessary. According to *Daniel Bell* this will be the philosophy of a post-industrial society.

Not all criticism of technology concerns obvious problems such as pollution and mass consumption. There is also concern about more subtle effects: the loss from individuality and the dangers of computer data systems for the individual. So far these problems are, happily, mostly American problems. First of all computer technology here is far ahead of that of any other country and such computer systems are already feasible. On the other hand, in most European countries the authorities have traditionally had much more information about their citizens than in the United States. A European is usually obliged to register his address and changes of address and to furnish a large amount of information each year in his report of taxable income. In many other ways the authorities gather information about citizens and this has not yet been considered any great danger for individual freedom in European countries although it is realized that, with modern computers, such information could be used maliciously. Therefore there should be adequate social safeguards and controls to prevent mis-

use of information. It must be left to each individual society to decide what it considers to be misuse. In addition every individual should have access to information concerning himself and an opportunity to try to correct any errors.

In most European industrial societies one aspect of technological development is becoming more and more obvious: automation with all its implications. One of the greatest effects of automation has been on education, which is rapidly changing in most European countries. The change is deep and runs from elementary education to the universities. The obsolescence caused by rapid technological change is changing the concept of learning in many ways. It may no longer be wise to train young people for specific jobs and professions which may not exist when the training is finished. It may be better to give the student a good basic knowledge and then to leave his vocational training to employers. Also the whole question of adult education is under fresh consideration: a large number of people have to be retrained into new jobs each year when their old jobs disappear because of automation. The apparent fact that changes in educational systems usually come about twenty years too late is a serious problem in most modern societies.

The industrial society with its economic growth and mass consumption has been a necessary phase to channel human resources into the development of a welfare state. However, one must also admit that the growth has developed a materialistic value system which is unnecessary after a certain level of well-being has been reached. The younger generations are already rapidly developing a new value system in most modern industrial societies. I conducted a survey on expectations for the future among students of the School of Business Administration where I teach. I asked the students to predict what they think Finland will be like in the year 2000. The most frequent answer by far was: polluted. Yet Finland is a country where pollution is a minor problem compared with some other countries in Europe. It makes me a little sad to think that in years to come I may be remembered as one of the generation which polluted the country instead of being remembered as one of the builders of its welfare.

EDUCATION AS AN INFORMATION SYSTEM

GEORGE KOZMETSKY [1]

Mr. Chairman, members of the Committee, I am honored to have this opportunity to appear before you on a subject as vital to our Nation as Education for a Changing World. Our subject matter can best be exemplified from a management point of view by the quotation: "For a manager, a lifetime of experience is no longer enough." Nor is a "lifelong learning" sufficient without relevant experience. Managers must have the ability to learn by analogs in a continuous process from formal education to experience and from experience back to formal education as well as through personal learning interrelated by communications within a network of reality. In this manner, we can visualize education as a "continuous process" involved with multi-faceted information systems that permit tomorrow's managers to stay abreast with or even enter into a varied multi-career.

There are no higher education institutions for the development of managers with multi-careers, or courses for such innovative management. And if one were referring to the kind of management required over the last third of this century and the first quarter of the 21st Century, then there are very few, if any, universities concerned with the problems. Yet it is becoming one of the great socio-economic-cultural requirements of our day.

One must, at this point, be personal. In September 1966, when I assumed the deanship of the Graduate School of Business at The University of Texas at Austin, it was my dream to develop an educational program for the American manager of the 21st Century. In the pursuit of this goal, I have kept uppermost in mind the explicit caveat of Harold Laski: "When the leaders of a people ask their followers to die for a dream, those followers have a right to know in whose behalf the dream is being dreamt."

More specifically, as a Dean and a hopefully dedicated citizen, I established for the college the following guiding objectives:

In order to become one of the best colleges of business in the nation, at least two very fundamental requirements must be met. First, the college must have its own objectives which are achievable and which reflect primarily the needs of its students while at the same time recognizing the development needs of its faculty, its society, as well as government and industry. Second, the way in which the college initiates its objectives will to a large measure determine if it will successfully meet them.

The objective of the Graduate School of Business is to train the managers of the last third of the 20th Century. More specifically, the college must educate the future managers of the technical and intellectual resources of our nation. This charge is an extensive one which challenges all of the college's ingenuity and resources.

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A quick reflection about the future brings the magnitude of this challenge into clearer focus. Managers for the last third of this century must: deal with emotional and behavioral as well as technical changes; learn to converse in the appropriate language of mathematics; communicate with and manage scientists, engineers, accountants, and artists; use sophisticated new tools for effective planning and controlling strategic and tactical decision making; and understand and implement the social and individual value system of our nation. In essence, the managers of the last third of this century must be cross-disciplinary and must embrace new methods and techniques.

This presentation includes the more relevant experiences, accomplishments, and researches to date of the faculty, students, and my colleagues at The University of Texas and other institutions with whom we have collaborated. I would be remiss not to mention my gratitude to a great many individuals who have helped shape the thoughts and ideas reflected herein. A complete listing is impossible; however, among those at The University of Texas at Austin who have had particular influence are Professors Eugene Konecci, Floyd Brandt, Abraham Charnes, Lanier Cox, Lawrence Crum, Edward Cundiff, David Huff, Gaylord Jentz, Judson Neff, Albert Shapero, C. Aubrey Smith, Burnard Sord, Tom Tucker, Ernest Walker, and Glenn Welsch. My academic mentors of the past including Professors G. I. Butterbaugh, Ed Learned, and Georges Doriot provided me with the necessary academic foundation. My associates in academic and industrial research include W. W. Cooper, Herbert A. Simon, C. B. "Tex" Thornton, Roy L. Ash, David Learner, and Henry E. Singleton; they gave me inspiration to approach in a direct, systematic and pragmatic manner the problems under discussion. Equally I am grateful for the assistance and close collaboration of Carl Mueller, Bud Coyle, Fayez Sarofim Jim Bayless, and Arthur Rock for the insights gained for relevant entrepreneurship formations for tomorrow's industrial society.

Systems Analysis for Integrative Higher Education Planning

Today educators are facing relatively the same question asked by Professor George Counts of Teachers College in the 1930s, "Dare the Schools Build a New Social Order?" Let us pause for a moment to review quickly the change in higher education philosophy since the 1930's. It became somewhat clear to educators between 1939–45 that the armed forces needed high mental capability as contrasted to physical capability. This was reinforced in the post-war period. It is clear that our military-industrial complex requires increasing levels of intellectual capabilities as well as an understanding of science and technology. The practitioners of the futuristic art have already heralded the need for the extension of these more technical skills in order for our nation to enter tomorrow's meaningful community of humanity.

The above causes have, in turn, had their effect on higher education. Their early manifestations were the stress upon excellence in education through excellent teachers and excellent students. Our universities directed their changes towards tougher academic entrance standards for their professorial staff as well as for students. They initiated and maintained more academic specialization, especially at the graduate levels. Qualitatively, the faculties emphasized depth knowledge;

quantitatively, the faculties increased the scope and amount of reading expected from their students. Research by individual faculty, individually selected and sponsored by government or foundation grants, prospered until it became relevant to discuss "publish or perish." All of these were the effects of an increased emphasis on excellence as a standard for our community of scholars—student body and faculty. The accomplishment of the sum total of these reforms was that between 1950–1965 our universities turned out over 4 million graduates, which was almost 80% of all college graduates turned out up to 1950.

The quest for excellence in education between 1945–1959 had some negative side effects. Frank G. Jennings stated these as follows:

"They hunted out the gifted child and tried to hound him into competence. They began to rescue physics from the scrawny hand of Newtonian mechanics and cradle it in the nucleus of the atom. They redressed mathematics in properly regal garments, threw away the abacus, and plugged in the computer. They sought good young minds everywhere and found them most often among the well-fed, the well-born, and the fair-skinned." [1]

On the other hand, the quest for excellence in education between 1945–1959 has had, in my opinion, some positive benefits. The first of these was that it provided for education a goal of leadership in our society—to lead it, not follow it. This was succinctly stated by Professor Sterling M. McMurrin as follows:

"Our society is marked by scientific intelligence, social conscience, and an acute historical consciousness; it possesses a remarkable capacity for invention and change. Since for us change is inevitable, unless we move forward with resolution our society is in danger of retrogression and our culture in danger of decline. We cannot live simply by the conservation and perpetuation of the past; we must be critical and creative.

"The proper function of schools, therefore, is to be the chief agents of progress, whether it is the advancement of knowledge, improvement in the arts, technology, or the social conscience, in institutional organization and administration, or in the attainment of those large visions of the future which are the prime movers of history. For the schools, colleges, and universities provide the most effective means for the achievement of the intellectual skill, knowledge, understanding, and appreciation necessary to the analysis, judgment, and decision without which there can be no genuine progress. We depend upon them to stimulate that freshness of ways, attitudes, and ideas which alone can bring vitality and high achievement to a culture." [2]

So accepted has this objective become since the times of Professor Counts' challenging speech that when the American Academy of Arts and Science Commission on the Year 2000 was meeting, there was general agreement with Dr. Herman Kahn's statement:

"Let us assume that it does not take much time or effort to worry about internal order, international order, national security, or material goods. I submit [then] that the main motives for our going to school would then disappear." [3]

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[1] Frank G. Jennings, "It Didn't Start With Sputnik," *Saturday Review*, September 16, 1967. p. 97.

[2] Sterling M. McMurrin, "What Tasks for the Schools?" *Saturday Review*, January 14, 1967. p. 40.

[3] Herman Kahn, "Working Session 1: Baselines for the Future, October 22–24, 1965." Richmond, Virginia: American Academy of Arts and Sciences, 1967, p. 674.

As we turn to the 1970s, educators are once again faced with "Dare the Schools Build a New Social Order?" We are aware that a quest for excellence in education as promulgated was at best a short-run objective. The advance of technology in our society already demands all levels of intellectual talent for building the industrial society emerging from the second industrial revolution. The requirements of our "nonroutine industries" as contrasted to the "mass production industries" will require over 60% of our productive population in the year 2000, or a work force equal to the 80 million we have today. From a philosophical point of view, Whitehead reminded us a long time ago that: "in the conditions of modern life the rule is absolute. The race which does not value trained intelligence is doomed." Intelligence is not measured solely by intelligence quotient. That was well known to the educator in the 1930s. In today's idiom and in a very pragmatic sense, we can no longer discriminate on the basis of race, color, creed, or intelliegnce quotient. In economic terms, our nation has an inelastic supply of people to meet their ever-increasing demands. In a philosophic sense, education must enable every person to develop to the fullest whatever he has in him to become. In short, there is no conflict between what so many think are firmly inflexible or polarized needs of our society.

The transition towards these goals will not be easy; yet in some respects it will be much easier than that experienced from 1952–1969. The past five years have seen educators delineate the basic assumptions which will become the base upon which the new and enriched standards for education of the 1970's will be structured. Challenges to seven basic assumptions of the previous generation of educators are being evolved:

(1) *Education is a privilege.*—There is increasing acceptance that education is a universal necessity that has yet to be based on meaningful standards.

(2) *Schools must group, sort, and screen students as to their ability and responsibility.*—There is increasing awareness that schools will accept, stimulate, and nurture each child to find his proper level.

(3) *Education must be separated from the real world.*—There is increasing awareness that there is a broad area of congruence between education's role as a service to society as well as the shaper of society.

(4) *Schools are the only educative force in our society.*—There is increased recognition that schools are not the only educative forces. There are other enterprises, public and private, involved in meaningful education that will be interrelated with the school systems for a lifetime of individual learning.

(5) *Education is exclusively a process by which the older generation transfers relevant knowledge to the younger generation.*—There is growing awareness that much of what the young people need to know for their generation's time today's educators have yet to learn and that there is a growing need to learn more things together.

(6) *The process of learning is essentially a formal process.*—There is a growing awareness that there is a great deal of informal learning outside the classroom. This is evident in mass media, industrial corporation training programs, and military-services training.

(7) *The teaching-learning environment is primarily batch processing involving teacher and students.*—The fear of technological devices (e.g., computers) is being gradually replaced by the growing awareness

that these devices are natural extensions for the individuality of teaching as well as for the individual's development of creativity and inventiveness.

In spite of all the above awareness and pressures for change, our principal problem in higher education is widespread, habitual, institutionalized resistance to needed change. My purpose is to discuss some new horizons that provide for the acceptance of change.

The application of systems concepts to all aspects of higher education is still in its infancy. By the same token there has been minimal application from the field of cybernetics to higher education even as an information system. Systems concepts and the other principles are found in all phases of scientific disciplines. Only recently have many of our institutions of higher learning become interested in their application to the university itself. This is only natural, for the emphasis upon a systems methodology has come from both the sciences themselves and the double-barreled major thrust of modern industry's development and recognition of many of our social and economic problems. These thrusts, which in turn have made possible the explorative system methodologies and the creation of principles, techniques, and tools for their partial solution, have provided the main impetus for considering education as an information system.

Higher education's approach in the past, and at the present, has been to do research in bits and pieces and to incorporate the results into the curriculum on a piecemeal basis. When viewed from the application of communication and information principles, such research commingled the data and information so that it covered the need to identify clearly the additions from research to the current state of the art, the advances in techniques or in the processes of teaching, and the advances in the learning process by the student. This method has three significant drawbacks. First, current instructional methodologies are often inadequate vehicles for the transmission of the product of research. Conventional teaching methods in the area of management decision-making, for example, do not lend themselves well to the teaching of the newly developed techniques of modeling. Such techniques are best taught in a curriculum where the conversational use of computer is an integral part of the instructional methodology. Second, current modes of curriculum change yield curricula that may have certain outstanding areas; but, when viewed from the perspective of systems analysis, rarely exhibit a coherent structure and are often plagued by inadequacies and redundancies. Third, the time required to transfer the relevant findings of research to specific areas of knowledge and/or technique with the appropriate method of teaching a specific course is so extensive that often it is outdated by newer research before it is utilized.

During the past two years, Dr. Thomas Burke had been Special Research Associate at The University of Texas at Austin and worked on "A Systems Approach to the Planning and Formulation of Technology-Augmented Programs for Management Education." His research resulted in the definition of two main needs in order to develop new curricula and courses using new technology in its teaching by the educator:

> (1) An educational approach for the practicing professor who, while perhaps untrained in computer applications for teaching, is seriously interested in upgrading his ability to recognize and

put to work improved practices which exploit the full potential of technology such as that provided by the computer.

(2) A curriculum framework or perspective for use by management faculty and/or administration in the identification, evaluation, and incorporation of innovative subject matter into the curriculum.[4]

By now it is clear that systems analysis can be used for the development of integrative curricula. The problem of developing effective curricula relative to teaching resources, research, data gathering, and physical resources suggests an enormous field of inquiry. However, it is the integration of the forces of curricula change, of restructuring our colleges and schools, and of their required resources that is mandatory for tomorrow's society.

Innovative Management Under Creative Capitalism

When Neil Armstrong took that giant step for mankind, he opened the scene for a better society on planet Earth. Something greater than a step on the moon happened on that historic day. On July 20, 1969, the curtain rang down on the "*First Industrial Revolution*" of the past two centuries and the stage was set for the transition towards an "*innovative socio-technological era.*"

The economic and political success of the United States has been in part due to its "traditional 'capitalistic' [and democratic] factors as sufficient flexibility to accommodate entrepreneurship and a fundamental belief in the value of individual initiative and free competition." [5] Capitalism as a philosophy has gone through at least several phases in the United States. The famous business historian, Professor Norman De Gras, had delineated these phases in terms of "financial capitalism" to cover the period of U.S. business growth from the 1860s to the 1930s and "national capitalism" to cover the period from the 1930s. The first period relied on private capital first from outside the United States and, in later times, to internal United States private financial institutions. The shortcomings of "financial capitalism" led to what many of us in this room lived through as the "Great Depression." The second period was more of a reliance upon federal sources for financing or government guarantees and extensive use of private management. In fact, the major concentration of this second period has been a dramatic partnership between the federal government and private enterprise to prevent the "scourge of depressions." The successes of this partnership in terms of historical "national capitalism" have been legendary. They have made our nation economically affluent and thrust our nation into the forefront of world political powers.

Success at a national level too often, as at a personal level, lays the seeds for unforeseen possible problems. Today it is clear that "national capitalism" has been deficient in two respects. The first of these is that

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[4] T. E. Burke, "A Systems Approach to Planning and Formulation of Technology-Augmented Programs for Management Education" (Ph. D. dissertation, the University of Texas at Austin, 1969). p. 130.

[5] Robin Marris, "The Role of the 'Business-Like' Organization in the Technology of Social Change," *Social Innovation in the City*, ed. by R. S. Rosenbloom and R. Marris. Cambridge, Mass. : Harvard University Press, 1969, p. 2.

it has resulted in the United States' creating and exhausting from 40% to 60% of the total world wealth with only 6% of the total population. The second is that national capitalism has, by its very success, dulled our ability to react to the existence—and their timely prevention within the nation—of underprivileged classes, urban crises, pollution, crime, a rising group of lost youths, an emerging new left, and insufficient regard to our more rural areas and their transitional problems into tomorrow's industrial society. In short then, the deficiencies of national capitalism have created the need for what I call "creative capitalism" based on innovative private management.

Today many believe that our social problems are those of crime prevention, pollution, urbanization, poverty, employment of youth, and determination of a stalemated peace. Yet in many respects these are symptoms of the unsolved problems that emerged from an aging, maturing, and declining phase of the First Industrial Revolution. This is not to say that these are not important problems for our present society. They are. However, concentration of a majority of our intellectual resources on these problems to the extent that we ignore those based upon the predictable advances of the Second Industrial Revolution will permit newer problems to arise as continued crises too often wrapped in protest for immediate solution. Such problems of transition were succinctly stated in an editorial of the *Economist:*

"What has happened in France this month ought to nag at the minds of people who are concerned at the way the world's industrial societies are developing. The crisis in France has raised expectations in countries which, though they are rich by the world's standards, are not rich enough to match the rocketing demands of their people. It has also raised the problem of completing the transition from an oligarchic society to a democratic one in a world where efficiency demands that life be organized in large units. These are problems for both communists and democrats." [6]

To this may be added a statement from an editorial which appeared in the June 12, 1968, issue of the Austin *American-Statesman:*

"Our professions, our schools, our fiscal and financial institutions, and all our agencies of government face a double crisis. The demands upon them are increasing in scale and changing in quality at the same time. Only the overhaul and redesign of the institutions themselves can give them a fighting chance to keep pace with the human needs they are trying to meet." [7]

Technology, science, and formal education are not enough, in my opinion, to solve these fundamental needs. The impact of continued automation is familiar to all of us. They range from the concern of the human use of the individual to the concern of the continued economic growth of our 500 largest corporations. Mass production two decades ago made it possible to create as the high-income earners the self employed: professional, small businessman, and farmer. Today automated mass production has changed the mix of this group to salaried executives, scientists, engineers, and other professionals.

In short, we are witnessing a relative decline of mass production requirement tasks for employment. The routine requirements of the

[6] *The Economist,* May 25–31, 1968, p. 8.
[7] David S. Broder, "The Need for Institutional Change," *American-Statesman,* June 12, 1968, p. 4.

past two-thirds of this century are rapidly being replaced by machines. To date much of our educational system has been geared to educate and develop people for an industrial society which can be generalized as "routinized" or mass productive.

The task that the last third of the 20th Century industrial state imposes on our educational system is the increasing development of people for nonroutine tasks under "creative capitalism." Particularly since World War II we have seen the rise in what we could call the technological industry, which is concerned with "nonroutinized" kinds of problems and demands that require a new order of solution. These problems are concerned with space exploitation, buildings of megalopolis, control of environment, water and air pollution, marine sciences, crime, transportation, and environmental health.

As stated earlier, these areas provide the bases for an expanding nonroutine industry of the next decade or two. On the other hand, the innovative management is aware that the problems of the Second Industrial or Socio-Economic-Cultural Revolution also provide opportunities. Cybernetics as a science has yet to delineate clearly and specify these opportunities. What are some of these yet unexposed problems that only man can identify as problems?

(1) What will be the 21st Century industries in the United States? How will their development be financed? What will be their markets?

(2) Leisure as an industry is not only in its infancy but is not yet clearly delineated. During the transition to the 21st Century, there will be four types to satisfy the following groups: first, the unemployed (waiting between jobs); second, the low-salaried employees working short hours; third, the higher-salaried groups working short hours; and fourth, the professionals (including statesmen) working long hours and who will have limited leisure in sporadic bursts.

(3) When will a black cease being a black?

(4) How do you redistribute the wealth under "creative capitalism"?

(5) How do you allocate the abundant resources—short run, long run?

(6) How will new forms of organizations change the institutions to fit the social and individual needs?

We have witnessed the advent of technology to newer industries such as nuclear energy, aerospace, and petrochemical and, thereby, have witnessed emerging industries for nonroutine activities. These nonroutine industries have given employment to more people at all levels of our society at a faster rate than possible in the mass-production industries. The nonroutine economic activities are characterized as follows:

1. They are technically based, and their products have a relatively high proportion of technical and professional labor in the final product.
2. There is a continuous shift of the high technical content within the activity from the final product to its tooling or processing.
3. The number of final units is not larger; in fact, it can range from "one of a kind" to what would be generally recognized as a "short production" run.
4. The problems and processes involved can be typified as "messy." That is, there are no single clear-cut solutions including scientific and engineering principles. Often, so-to-speak solutions must be "invented" on the spot.

5. The nonroutine activities thereby utilize large quantities of intellectual capacities; e.g., people ranging from semi-trained technicians and laborers to noted scientists—social as well as physical.

6. The management of these nonroutine activities often requires the full coordination of government, universities, and industry. However it is generally recognized that industry has a major role to play in the economic exploitation of these technological advances.

7. Finally, the ability and capacity of our management of these technological and intellectual resources will determine to a large measure whether our nation will continue to increase its advantages in the nonroutine activities. The reason is that some technologies are more currently available and enjoy a higher probability of success over others; in addition, each has its own costs associated with it in terms of research and development, tooling, product costs, distribution and marketing, service and maintenance, as well as its social costs of retraining, dislocation, and expansion of our urban and rural areas.

There are, however, two underlying requirements to all these "nonroutine" pursuits. First, they demand large quanta of technical and intellectual resources such as individual scientists—social and physical—engineers, and other professionals and service personnel and technicians as aides to the professionals. Second, they require relevant and up-to-date information necessary for the solution of the nonroutine problems. Of course, the key requirement is managers with the ability to identify and formulate the problems for solution.

Any approach we may make for meeting the tasks required for the nonrepetitive problems brings sharp changes in the economic, social, and political environment surrounding the conduct and management of these resources. There are good reasons for this. Our society does realize that our intellectual resources are in short supply. Furthermore, the scarcity of intellectual resources is not only recognized by industry and government but there is an awareness that their supply is relatively inelastic.

In short, technological change has set up a self-amplifying system in its demands for intellectual resources. Technology generates new advancements which, in turn, generate still greater need for sophisticated intelligence and action. The task for management education is not merely to select the gifted or excellent student for training but to develop on a broad front all levels of skills to meet the requirements of society in developing people for all their roles in a society which are essential for the full cultivation of each individual's talents and abilities.

An easy way to summarize the employment needs of our society in the last third of the century is shown on Table 1. (Please note that the data herein are, at best, estimates.)

TABLE 1.—ESTIMATED PROJECTIONS FOR RELATIVE WORK-FORCE REQUIREMENTS EXPRESSED AS PERCENTAGE OF WORK FORCE

[In percent]

	1860	1968	2001
Agriculture	90	10	5
Mass production and service industries	9	70	30
"Nonroutine industries"	1	20	65

The problem for today's education is to develop innovative management that can take intelligent action to solve the cumulative consequences of continuing rapid technological change, economic growth, urbanization, and continuing deescalation of rural areas in a way that provides for a renewed democratic society in a context of "creative capitalism." Another way of saying this is to repeat the late President John F. Kennedy's call in his inaugural address to confront the "unfinished business of our generation." No rhetoric alone can solve these problems. Nor may it be possible for any one of our 19th Century institutions to solve these problems alone. The 1950s and 1960s saw the growth of a new complex that was instrumental in solving many of our defense, space, and nuclear energy national problems; namely, the Federal government, university, and private enterprise complexes. Their potential problems were clearly stated by the late President D. Eisenhower in his farewell address. The 1970s and 1980s could well see the rise of a broader set of complexes which would include not only the Federal government but also local government entities; not only universities but also graduate centers; not only private enterprises as represented in the urban home offices and plants but also in their local plants found in the rural areas supplemented by emerging new firms that utilize the local resources relative to the economic utilization of advanced technology. In many respects, "creative capitalism" can well be institutionalized on these more broader-based complexes.

Creative capitalism must advance our society beyond the need for imperialism or exploitation of people. Creative capitalism's success depends on its creation of wealth in a manner that truly establishes the community of humanity as the goal of our society. Wealth produced under creative capitalism must be distributed in a manner which makes it possible to increase the standard of living of all the people in the world. The new institutions or complexes upon which creative capitalism is based will make it possible to solve in a timely basis our social problems simultaneously while creating wealth and providing for meaningful leisure for all people in the world. Education for creative capitalism thereby provides a challenge as well as an unprecedented opportunity for innovative management of all public and private institutions. Thereby education contributes and receives from experience a continuous process of developing a socio-economic-cultural society while developing the required knowledge of information for transmission to the coming generation.

Knowledge and information for development of innovative management under "creative capitalism" does not exist. In this respect, education today resembles a research and development organization which is geared for change. Professor Albert Shapero described the problem as follows:

"It is almost as if we were now in the position of those who began to develop our present body of management knowledge at the turn of the century. We have some skillful practitioners and some artistry, but do not have anything that can pass as an organized body of management knowledge relevant to R & D and the other growing areas of commitment in which technical and intellectual resources play a dominant part. We have a powerful and growing awareness of need for this kind of knowledge in order to cope with the problems that

are crowding us now and that can only increase in importance in the future." [8]

Herein lies the opportunity and needs for education for a changing world. The body of knowledge for transmission lies somewhat in our current materials in basic research of the past and present and in other governmental and industrial institutions although not published or partially published. The education needs are to develop principles of relevances to identify and extend such information. Teaching while developing an integrated body of relevant knowledge is a requirement for which education has no past experiences to fall back on. Simple solutions such as new techniques of multi-media, computer simulation, computer time sharing, and of computer augmentation while advances and often necessary are at best tools that can be used once the body of relevant knowledge is identified. For in the parlance of the computer profession, "garbage in, garbage out." More apropos are the remarks of the famous philosopher Alfred North Whitehead, "that the role of progress is such that individual human being of ordinary length of life will be called upon to face novel situations which find no parallel in his past. The fixed person, for the fixed duties who in older societies was such a godsend in the future, will be a public danger."

The development of the concept of innovative management identification and transmission of data is an example of education in a changing world. Several years ago, I spent endless hours searching through literature for concepts in this field to little avail. Computerization would have helped to reduce the search time but only in the sense that it would have identified a large number of possible books and articles. However my personal acquaintance with H. Igor Ansoff, Dean of the Graduate School of Business at Vanderbilt, quickly reduced the search time, as he has devoted a lifetime to the academic and practical aspects of innovative management. He quickly identified a workable concept that he was developing at the time. More specifically, he stated:

"*Entrepreneurial Planning.*—In this advanced stage, the firm sets corporate objectives, examines its strengths and weaknesses, probes deeply for external threats and opportunities, and—combining all of these—makes a systematic evaluation of its prospects. Any proposals for change undergo intensive search and analysis, culminating in an action decision, which then enters the flow pattern established in earlier stages of planning. Entrepreneurial Planning represents a major commitment of the firm's resources and top management time and can altogether alter the organization and atmosphere of the company.

"This stage-of-growth analysis of management functions suggests several changing roles for the planner as planning evolves in the firm. Further, since the essence of advanced planning is organized entrepreneurship, the planner's job can be viewed as helping to provide the firm—through marshaling its full resources—with the nine types of talent that mark the entrepreneurial genius." [9]

Trying to abstract information on entrepreneurship and principles from the state of knowledge is a difficult task. While entrepreneurship

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[8] Albert Shapero, "The Management of Technical and Intellectual Resources," Working Paper, Graduate School of Business, the University of Texas at Austin, 1968.

[9] H. Igor Ansoff, "The Evolution of Corporate Planning," Reprint No. 342, Graduate School of Industrial Administration, Carnegie-Mellon University.

has held fascination for the individual in terms of the American dream of being "in business for one's self," it has also been an area for research and study for over 150 years by economists and social historians. Yet there is little research work published and an extreme paucity of theory of entrepreneurship as it pertains to company formations and growth.

In view of a changing society, it is important that we review the concept of entrepreneurship particularly as it relates to nontechnical company formation and to technical company formation. The contention of this presentation has been that not only are their requirements entirely different but also the trend toward nonroutine industry requires changes in business entrepreneurship as well as changes in all institutions including education that nurture and supplement them. The entrepreneurs who have been interested in nonroutine ventures have characteristics and needs far different than those who are interested in ventures that are more concerned with technological products or services.

It is possible for the professor to develop knowledge together with the student. In the case of entrepreneurship, Dr. Susbauer devoted his effort with a faculty committee to explore the technical company formation process.[10] His doctoral dissertation is an outstanding review of the literature and clearly discloses the lack of knowledge of company formations in both nontechnical and technical companies. There has been little cohesive research in looking for the problems and thereby distilling the principles for entrepreneurship. His thesis showed that specific data could be gathered and maintained on technical company formations in the city of Austin, Texas. However, unless subsequently interested doctoral candidates write their theses in this area, the knowledge so gained will cease as of 1967.

Dilemmas Facing Education

At this point we can look more closely at the major dilemmas facing education. The first of these arises from the fact that our educational administrators are truly managers of our society's intellectual resources. These intellectual resources consist of the students who are in inelastic supply and the teachers who will be in scarcer supply because of the increasing future demands by industry and government.

There are today 50 million students in school and they represent 90% of our school-age population. In the next decade there will be 11 million children who cannot read or write; 7 million will not complete high school; and 2 million will drop out before they reach high school. In this next decade 30 million boys and girls will be looking for jobs. Our dilemma is that our educational administrators have to establish the basis for educating the students for an industrial society which is rapidly changing. They do not have the time to analyze the new requirements or establish an integrated curriculum as the students progress from elementary school through higher education. Therefore there are required the means and process for collaboration between the systems of higher and secondary education, between leading scholars and teachers, and between graduate departments and undergraduate departments and the establishment of comparable standards of achieve-

[10] J. C. Susbauer, "The Technical Company Formation Process: A Particular Aspect of Entrepreneurship," (Ph. D. dissertation, the University of Texas at Austin, 1969).

ment of students. Finally, channels must be kept open to transfer the flow of technical information and innovation to the students from industry and government.

As managers of our education's intellectual resources, we face the predicament of shortages of teachers. Already we have seen that higher education at the undergraduate level cannot be staffed by full-time tenure staff. Teaching assistants and associates are utilized by most, if not all, universities—public and private. In the secondary schools we are using assistants to teachers for less skilled portions of teaching or for giving individual pupils attention. There is a profusion of experiments in team-teaching to utilize scarce teaching resources, in the use of teaching machines and electronic blackboards, and in educational television. There are yet to be adequately developed measures of teaching effectiveness for the last third of this century.

It is appropriate at this time to examine in some detail the use of the computers in education, more specifically business education. It is indeed a shock to realize that the impressive multimillion dollar computational facilities are often as not used to solve the same problems as were assigned under paper and pencil teaching days. Such usages of the computer more often than we like teach the students that they cannot accurately punch a deck of 100 cards after a half-dozen attempts. More surprising is that the problems assigned to the computers often can be solved by the students on today's modern electronic calculators in less than a quarter of the time spent in the modern computer labs modeling, programming, punching cards, debugging, and evaluating the quality of the results.

Since becoming Dean of the Graduate School of Business, at The University of Texas at Austin, I have discovered two concepts which are applicable to computer designers as well as to educators. The first is that both are equally reluctant to use the principles or techniques which they develop. For example, computer designers, as a class, do not like to use computers to design new computers. Nor do educators generally apply the principles of management they teach to their own problems. The second is that both professions are reluctant to predict the future. Computer designers and educators feel that they do not want to be put in the position to do long-range predictions for they may be held to it.

In industry one quickly learns that a manager has no excuse not to try to predict the future. In fact, the reward system is such that it attaches heavy penalities for errors or omissions; conversely, the rewards for partial success are also high. One cannot start to build a major new company within a five-to-ten-year period in the United States without trying to predict the future. Indeed, one cannot enter into the electronic computer industry by extending a current operation or beginning a new enterprise without trying to predict the future. The consequences are evident from following the financial fortunes of G.E. computers, Control Data, and Scientific Data Systems, among others.

No manager will give up his current noncomputerized or semicomputerized formal and informal management system for an untried "quantum jump" of an integrated management information system or "system" management on the computer. On the other hand, I do believe that providing the principles, methods, and technologies as well as the required training for those items which make these concepts

relevant is a proper function of the schools of business. In other words, I believe that the schools of business if they are to provide leadership for our business communities must undertake to fulfill these tasks of evolving the future managers for business, including computerized management.

Many tools, techniques, practices as well as experiences exist to help us forecast the future trends and opportunities in the use of computers in business and business education. To make the longer term forecasts of trends in this paper, I have used the information system available to me as a manager and dean. There is no available digital computer, heuristic program, or cognitive processor machine to do the strategic planning required for such a talk today. On the other hand, I have used the results of my industrial computer applications as a base for extrapolations when they are applicable to either uses of today's computers or needs indicated for development of advanced mathematical and nonmathematical techniques, computer devices, as well as research in the better understanding of man-machine system in developing the top management of the future.

The role of computers in the future, in my opinion, is the result of applying current advances in research rather than depending upon startling, unpredictable breakthroughs. By extension of the current state of knowledge and current research efforts in the fields of (1) servo-mechanical control and computation and (2) management sciences or operations research for management planning and control, it is possible to make a number of useful predictions in the use of computers in business and thereby in education.

A useful starting point to establish the basis from which predictions will be made is found in examining trends of the past two decades. Twenty years ago the United States had entered the postwar period of the mid-'40s. The techniques and electronic devices used for purposes of war were being studied for peace-time applications. It was found that servo-mechanisms formerly used to direct anti-aircraft guns could be used for industrial controls—material handling, positioning of machine tools, and semiautomatic process sequencing. A newcomer at that time on the scene, the digital computer could provide a means to mechanize complex manipulative and control problems associated with automation.

By 1960 it turned out that it was not enough to merely recognize that elements of industry could be broken into the parts of a closed loop control system, such as structural units, sensor units, communication units, actuator units, and visual displays. It became apparent that any organic system, of which industry is one type, operated by virtue of something other than just simple feedback. Organic systems had to be examined in terms of the reasons for the functioning of the system. While these principles were set forth by Norbert Wiener in 1948, it took a number of military and nonmilitary systems applications to outline the practical problems of implementation.

Organic systems are characterized as manifesting in the broadest sense a form of intelligence. As such, their basic building blocks are people, machines, and their respective interfaces. How these elements are interrelated has been a continuous effort of study on the part of those working on complex systems projects. Most recently attention has turned to the problem of considering the interrelations between

multiple weapon systems which must function in close coordination with each other. Here the problem is not one of optimizing any one system but designing sets of weapon systems which adequately assure our national defense posture. In their fundamental respects these studies are closely related to the managerial problems of giving order and significance to those found in some conglomerate industries or in larger national and international corporations.

The modern research in the areas of Management Sciences and Operations Research also dates from the post-World War II period. By 1960 practical applications of early research were being made in both military and industrial areas. However, the advanced research of today is predominantly focused on industrial applications and is being conducted principally in a few of the country's leading universities.

The need to understand the role of the manager in organic systems provided much of the impetus to perform advanced research in Management Sciences. Accomplishments to date have been significant. Advanced quantitative techniques which are applicable to management decision-making rely on the aid of digital computers. Management Sciences with the aid of computers have solved such problems as location of warehouses or plants, scheduling production and inventories, selecting stocks and bonds for investment portfolios, determining the best advertising media for a product, estimating acceptance of new products prior to their distribution, and finally, monitoring and controlling operations of a complex and continuous production system. Recent thinking indicates that the piecemeal application of Management Sciences to separate aspects of industrial problems is not enough.

One of the major thrusts for looking at organic wholes came from the application of computers to the development of integrated total management information systems. Other current research indicates that even more is required in terms of looking at the problem as an organic whole. By development of computerized total information systems, the interfaces between human decision-making with machines, market requirements, technical confidence in new product development and their successful introduction for a world market became evident. In addition, concepts and methods need to be developed that will enable the procedures to be formed for the establishment of over-all company policy goals and subgoals. Advanced techniques of an analytical nature are required before it is possible to minimize the usual corporate drives which operate through techniques of compromise, conflict, and occasional corporation.

There is work going on in the research laboratory for new methodology on the conceptual level and on computer models as well as various display devices. This is one of the reasons why schools of business can play such an important role in the development of computer applications in business. There is need for stating requirements of top management so that they can be executed in meaningful devices that meet the flexible needs of executives.

Research as to how to present meaningful management action reports is required. One cannot help but speculate that some of the action reports should be given directly to other machines by the computers while others come to management attention. To the best of my knowledge, there is still no truly cross-disciplinary research group for display of information to top management. Schools of business, colleges of engineering, psychology departments, and mathematical depart-

ments can help to do basic research in this area. In fact, such cross-disciplinary exchange is a requirement if colleges of business are to extend their training of management for the future through computers. However time sharing for faculty member research is one thing, but time sharing for class purposes is another.

In the future such uses of the computer will be more commonplace in all business and education. The key point is that top management must participate in the total planning of any major projects. They cannot wait for the various functions to bring each of their various alternatives and then try to relate each of these to select a major alternative for coordinating their companies. Model builders cannot build models without working with top management. Otherwise, they will build models that satisfy them. They will be elegant models, but they may not be solutions anywhere near what top management requires. Today management must learn to crawl in the skin of the model builder and the model builder in the skin of the manager. The computer is one tool which facilitates this process. In the future when our schools of business have trained the top management of the future, special staff modelers will cease to be required. Just as operations research groups have begun to be replaced by either becoming parts of the functional group or by taking over operational responsibility, so too will the computer modelers of the future.

The role of the leading business schools is to prepare this new breed of top managers so that they understand and have the know-how to build these computerized models. Our nation is currently in the midst of a management gap as well as an educational gap. Industry, especially the technically based, has developed managers only through limited experience. Their numbers are still too small to be effective in extending our nation's industrial leadership or continuing the rate of growth our companies require. The schools of business are lagging behind industry in this respect. They have yet to have on their faculties scientists, engineers, life scientists, etc., that are found in fair-sized projects in the technically based industries. While it is true there is much talk and excitement on our campuses about cross-disciplinary education in the future, there is little being done. Even when there is such cross-disciplinary education, such as at Texas, we have found that the computer is a bottleneck. A central computer facility for teaching and research becomes quickly over-scheduled, and delays extend for days if not weeks. Waiting for computer runs is not conducive to such cross-disciplinary research and teaching. We at Texas are in the process of establishing a separate computer facility for this class of research and teaching as we start a research project for an integrative curriculum to teach starting in 1975.

Computerized models do not obsolete faculty as is generally assumed. For example, at Texas a model was put into a computer in Los Angeles with terminal boards in Austin. After two days of training the faculty members, one of our current accounting classes used it to evaluate the cost procedures used and their method of estimation. Our production department used it to teach critical path programming. Our quantitative controls department used it for the teaching of chance-constrained programming. Our executive development program used it for teaching strategic planning. Our College of Engineering included it in their engineering executive program. Quite

straightforwardly, the classroom use of computers for management training, as most academicians recognize, is in its infancy.

Management of technical industries and educators of management for these industries, however, cannot continue to wait for required breakthroughs or new curricula. Let me explain why I believe both managers and educators will need to use computers to expand their abilities before 1975 and will need to rely on expanding their conceptual abilities through the use of computers to process large amounts of information for their strategic and tactical decision making. The requirement for such an evolutionary step comes from the rate of technological growth and the resultant explosion of data. As our technology advance continues to increase exponentially, so does our body of knowledge. The university professors are not the only ones who have been publishing books and articles. Members of industry and government have also published profusely. Technical reports published by NASA alone number over 100,000 a year.

Let me try to relate the data explosion to the amount of reading one would have to do weekly in order to keep current with technology through published works. In 1900 the weekly stack of published material would be five feet high, one foot wide, and one foot long. In 1960, the weekly stack of published materials would be five feet high, one foot wide and sixty feet long. Predictions have shown that by the year 2000 the weekly reading stack will be five feet high, fifteen feet wide, and sixty feet long.

The current trend of computer application to bibliographical search microfilming, microfilm cards, print reading, linguistics and library sciences does help narrow the transference of technical data gap. Even under the most optimistic of claims it does little more than reduce the average search time for managers of technical industries, or their staffs, or the educators of management of technology from one hour a day to perhaps 15 minutes a day. Evaluation of studies made by NSF and Case Institute on what professional people do with their time discloses that the resultant savings of 45 minutes can be used to increase the normal four hours of reading and three hours of work for a normal eight hour day. Microfilms of any sort of computerized retrieval systems do little to reduce the reading time. Abstracts either in small or large print do not solve the managers' problems of extracting the required information for decision making or the educators' problems of extracting the required information for decision making or the educators' problems of teaching, individual research, or determining required research for graduate students.

The diffusion of technology by computers will be an extension of present day data banks and retrieval systems. The use of computers for diffusion of technology will be a step-by-step development. Transfers of technical information will first be done by getting people together from different disciplines and professions to mutually discuss their needs and thereby transmit their research and development results. In other words, it will at first be a "mood" operation rather than a "computer mode" operation, and computers will maintain cognizance of each individual's area of interest in research and development in biomedicine, nuclear energy, defense, space chemistry, etc. Cross-indexing of technical interests at detail levels is not a difficult task. A next step could be that where information is extracted in an orderly fashion by

technically trained personnel and filed in computers that are accessible to research and development experts, top management, as well as to educators through time shared computers. Another step would be to establish orderly informational systems for selected areas of technology so that there are acceptable hierarchies of information files that minimize extraction, communication and filing time.

At this point, it is appropriate to review the second dilemma faced by education. Namely, how do we come to grips with the economic and technological considerations in educating for the full development of the abilities of each individual? How do we evolve the education of individuals for both the mass production, repetitive industries and the technological, nonroutine problem industries? How do we bring the resources of the school into full effective use so that each student's capabilities are fully utilized?

One thing is clear: American parents and individuals will not let us say we cannot or we do not know how. We must organize research programs for increasing our teaching effectiveness. Teaching machines and other material technologies are only one means of doing this. Evolving social systems of permitting each student to develop at his own capacity may require provision of a large number of decentralized microfilm libraries. It may even change our methods of grading. The requirements are clear. Policies are fairly easy to enumerate. The implementation is not beyond our abilities, nor must the future of education be projected from present lines of development. In many respects, a simple extrapolation of today's developments would lead to agony. On the other hand, the future must be imagined; and therein lies the ecstasy.

EDUCATION AND SCHOOLING IN POST-INDUSTRIAL AMERICA: SOME DIRECTIONS FOR POLICY

THOMAS F. GREEN [1]

I have been asked to discuss a series of questions about the future of American education. What is likely to be the link between education and work? What consequences can we expect from a world-wide movement in which education is conceived virtually as a birth-right? How will access to education be made possible? And for what purposes? These are enormous questions. They cannot be handled in the detail they deserve. Nonetheless, it is possible to gain some perspective on these problems in a way specific enough to suggest some directions for policy. I shall attempt this under three general headings: (1) *The Social Demand for Education*, (2) *Education and Work*, and finally (3) *The Conditions for Functional Literacy*.

Before turning directly to these topics, however, there is one useful preliminary dealing with the applications of technology *in* education and the effects of technology *upon* education. I wish to make two clearcut judgments. First, it is unlikely that the application of technology within the educational system will resolve any major current problem or any problem likely to confront American education within the next fifteen years. Secondly, likely developments in technology—especially new techniques for control of behavior—may present the educational system with new problems of structure and content within the next fifteen years. These two judgments reflect a particular understanding of technological diffusion. But more important, they reflect an attempt to keep in mind the difference between what is an educational problem, on the one hand, and what is a social problem affecting education, on the other.

The first judgment on the applicability of technology within education stems from the following considerations. On the whole, we get widespread adoption of technology in this country only under some combination of three conditions—(1) when it is reasonable to expect economic gains of a large magnitude for the producer and the user or the society, or (2) when it is politically advantageous to adopt a technology even though the short-run economic gains are slight, or (3) when it is widely believed necessary in order to surmount a crisis. None of these conditions are currently satisfied in the case of any educational technology known to me. Costs are not competitive, running for some school districts twenty times the current per pupil per day expenditure for instruction. Thus, the economic gain is not evident. But even if it were, the present structure of school finance will not permit an easy or rapid transition from labor-intensive practices to a capital-intensive enterprise. Education represents a growing public expenditure, but the size of that expenditure does not increase market

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behavior in the management of the system. Moreover, there has been no clear demonstration that the new instructional technologies will permit dramatic gains in achievement. Relative advantages for school systems are not obviously attainable. Gains in motivation and in the enjoyment of learning do occur, but not with enough magnitude to justify the rapid introduction of such technologies, especially when such gains often seem attainable by more conventional and less troublesome means.

The most likely scenario depicting the rapid adoption of instructional technologies is one in which the costs of instructional systems declines and their quality improves together with continuing and increasing pressure to raise the level of professional salaries. These factors jointly would produce a crisis of major proportions. It would then become politically advantageous and economically necessary to try every possible device to reduce instructional costs by reducing the number of professionals. All of the conditions for rapid technological diffusion would be met.

There are two points to make. First, the formula for the most rapid adoption of technology within the educational system may therefore be a formula for disaster. Secondly, even if the crisis were met, it is not clear that the result would be desirable for education. Perhaps the word "disaster" is too strong. Such a crisis would be disastrous for the present set of arrangements for education, and that is precisely the point. We must focus attention not on the possible adoption of technology in education, but on the arrangements necessary if that diffusion is to take place. The application of technology within education will probably occur only when we find new methods of finance, and different ways of representing the public interest in education. This will require a fresh understanding of how the interests of the profession are to be handled in consonance with the interests of parents, students, and legal authorities. In short, the barriers that stand in the way of a new system of education have to do not so much with issues of educational policy as with the structure of the educational policy, the systematic ways that we relate the public and the profession within the governance of education.

But is the cure more deadly than the disease? This is the point where questions of good and purpose come into view. Technology is a means, not a goal; but what is problematic in the present educational situation is precisely the goal. The issue is not what is it that will be good for schools, but what is it that schools are good for? The question that needs asking is whether the goals of policy appropriate to an industrial society can be made appropriate to a post-industrial society. The point at issue is not whether educational technology can provide us answers. It can, but we are in the position of the person who goes to the "answer man." Having found an answer, we need to find out what was the question?

It should be apparent that these observations emerging out of my first judgment about the employment of technology are quite as appropriate to my second judgment about the impact of technology on education. I turn then to consider directly the basic issues.

The Social Demand for Education

By the "social demand for education" I mean the demand for formal schooling. It is a commonly voiced charge both by students and parents, but often by teachers and administrators as well, that the experiences provided students in the educational system are irrelevant. The charge is difficult to understand, partly because it is often accompanied by the acknowledgment that whether one goes to school or "gets an education" is extremely important. Thus, it seems *prima facie* that schools and schooling are viewed as consequential even by those most vocal about their irrelevance. But that observation is really not to the point.

Another reason why the charge is difficult to understand is that it is so ambiguous. One wants to ask "Irrelevant to what?" Sometimes the charge has to do with the irrelevance of the schools to formulated goals of personal growth, sometimes to clear-cut vocational objectives. Sometimes the charge of irrelevance is a judgment about the behavior of schools as institutions—either in their internal behavior or in their corporate actions in relation to existing social problems. They could be more relevant, for example, by providing more jobs for blacks. Sometimes the charge has to do with a judgment about the discourse of educated men, the results of getting an education. This form of the charge is well captured in an observation made at the last meeting of the American Philosophical Association, that when a finger is pointed at an important problem in the world, philosophers will study the finger. The charge of irrelevance is, therefore, not one thing; it encompasses a variety of charges, sometimes personalistic, sometimes programmatic, sometimes institutional, and sometimes just the observation that getting an education isn't as beneficial as it might seem.

Instead of considering the merits of the charge, I would like to raise a slightly different point. What needs understanding is not the question of fact as to whether schools and schooling are irrelevant or in what respects. Let us simply grant as a fact that they are, and give to the term "relevance" whatever meaning you like. What needs explanation is how that fact can be converted into a significant social claim. Or to put the matter in a slightly different way, from the claim that education is irrelevant, it is meant to follow that something is wrong. Why? How is that made to follow? What's wrong with irrelevance?

Certainly, the relevance or irrelevance of schools and schooling was not a matter much discussed ten or twenty years ago. Why is it that now anyone would expect schools or schooling to be particularly relevant? I remember that as a boy it was unequivocally pointed out that education is relevant to one's future life-chances, but not decisively so. In any case, that was not the point in gaining an education. Some people went on to learn more not because it was going to be especially relevant to anything they would do later, but simply because it was believed to be a good thing to do. In fact, education was often understood functionally to set certain people apart simply because they knew a lot of things admittedly irrelevant. Certainly, there is a strong tradition in America along those lines.

Besides, if one really wanted to pin the tag of "irrelevant" on some institutions in modern America, there are a lot of better candidates

than the educational system. For example, the claim that the Churches are irrelevant in modern America is a proposition widely accepted, admittedly with different credibility in different regions of the country. But it is a claim widely accepted even within ecclesiastical and theological circles. Yet that has not been cause for any basic and socially serious complaint on the part of the younger generation. Among those who are ecclesiastically "hooked" that fact has prompted a huge amount of rhetoric and even a degree of intensive, sometimes narcissistic, self-examination. But for the most part, people simply learn to "kick the habit" and they leave. If education is really irrelevant, why don't people kick that habit too? Are they addicted? Is it narcotic?

How can we account for these changes? What are the conditions that seem either necessary or sufficient to render the relevance of schools and schooling a matter for serious thought? (1) One of the necessary conditions is simply that *there are a lot of people in schools.* It is hard to imagine any putative irrelevance of education to be a serious thing, even for schools, except when there are lots of students in the schools. Whether schools or schooling are relevant to anything at all is not a problem if hardly anyone is in school. I do not mean that there must be a lot of students in this or that school. There are policy issues concerning the optimal size of an educational institution. But that is not the point. I mean that in order for the relevance of education to become a factor in social policy, there must be a large percentage of an appropriate age group of the entire population in school.

That this condition is not sufficient can be shown by a simple intellectual experiment. Imagine a society all of whose members are in school, all at the same time, but for only two days each year. That would clearly satisfy the requirements of the first condition. But whether their schooling is relevant or irrevelant would present no serious social problem. Imagine instead a society in which every child is required to be in school for the entire calendar year, but only up to the age of eight. That would not generate any deep problems of relevance either. What seems to be essential is a circumstance in which (2) *a sizeable portion of the total population is in school not only for a substantial part of the year, but for an increasingly enlarging span of their lives.*

Not even this second condition, however, will be sufficient. There is no *a priori* reason to deny that the schools of such a society might be quite successful and no problems concerning their relevance need arise. In addition to these two conditions, one might add others. Suppose that such extended schooling takes place in a society confronted with pervasive and basic social problems. Surely, it is hard to imagine issues of educational relevance arising in a society without any grave problems. Suppose, further, that the management of those problems or at any rate that the questions students ask about those problems are not being raised in the school. That would certainly be frustrating, and it may be that these two conditions are a part of the present scene. However, I would like to emphasize a slightly different point.

What apparently must be added to any list of necessary conditions is a third, namely that (3) *it is widely assumed among those in school that schools are, or ought to be, a fit instrument for confronting or*

learning to confront such social problems or for learning to become a better person in the process of confronting those problems. That is to say, what seems essential to this problem of relevance is the development of a set of expectations about the functions of schools and schooling, about the appropriateness of a certain social fit between means and ends when the school is viewed as the means. Schooling, in short, comes to be viewed instrumentally.

It is the combination of these conditions that underlies the issues of educational relevance. Observe what is contained in this particular combination of social conditions.

1. In the first place, what is involved is the idea that somehow schools and schooling should be made to change rather than the idea so common in the past that because schools and schooling are not particularly relevant, therefore, one ought to leave them and get on to something more useful in life. Confronted with the irrelevance of education, there seems to be two basic courses of action—(a) leave education alone and encourage people to do something else, or (b) change the schools. The first course of action will mean abandoning, at least in part, the first of the three conditions necessary for the problem of relevance to arise. The second course of action involves the implicit assumption that education in the formal sense is or can be made a fit instrument for the attainment of all kinds of personal and social goods.

From the premise that schools and schooling are not particularly relevant, we used to draw the conclusion that one ought to leave the schools and do something useful. Now from precisely the same premise we draw an entirely different conclusion. We now conclude that the schools should be made to change. Why is there this difference? Well, the reasons are many, but the significant point that I want to make is that *the fact that we do incline to draw a fresh conclusion from the same premise provides an operational definition of what we mean by a high social demand for education.* The tendency to draw that conclusion, resting upon a strongly instrumental view of schooling, is both what produces a high social demand for education and also what justifies the behavior that expresses that demand, *i.e.*, the behavior that translates a demand for education into a demand for schooling.

2. Secondly, consider the following question. Is it possible for a society to satisfy the first two conditions for the problem of relevance to arise—namely increasing numbers of the population in the school for an increasingly extended period of their lives—and not to adopt the third condition—namely that education stands in an especially direct means-ends relation to the attainment of a wide range of personal and social goods? It seems to me a reasonable expectation that in any society where the social demand for education is maintained at increasingly higher levels, the issues of educational relevance will arise necessarily, because the only way to maintain that high social demand will be to inculcate high expectations concerning the utility of "getting an education" as opposed to other ways of spending important years of one's life.

In short, the issues of educational relevance are symptomatic rather than basic. But they are useful in revealing the basic problems. They arise not because schools and schooling are any more irrelevant than they ever were. These issues may arise simply because we have reached

a point of very high social demand for schooling, and because we have reached this point by promulgating an ideology that says education, *i.e.*, formal schooling, is good for whatever ails you, and more of it will be even better. That, of course, is a false doctrine—a point to which I shall return.

The essential point to recognize, however, is that the attainment of a high demand for education does not constitute simply a quantitative growth in the educational system. It does not simply represent a commitment to an increase of "productivity" relative to the demand for skills. It represents rather a commitment of the society to a qualitative change. It means, in short, that education will be understood increasingly in instrumental terms, that schooling must be justified in the light of its instrumental value. This is not a new point to American educators, but the intensity of it is new. It is qualitatively new.

3. Thirdly, I wish to make a point that partially retracts the one just made. I said that the only way to maintain a high social demand for education is to promulgate the belief that education will (or should be) instrumentally useful and personally rewarding. There is another way to create the *appearance* of a high social demand for education. It can be made compulsory. There are a hundred ways of making education compulsory without direct legislation. Child labor laws are important at the secondary level, and the draft undoubtedly has a huge impact at the post-secondary level. Because of the draft, we do not in fact know how large is the demand for higher education. But more subtle and important are the employment practices and work-organization in business and industry—another point to which I shall return.

For the moment, however, it may be enough to recognize that, however arrived at, an increase in the social demand for formal education experienced as a sequential requirement in the lives of people, may be dysfunctional because in practice, it constitutes an extraordinary extension of adolescence at precisely the time when people are maturing earlier. It means, among other things, the extended deferment of entrance upon meaningful work. It is ironic, if not downright paradoxical, that the application of one's education to socially meaningful tasks should be increasingly deferred at precisely that time when the instrumental promises of education are most vigorously advanced. The result cannot help but be frustrating and indeed alienating in a society that has promised much to be gained from extended education and then has progressively deferred the reward. When we speak glibly of the decline of the Protestant ethic, we ought to keep in mind that no society has ever placed such great stress on a capacity for deferred gratification, the delayed validation of one's life.

My conclusions are no less paradoxical than the analysis. As we move in America to a post-industrial society, one based upon the cultivation of knowledge rather than craft skills, we shall have to adopt policies that will contribute to a lowering of the social demand for education in the sense in which that demand is currently expressed and experienced, i.e., as a demand for increased amounts of schooling in the formal sense offered in a sequential fashion for a long period of time. To this point, I shall now turn attention.

Education and Work

Among the questions addressed to this panel, it was asked how might the link between work and education be expected to change? An answer can be formulated by asking where, in the knowledge society, will learning be acquired? Where will essential skills be developed? Two alternatives come immediately to mind. Skills will be developed in schools; and skills will be developed on the job. Undoubtedly, what in fact occurs will be a combination of these two. The first alternative is the usual response. If the chief characteristic of the knowledge economy is that it requires not craft skills, but knowledge based skills, then formal education becomes strategic. This alternative requires a strong link between education and work and undoubtedly an increasing social demand for education in the sense just discussed. There is reason to believe that this path will not take us very far. The second alternative requires a different understanding of work in the life-cycle of the individual, a different view of the organization of work, an enlarged understanding of where education takes place, and a weakening link between schooling and work. This seems the more promising alternative and one that is actually occurring.

Consider the grounds for these judgments. First, let us take a brief and startling look at the development of educational attainment in the U.S.—elementary, secondary, and higher. Secondly, let us examine the implications for work in a knowledge society. Perhaps the most startling achievement of the American educational system is the consistent enlargement in the proportion of each generation attaining the level of grade twelve. There has been a steady growth of attainment at this level from about eight per one hundred in 1910 to about 80 per one hundred in 1969. From 1910 to 1968, the number of eighteen year olds completing grade twelve has increased at an annual rate of about 1.2 per cent. At that rate, by the two hundredth anniversary of the Republic, 90 per cent of those reaching age eighteen will have completed grade twelve.

It appears to have been an implicit policy of the American people for some sixty years to make education at grade twelve a universal achievement. We are very near the point of attaining that goal. Expressed in this fashion, the growth of secondary education is reaching its limit. The 90 per cent level will probably not be reached. The implications of this perspective stagger the imagination. What does a nation do when the objective of a policy of such long standing is near attainment? Do we simply seek a more remote target of the same sort, or do we turn attention to a new agenda? Having built the house, do we simply live in it? Do we set the target higher and now seek to make attainment at grade fourteen a universal achievement? That is the easiest answer; it is also the one most commonly offered. I would like to suggest, however, that such thinking is the sort appropriate to a developing industrial society in which capital formation and productivity is the main problem. But in the post-industrial society policy choices will probably have more to do with problems of distribution than with production. I shall return to this observation in the final section of this paper. But for the moment, I wish only to make clear that we cannot expect the skills needed in the knowledge society to be produced by a proportionate increase in the numbers of people completing education at grade twelve.

Perhaps, therefore, we can expect the colleges and universities to provide an ever-increasing portion of the population with the skills essential in the knowledge society. It is not easy, however, to make the record of the past justify such a view. Over the past twenty years, higher education has expanded enormously. But so has the population in certain age groups, and so has the number of people completing high school. Has higher education grown relative to the size of its prospective clientele? That is the more meaningful test of growth. If we relate the number of BA level degrees to the number of high school diplomas five years earlier, we will find that the ratio has been remarkably stable since the 1920's. That ratio, except for disruptions of war and depression, has hovered around a figure of slightly less than thirty per cent, being in 1967 almost exactly where it was forty years earlier, in 1926.

It is widely believed that greater proportions of students who start higher education are persevering to the first degree. The fact is, however, that during the period of most rapid growth in higher education, the ratio of completions to starts has been remarkably constant. That proportion is approximately 55 per cent and has remained so since the 1920's with deviations during the war years and during the depression. It is easy to describe one reason for this stability in the educational system. Imagine a college professor who in 1968 had 500 students all of whom would have qualified for a grade of A in the same class ten years earlier. Can anyone honestly believe that the professor would give them all A's? Of course not. His task, among others, is to discriminate. He does not graduate a higher proportion of qualified students. Instead, he shifts his standards to give the same distribution of grades that he gave ten years earlier. In short, one of the social functions of the college and university system as it currently operates is to maintain a constant ratio between the numbers of those who start and the numbers who graduate, *no matter how many students may come to study*. Academics describe this process as "maintaining academic standards," and they have supported such behavior with an enormously powerful ideology. In fact, it is not a process of maintaining standards. It is a modification of standards in order to maintain a constant ratio between starts and completions.

It might be supposed that higher education has grown because an increasing proportion of high school graduates are seeking a four year degree. There is some evidence to support this view over the long run, but during the recent period of 1950 to 1969 the change was far from staggering. In 1939 first year enrollments in higher education were 34 per cent of the high school graduates of a year earlier. In 1968 the figure was 61 per cent. So over such a long period, the growth is substantial. But during the more recent period from 1954 to 1968 the rate of entry fluctuated mostly from 51 to 54 per cent. So not only is the rate of completions understandably stable in the college and university system, the rate of entry has also been remarkably stable.

This brief picture of the growth of educational attainment must be viewed with certain reservations. In the first place, in the rate of entry as well as in the rate of completion in higher education, some upward turn is detectable in the most recent observations. We do not know, however, to what extent these recent signs of change may be due to the Viet Nam war and to the draft. But probably, the growth is even

more gradual than I have described and the stabilities in the system even more intractable. Secondly, these most recent tendencies may be partly due to the enactment of the Higher Education Act and subsequent legislation the consequences of which would not yet appear in these figures on attainment. Finally, I have omitted mention of the growth of Junior Colleges and Community Colleges. The development of these institutions is recent. Still, some hunches can be made as to their effect. They have grown to the point where they now represent one-third of all initial enrollments in four-year degree programs. It is not clear, however, that this growth represents an increase in the proportion of high school graduates seeking higher education. It may be instead that we have provided an alternative path for securing the first two years of college without, in the process, expanding the system to reach a greater proportion of the potential public. The remarkable growth in higher education has been barely enough to keep pace. It has not stemmed from a new beneficence and public spiritedness of colleges and universities. It has been a consequence primarily of the age distribution in the population together with the extraordinary growth of educational attainment at grade twelve. I do not mean to minimize what has been achieved, but neither should we overlook the remarkable stabilities in the system of higher education and expect it to simply expand to serve ever larger segments of the population and ever expanding needs for schooling.

What do these observations mean for the development of the knowledge society and the organization of work within it? If technical competence is to increase throughout the society in the decades ahead, how will it be done? Where will people acquire the knowledge to apply to the organization and conduct of work? Since we cannot expect a greatly increased proportion of the population to complete high school, we cannot therefore expect the increase of knowledge skills to occur through quantitative gains in that sector. And if the stabilities that I have described exist in the system of higher education, then we cannot expect substantial quantitative gains from that quarter, *unless we can find ways to change the behavior and indeed the structure of the higher education system.* As a member of the university community, with an intense interest in trying to understand it, I think I can assure you however that change of the type needed will be about as easy to bring about in universities as it would be in organized religion.

There remain two major sectors where change might be made to occur. On the one hand, we could probably make sizeable gains in the *quality* of education at the secondary and undergraduate levels. That might constitute an interesting and useful increment in the skills available to society through the total population. Indeed, this is precisely the point in recognizing that the problem for the knowledge society is not so much production as it is distribution. The fruitful direction for policy is not toward increases in the levels of educational attainment. Educational attainment is not a concept that describes what people learn. The focus of policy must be on narrowing the inequities of quality between schools. It must be recognized, however, that *some discrepancies in quality is the price that we have paid, and will continue to pay, for growth in the levels of educational attainment. What must be examined is the trade-off between these two sets of objectives.*

On the other hand, it is possible to seek growth in education totally outside the formal educational system. It is not necessarily a loss to society that about half of those who start in a four-year degree program do not finish. We can seek a vast increase in the number of non-degree programs, an expansion in education for adults at all stages of their lives, and a multiplication of proprietary schools that educate for specific skills. We can learn to appreciate the educational advantages of programs operated under the poverty program and seek to make more useful the vast educational resources of the Armed Forces. That is to say, in the decades just ahead, probably the greatest increment in the level of knowledge skills available in American society will have to stem from non-degree programs of an enormous variety or through degree programs begun, but not completed.

We must keep in mind that the post-industrial society is likely to require an enormous expansion in learning—not necessarily in education. And not for a few short periods of time, but for many. What it will require is not degrees, but skill. The two should not be confused. The educational system does not seem the most promising direction in which to seek an answer as to how that can be done. It will probably be done best through many forms of education outside the formal system of schooling.

The growth of education outside the formal system has probably been the most significant change in education over the years just past. Current estimates at the Educational Policy Research Center at Syracuse indicate that in the United States, in the current year, more people will be receiving instruction of a formal sort outside the formal educational system than within it. The view that education for the knowledge society will be carried on only in schools and colleges represents simply an outmoded view of the way we cultivate learning. What is needed is a view of the *educating* system of American society as opposed to its educational system, and that educating system will have to include the places where work is done. We need to view preparation for work and even the execution of work itself as part of a single process whereby the skills of the knowledge worker are stretched. Work itself will need to be organized for its educative value instead of organizing education for its value to work.

It is, after all, the underlying principle, indeed, the very idea of a knowledge society, that a man's marketable skills are no longer tied to a specific set of tasks within one organization. Knowledge skills are the result of years of diverse training and practice. They are polyvalent; *i.e.*, applicable to an enormous range of tasks. The consequence is that the worker need no longer remain captive to a single work situation; he can market his talents in a broader sphere. Consequently, as the worker becomes more competent in his capacities, he also will become less attached to the specific organization that employs him. Thus, the organization must learn to exist for the man, and not the man for the organization. Those businesses, industries, and work organizations which fail to understand this shift and which, as a consequence, set up blocks to advancement and under-utilize the talents of their personnel will have to face higher levels of personal frustration, the mad rebellion that comes from smashed hopes and the enervating results of defeated expectations.

Thus, a viable organization will arrange work to develop the capacities of people rather than simply use the capacities of people to accomplish the work. Think what that means! It means, among other things, the growth of serial careers. One of the best ways to guarantee the continuing development of people is to permit them access to different careers, even careers for which they are not well prepared. For example, there is no rational defense for the view that competent people should be excluded from teaching simply because they lack the professional degree. Similar judgments can be made for enormous numbers of so-called career patterns. The usual standards for admission into the guilds of the academic world are similar in function to the standards for admission into the guilds of labor and the other professions. They are based on a principle of exclusion. The purpose is to exclude incompetents. Obviously, such devices do not succeed very well. But the point is that they ought to be based on a principle of inclusion. Their purpose should be to draw in those who can perform. The result would be to encourage multiple careers.

The converse principle is equally important. Obviously, if there are multiple paths for acceptable entry into different careers, then there are also graceful exits. I suppose there is not a career path in any area of work that does not have people who would be better off doing almost anything else. They are usually the bitter ones, frustrated by reaching a dead end, possessing unused talents, blocked in advancement, and atrophied in their capacities. A graceful exit to another career would often be a welcome relief. Surely it would be a blessing to the vigorous, as yet undefeated, eager, and competent younger generation on the rise. Surely there is nothing more damaging to the human spirit than the knowledge—or belief—that one's capacities are unused, unwanted, or expended in something of no particular value. Who knows what human misery would be relieved and what human energies released if the possibility of multiple careers were the rule, and if there were, as a consequence, ready means of entry and exit to and from new avenues of work.

The principles of this scenario are not difficult to unravel. I shall not do so except to point out the underlying relation to issues raised earlier. The basic principle is to see education not as preparation for work any more than work is seen as the arena for education. This will mean a strengthening of the relation between work and education, but a weakening of the social demand for education in its present form. The more comprehensive unity of these observations will be clearer if we attend to the final items in this discussion—the conditions for functional literacy in the future.

The Conditions of Functional Literacy

"Functional literacy" is usually defined as a minimal level in the skill to read. The failure to attain functional literacy in this sense is still a critical limitation on the lives of many people in the United States. By "functional literacy," however, I mean to refer to other capacities, those that appear to be essential for an individual to attain a validated life in modern America. They include sometimes more than a minimal capacity to read, and sometimes less. Those conditions can be made clear by establishing their relation to some rather specific

proposals for the direction of educational policy. In relating these proposals to the idea of functional literacy, I am following the lead of Professor Manfred Stanley of Syracuse University in a brilliant working paper he has prepared for The Educational Policy Research Center at Syracuse.

Suppose we take seriously the most pervasive and at the same time most fundamental of our intentions in educating the young. Suppose we view the process as directed at the individual, a process of growing up in which the objective is to enable the individual to compose as it were a human life organized around a story that is his own, assembled around a variety of plots and sub-plots of experiences which define his history. It follows that our intention should be to maximize the opportunities of the individual in certain ways that require structural and economic arenas for his action. We might conceive of the public, and the life of any individual in that public as the passage from one organized theater of action to another.

Given such a view, there are three particular kinds of opportunities that need to be stressed. First, the individual must be provided an opportunity to start over, that is to retreat from the direction that one's life has taken and to seek a new direction, the opportunity to follow a path and then to retreat to pursue another. I have spoken of the emergence of serial careers and the way that that development modified the relation between education and work. This development is particularly germane to this first fundamental kind of opportunity. But there are at least two characteristics of the current educational picture that stand in the way of this development. The first is the assumed relation between education and work according to which education is viewed as the prelude to work. The second is the fact that increases in education are assumed to have to occur in a sequence that is irreversible. That is, each level of education in the formal system presupposes passage through the immediately preceding level. Thus, it is practically impossible for a person to drop out of the educational system for a period of time and then re-enter it at a so-called higher level.

The second condition that seems to me essential is to provide the individual with some structural capacity to retreat periodically from a productive role in the society and to reassess his life. This might take the form of a capacity to claim from time to time some of the benefits of retirement before the time of retirement, a capacity for a "moratorium" with the expectation of returning to productive life perhaps in some new way. There are specific steps that can be taken in this direction. We should observe also that if it becomes possible to attain certain economic goals in the United States with a smaller employment of the total labor force, then one way to meet this possibility is to redistribute the work not among different people, but between different periods in the lives of individuals. For this opportunity to become real, we must have an educational system with much more open avenues for entrance and exit at a greater variety of ages and levels.

A third condition for what I would call "functional literacy" is the demand, at different stages of life, to play a role that is validating for the individual as a participant in the society. The meaning of this condition will be clearer if we pay some attention to the treatment received by that part of the population currently included in so-called special education.

The categories of special education are variously designated—the handicapped, brain damaged, retarded, exceptional, emotionally disturbed, feeble-minded, etc. These terms usually receive either a legal-medical definition or a statistical definition. That is the way that they are defined for the profession and for the public generally. But the social meaning of these definitions, the way the marks of membership are handled in the society, is much less antiseptic and much less morally neutral. On the whole, the social definition of special education is that it deals with those people who, for one reason or another, are either useless, ugly, or strange.

The criteria used professionally to define the population of special education are not easily extended to new populations. But the social stigmata that accompany these definitions can easily be extended to new populations. People can be useless, ugly, and strange without having any of the medical-legal infirmities that currently would designate them as warranting special treatment. Why are not the elderly, the occupational obsolescent, the racially abused also included in the field of special education? Our educational system, and indeed, our social system, tends to exercise with respect to these populations the same kind of custodial and sometimes even punitive control.

Suppose we imagine the entire educational system as a kind of institutionalized process of auditioning for a set of theatrical roles. What one wants to do is to enter the play on stage and not simply in the audience. We might imagine then two contrasting circumstances in which "show-biz" exists. On the one hand, it can be that there are plenty of roles to go around, but some will go unplayed because there are some whose auditions were just complete failures. For one reason or another, they are not capable. They are the useless people. In short, there can be more roles than there are useful people. But on the other hand, we might have a situation in which there simply are not enough roles to go around for the capable people to fill, more useful people, as currently defined, than there are roles to play. The latter condition would exist, for example, if the adult social roles of the society could be filled only by people of 100 IQ or better. That would mean that 50 percent of the population would fall in the category of "useless" people. I do not think that condition is likely to arise. Indeed, I am not even sure that it is conceptually meaningful. But it illustrates what I mean by the third condition for functional literacy. Such individuals who have no "validated" existence within that kind of society. The provision of that opportunity, for the elderly, the disabled, indeed for everyone, is what I mean by providing the opportunity for societal relevance. There are already large segments of the population for whom that opportunity does not now exist. That population is likely to grow.

Let us ask then, in some final and direct remarks, "Where do these observations lead us?" I would suggest that they lead us precisely in the following direction. We need to move toward a comprehensive national policy that provides for each individual a claim to receive as much as fourteen years of education at the public expense. But this basic intention should be framed so that it does not assume that those fourteen years will be spent consecutively in formal schools, nor should there be any but the most general restrictions at the upper

levels as to what the content of that education should be or whether it occurs in schools or businesses. If a man reaches fifty and has claimed only twelve years, then he should be entitled to two more. If necessary his employer should be paid to provide it. If a child chooses to leave school at grade twelve, he should be permitted to return to some kind of formal educational program at public expense and if possible at a higher level if he so chooses. Something like this is contained in *some* features of some proposals for "open admissions" at the college level. But the assumption is not even hinted at that this procedure might be viable for persons in their 30's and 40's or even 60's. The problem is still viewed as a productive rather than distributive problem.

Such a direction of change should be accompanied with an initial lowering of the upper age for compulsory education to fourteen, and subsequently with a removal of compulsory education laws from grade one progressively on up. Simultaneously with this we need to move toward lowering the age at which adolescents can undertake their first full-time employment.

The consequences of such measures would probably include the following. In the first place, the social demand for education as it is currently expressed would decline. Secondly, the forms in which education takes place would be greatly expanded. We would move more rapidly in the direction of an educating system rather than the more limited notion of a system of schools and colleges. Thirdly, the attainment of education would be distributed not over longer consecutive periods in the life of the individual, but over shorter spans of time in the entire life cycle of an individual. Fourthly, the human demand to be able to change directions would be greatly facilitated. The reverberations would be felt in every direction.

OBSERVATIONS

FERNANDO GARCIA-ROEL [1]

It is a great honor to have been invited to participate in this 11th meeting of the Committee's Panel on Science and Technology, and to have the opportunity to offer my comments on today's most interesting papers on the subject of "Education for a Changing World."

Let me ask you to forgive me for my poor English. I have never formally studied your language. When I received my formal education, since we did not have computers, I could not predict which foreign language was going to be most needed. It left me with the vacuum of mastering your language and studying other foreign languages.

I have listened very carefully and read very carefully the papers presented by Dr. George Kozmetsky and Dr. Thomas Green. Both papers presented very clearly the role that education should play in your changing economy. I feel that my contribution should be to add the view of a person living in a developing country, and the expected similarity of the extreme importance of education.

As a large industrial country, you have to pay attention to the changes in other areas of the world. Your country, the United States, is changing from an industrial country to what you call a post-industrial economy. In a developing country, we have the same or larger pressures—to change to an industrial economy.

The main bottleneck of development often is a lack of human resources to do it. I don't mean that this is the only problem. It is one of the largest and hardest. Probably the lack of trained personnel, combined with the still incipient process of developing capital resources, are the main factors that control the rate of change.

The first factor can be solved only with increasing education at all levels. Some changes that took several decades in the modern industrialized countries, we are forced to try to implement in shorter periods. We are forced to telescope these changes.

Developing countries import from industrial countries a degree of material progress immediately, like much better medical care, which decreases mortality and increases tremendously the population growth.

Some other forms of modern technology also are rapidly imported, like radio and television. But like Mr. Wiio said this morning, this makes possible a window for all to compare their living standards with the standards and kinds of living in more advanced regions.

This, of course, brings dissatisfaction and a strong motivation for a rapid change in standard of living. As you can imagine, most of the poor people don't have an idea that eventually the coming generations are going to inherit, together with a better living, the attendant problems that you have to solve now—like pollution, poverty in the ghet-

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tos, loss of individuality, or leisure time with no useful purpose, like Dr. Boorstin mentioned this morning.

The demands of the people for material progress bring tremendous pressure on those responsible for directing the changes, either in government or in business. These rapid changes also increase the already uneven distribution of wealth. It is common in the developing areas within a country to find some of the population that still live with the scarce facilities of 2 or 3 centuries ago, and at the same time to observe other sectors of the nation that enjoy facilities just like yours.

Even in the same city, some people keep going there to live and work for large industries, in conditions of pollution that the large industries have already achieved. It is very interesting to note also that in this type of city, any important ideology—exotic or totalitarian—can find very fertile ground for subversion. Sometimes these exotic ideas profit from the same popular motivation for progress.

In a world of this type, the responsibility of educators is very great. Sometimes universities have to be involved in extension work of a very primitive type, and at the same time be talking of systems engineering or buying a new third-generation computer; or perhaps helping in the creation of a trade school and at the same time organizing a graduate school of business.

Mr. Kosmetsky said that technology generates new advances which in turn generate even greater needs for sophisticated intelligence and action. In the developing countries, we also have our challenge. The need for telescoping the changes within shorter periods generates a greater need for using technology in our intelligence with ever-increasing efficiency.

The challenge of education in developing countries is extremely interesting, maybe as interesting as the challenge that the educators have in this country—but with one great difference. You can, in a sense, take your time. Only a few people can guess in which direction your society is moving. In the developing areas in our country, everybody wants to move in a definite direction. The desire and motivation of our people leave government and education with only one alternative: get it changed very soon. Thank you.

SUMMARY VIEWS AND COMMENTS

IOAN D. STANCESCU [1]

It is a great honor, Mr. Chairman, for me to participate in this annual meeting with the Panel on Science and Technology, and I am deeply grateful for the invitation extended to me to take part in your deliberations.

My task today is to summarize some of the impressions I have gained during the last 2 days of proceedings and to comment upon them.

No doubt, my strongest impression is that of the whole concept of the working of the committee and its panel, and the high quality of teamwork involved. By the wise selection of problems of striking and immediate impact, or of long range effect, presented and discussed by outstanding scientists and guest panelists from inside the country and from abroad, the committee not only opens windows for the direct information of the Congress, but also really opens doors, as was so well expressed here by Congressman Fulton, for world wide benefit.

I am very happy to have been offered in this way access to the debates on the most interesting problem of the management of knowledge and information. Even if this problem is not so immediately pressing in other countries as it is in the United States, where the involved activities already have reached the gigantic flow characteristic of post-industrial society, by the high rhythm of introduction and progress of computers, these other countries, too, will soon be faced with similar problems.

It is not my intention, nor is it possible in the allocated time limit to comment in detail on both keynote addresses and all papers. I would like to share this task in an adequate way with my American colleague, Dr. Poe. As we could not find time for an optimum division of comments, he was so kind to leave to me the natural privilege of comments from a foreign point of view. So I rely trustfully on him for all the rest.

I will offer my remarks in the order of the agenda of the meetings, and I wish to point out that the selection of the points that I comment upon denotes by no means priority considerations, but only accents laid on aspects with personal resonance.

I quite agree with Mr. Bundy's views and alarm on the endangered environment, as already in my country we have had and continue to have to fight important air and water pollution problems. The high rhythm of industrialization determined in Romania a great concentration of industries and the erection of big power stations, so that in certain areas we nearly reached the upper limits of air or water pollution or both. We also have to face heat pollution of water. Several of our

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existing conventional thermal power stations with installed capacity of over one million kilowatts each, evacuate too large quantities of heat related to the available cooling flow of the rivers, which, except for the Danube, are but of medium size. This situation will get worse in the future when big nuclear powerplants will appear.

So we have certain examples that nature hits back—sometimes in a more direct way as in the rather sophisticated forms in advanced industrialized countries where these influences were built up in time, with no control in the early stages. As the problem grows rapidly, a priority research program on a national scale was started last year in order to best prevent pollution in the future. Insofar as burdens and costs are concerned, their allocation and distribution between producers and consumers or upon different public sectors make no difficulties, because these are done from the point of view of the whole economy. Their assignment between present and future generations is a problem which still deserves more consideration.

I am also with Mr. Bundy when he emphasizes that rigorous study and prompt action must derive from national governments. I see important possibilities for international cooperation and collaboration in urgent environmental tasks. I am sure my country would embark voluntarily in such action, as it always has done for actions in the interest of mankind.

To be frank, I still feel under the visual impact of the concentrated and interesting material displayed by Mr. Kahn. I did not quite recover from the effort of following his brilliant oral exposure delivered here with a higher order of ten. I would only like to congratulate him sincerely and ask if he agrees for the pleasure of more detailed personal comments sometime, as although all are fascinated by the millenium, we still have some time, I think, to prepare for it. So I will turn the comment here completely over to my new friend, Dr. Poe.

I would like to add to the discussion on Professor Beer's paper, that I cannot follow entirely his opinion on information expressed in the simplified form, that information is what changes us. Certainly, we change owing to information. But not all information leads to such an effect. The change is an integrated result of the action or lack of action of all information transmitted by data. So what we really need, I think, are data filtered or screened to information, capable or not, depending on its content and our own reaction, to change us. In that vision I would not mind large quantities of data, as far as they can be screened, filtered, selected or even ignored and stored for future, yet unknown needs, as was pointed out by Dr. Whipple.

Regarding the concept of models of esoteric boxes and superimposed metasystems, I can recall how well it works for large electrical macrosystems composed of interconnected networks of several States here in the United States, or of large groups of countries in Europe. Each local system has and keeps its own established inner order and its inertia, but what counts is the general benefit of the well-known technical and economic advantages of interlinked operation including the substantially increased stability of the entire supersystem, as we call it, equal in content to metasystems. Even if many questions are not yet answered as to how this concept will work when human beings are involved, I think it represents a contribution to better investigation

and penetration of the complexity of the information management problem and to cybernetic approaches. At the same time, it seems to me to be an anxious human message of great sincerity and deep conviction. We have to be grateful to Professor Beer for having delivered it here.

The debates on the individual, the state, and the machine were opened by the keynote presented by former Chief Justice of the United States Earl Warren. I was extremely pleased to hear the opinion of such an outstanding personality on how computers will interfere in the future not only in the activity of judges, but in many other directions of individual interests.

I completely agree with Dr. Spilhaus' appreciation of Dr. Boorstin's paper. It is really profound and delightful and for me, as a foreigner, of high documentary value. I would like to observe, however, that the so suggestively entitled "Self-liquidating Ideals" are probably exposed to an increasing influence of the dialectical change owing to overgrowth, the change of scale and proportions, and herewith to the new conditions appearing in almost all respects.

Dr. Wiio from Helsinki presented a home image of technology, mass communications and automation problems in Finland and the importance to solve them according to the conditions in his country. He is so well intended in that respect that I am certain that he will be remembered only as one of the builders of the welfare of his country and runs no risk from the pollution problem, as this will be somehow mastered in the meantime.

To the thoughtful paper of Dr. Armer, just two brief comments: If we think how people with low education learn to use electric power and telephone service, one has not to be too pessimistic about how people with modern training will quickly learn to use computer power, but not before they will appreciate directly its help and advantages. I congratulate Dr. Armer on the formulation of the Paul Principle. Most of us felt more or less consciously its ruling. But it deserved a clear formulation and a name, I like, as somewhat predestined.

"Education for a Changing World" is a most attractive item and a fascinating task. The papers presented by Dr. Kozmetsky and Dr. Green raise problems typical of the new development to the post industrial society in the United States. Rector Garcia-Roel reminded us of the problems specific to the stage in Mexico. I assure you we have to face many complex education problems in my country, too, because of the rapid technological and economic change and development. The discussion did but start yesterday on this item and will surely continue very active. I may add some remarks later.

I am supposed to comment, not to conclude. But I cannot refrain from insisting as a general observation on the high character of the theme of the meeting with the Panel, on its well selected items, on the quality of papers and verbal contributions, as well as on the efficient and attractive working style and environment conditions.

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At the end of my comments I would like to make a more personal remark. Of course, I have heard and read a lot about your wonderful and interesting country. I have many American friends in the field of science, power, and management whom I have met during years in con-

ferences and working sessions over the world. But I really began to understand your country last year on a 2-week lecture visit.

A further most significant step, of a higher grade of magnitude I should say, was accomplished this week when I had the privilege of attending this panel meeting. I have gained a basic insight into the goals, the level, the methods of your work and of the excellent spirit and atmosphere in which it develops. I was also most impressed by the cooperative relationship between Congress and scientists. I applauded, as everyone, the moon landing which I watched last summer in the TV in Bucharest. I understood it better yesterday in the basement of this building at the luncheon of the National Space Club.

I am very happy to have participated in the deliberations of such an outstanding panel, and I deeply hope that the international exchange of scientists, scholars and managers will be one of the positive activities to be rapidly increased in the future.

Thank you for your kind attention.

SUMMARY VIEWS AND COMMENTS

L. Harvey Poe, Jr.[1]

For the last 2 days we have heard of the increasing complexity of our world, the proliferation of new data, the increasing power of computers, new means of managing information, and, in general, the dangers from, and hopes of, our vast pervasive technology now available to become our slave or our master.

In this complex world, where we must manage or be overwhelmed, the danger is that technology, which we used to consider a docile tool and use as a means, is endangering our freedom of choice by threatening to escape our control, become autonomous and be an end in itself: that is, technology is threatening to deny its maker and no longer serve our chosen ends, but to pursue its own purposes.

It behooves us, therefore, as men, who after God are masters of the universe, to regain control of our creation, not to say our creature, and to bend the great power of this technology to our purposes and use it to accomplish our rationally chosen ends, assuming, of course, that we will be able to find and identify them.

We should, therefore, not look on it as a threat to our freedom and integrity as men, as Jacques Ellul does in *The Technological Society*, but as a potent implement, which, if transcended and bent to our purpose, will make us almost more than men. And if, as Mr. Kahn said, "there is no intrinsic limit to computers and they will in time transcend men," we will still benefit, because, if they do transcend most men, or any one man, they will be a composite model of the ideal man—the very embodiment of the idea of an "ideas man." Imagine what we might learn from this.

And if this new technology is misused by some men to invade the privacy of others, we must and can restrain such use through law; perhaps this should be an addition to our Bill of Rights which guarantees the right of privacy to all.

Neither the complexity of our new world or the quantity of the available data must be allowed to awe and overwhelm us. We must, undismayed, attack, reduce to order and manage such material through our techniques, so as to convert it into knowledge, which can be used to serve our consciously chosen ends.

And as a nation, searching of our ideas and purposes, we need the guidance of men informed by this knowledge—broadly educated men—if we are going to succeed in meeting and solving our present and future problems. Please note that I said knowledge, not information, for knowledge of a part has a way of expanding into knowledge of the whole, an overall understanding, or, at least, some vision of it

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which reaches across disciplines and which will be indispensible in ordering our priorities and identifying our goals.

Also, a comparable knowledge, but in a smaller compass, a knowledge of a whole given system, is necessary if we are to make correct models, i.e., models that mirror or reflect the real world and thus guide us to correct modes of behavior and possible courses of action.

The restoration and preservation of our physical environment, much emphasized here and elsewhere, is only one of the fundamental problems we face. For if we restore our environment and succeed in stabilizing our population at some acceptable level, we still shall have to decide what kind of lives we should lead as men; that is, what should the quality of our lives be, and what should the State or Nation do to support and help us accomplish these ends.

But to bring our State to accept the purposes we believe are proper to it, we must have the political process informed and guided by the knowledge or wisdom of these broadly educated and understanding men. At the least, our best educated men, not necessarily our educational leaders, must interact with, help inform and, in general, engage in a more or less continuous dialectic with our political leaders, in those cases where the two are not the same.

Thus a group such as this panel must interact with and help inform a group of political leaders, such as this committee, so that they will be able to examine alternatives even when they are in different disciplines and decide upon a coherent, rational policy for our State. Here I echo Mr. Bundy.

It has been suggested by Dr. Boorstin and others that we have fulfilled certain of the former ideals or purposes of our State and that we must discover our new priorities and ends, first for ourselves as individuals and then for our Nation.

If we look to our original public purposes, the basic purposes of our State, which our Founding Fathers adumbrated as the preservation of each man's natural right to life, liberty, and the pursuit of happiness, we see that besides protecting our lives and our basic liberties—purposes which we cannot fairly say have yet been entirely liquidated—we can recognize the great and unique benefits that the post-industrial age, with its codification of knowledge, power of action, and flow of services can open up for us: the basic structural and social changes that this age will bring, should be looked upon as an opportunity and not a problem.

We should now be able to make the material supports of a normal, natural life—food, shelter, clothing, medical care, etc.—available to everyone and, thus, for almost the first time in history, enable them to pursue, through their own efforts, their further individual ends, their particular versions of happiness which lie beyond our States' concern—at least as its purposes have been hitherto stated.

If we have, as Dr. Boorstin suggests, preserved the power of seeking out and setting new and higher goals for our Nation, we now have the material and technical supports, never before available to a people, for doing so.

In attempting to discover and define the new and emerging values or purposes of our society and our State, perhaps we should learn more

about our own past, as we have been here advised, so that we can draw more substance and guidance from it. Let us examine this past briefly.

Something less than 200 years ago, our Founding Fathers, faced with the choice of living under what they considered to be an intolerable despotism or fighting the most powerful empire on earth, set forth in the Declaration of Independence their resolve to fight for the right to govern themselves. They thought of themselves as having the responsibility for vindicating this right, not just for their Nation or generation, but for all mankind. The perils we face and the responsibility we bear today, as the leader of the West, are relatively no greater than those they faced and bore, but our material strength, at least—leaving aside our wisdom and virtue—is far greater than theirs, in fact, greater than any the world has even seen. With such strength, what are our true responsibilities and what is our proper national purpose, the ends toward which our State must strive?

We must, perforce, take all necessary military and diplomatic measures physically to survive, for the protection of its citizens is the basic purpose of any State, the sine qua non of all further purposes. But great power must be used with great restraint.

Our very material wealth and military strength can be a great and immediate danger to us when used with less than wise restraint. And, in a larger but clearly foreseeable prospective, this strength can slowly corrode our security and prosperity when it leads us to act without concern for the justice of the whole, which includes, according to our own precepts, the right of all men to have the opportunity of becoming, as far as they are able, complete men. Thus we must never forget that men are always more important than property and do what we can to make sure that everyone, everywhere is given the opportunity of acquiring the material supports of a decent, not marginal life.

In summary, we must "use increments of our growing wealth wisely and prudently for public and immaterial ends" . . . "like science and education and the public amenities," things of the mind as well as the body, civilizing things which mark the true quality of a culture. As we do these things, we will be fulfilling in large part the present ends of our State, which were set by our present political philosophy. It will not, of course, be easy. But, if our sense of justice fails to sustain us in these endeavors, our instinct of self-preservation should carry us through, since all these things are necessary to the very survival of our present way of life.

Then if our vision has not grown too dim with these labors, we might set new goals for our State, guided by a higher purpose and enlightened by nobler political philosophy.

The moral nature, or character, of man would again be explicitly within the State's concern. Laws would be sought which would educate or train as well as restrain the citizens. While retaining and enlarging our true freedom, we would concern ourselves more with its proper use. Right action and understanding would replace property and power as the goals of our personal lives; while public virtue would displace popular success as the criterion of our representatives, who would thus become statesmen, rather than mere governors. As a nation, our natu-

ral, unspoilt countryside, our beautiful and useful cities, our liberating and enlightening colleges, and our wise laws, in short all the public amenities necessary to a true policy, would, with our finest creation, our citizens, make us a civilizing force in the world.

We would become a force for the proper control of arms, and thus for peace and orderly government in the nations and in the world, a force for using all the vast technical knowledge we now possess to bring natural plenty to all and, finally, a force to help men everywhere become as fully human as their natures permit. Then, when we are well into these tasks, if we were asked what the United States of America is good for, we could answer with Odysseus, the wisest of our early ancestors: "It is a good place to grow men."

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