can technological progress continue to provide for the future?

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As an historian, I am obligated to point out that technology did not progress very rapidly for most of man's history. Until the last two centuries, technology developed irregularly and at so slow a pace that, for most of human history, the mass of mankind lived in a world of scarcity and deprivation. The Industrial Revolution ushered in an era of rapid technological advance. In accelerating measure since then, technological developments have increased man's control over his environment, ministered to his animal needs and creature comforts, rescued him from the ever-present fear of starvation, increased his mobility, lengthened his lifespan, and, in general, made work easier and life more comfortable for most of the population in the industrialized nations of the world.

Man's technical progress in the nineteenth century was dramatic; in the first seven decades of the twentieth century it has been spectacular. At the beginning of the nineteenth century, men could travel only as fast as a horse or sailing vessel could carry them, and these speeds had not increased significantly across the centuries. By 1900 the railroad was moving men across land at speeds up to 70 miles an hour, and steamships moved faster and more surely than the swiftest of clipper ships. In 1800 a man's voice could be heard only by those within shouting distance; by 1900 the telegraph and the telephone were carrying the human voice across continents. In 1800, when a man died, his voice and actions were buried with him; in 1900 the phonograph and the newly invented motion picture machine recorded him for posterity. In 1800 most Americans went to bed at dusk or perhaps stayed up a few hours later to read by the light of the fireplace or of flickering candles; by 1900 sundown did not mean bedtime, for there were gaslights, newfangled electric lights, and in the remote countryside, kerosene lamps to illuminate the darkness. The progress of mechanization in the nineteenth century had relieved man from many backbreaking tasks on the farm and in the factories, and had enormously increased the output of manufactured goods.

Given this record of past performance, it is not surprising that men in the year 1900 looked back with satisfaction over what had been accomplished during the preceding century and looked forward with blithe confidence and naive hope that technology would do still more for them in the century to come. Bearing a faith which might be termed «industrial humanism», they expected that the technological revolution in production and distribution would bring a brave new world into being.

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Poverty would be abolished; technology's benefits would spread worldwide to do away with misery and insecurity and hence with class and international warfare.

Well, a funny thing happened on the way to Utopia. Here we are three-quarters of the way through the twentieth century, and the promises of social betterment, world peace, and material progress have not yet materialized. But we cannot blame technology for all that went wrong. Indeed, technology more than made good on its promises of quickened transportation and communication, of new sources of energy, and of more material goods and comforts.

But the social promise held forth by an advancing technology did not materialize. I think that is largely because we utilized our technology in the contex of an old economy of scarcity, with values and institutions which had been made obsolete by scientific and technological developments. Social benefits were achieved, to be sure, but not to the extent possible if we had renovated our institutions and values by social innovations to accompany, and perhaps point the way for, our technological prowess.

In light of our recent record, «can technological progress continue to provide for the future?» My answer to this question is yes. Technological advance can, will, and must provide for the future economic growth which is necessary to meet the needs and wants of our American society and of people throughout the world. But, as we shall see, this technological advance must be guided by social controls which will enable us to employ our technology more effectively. These social controls will arise from new institutions, new values, and new mechanisms which now exist in embryonic form.

Not everyone would agree with my optimistic view regarding future growth. At the beginning of 1972 thirty-three British scientists published «A Blueprint for Survival» in *The Ecologist*,[1] in which they warned that an ecological breakdown was imminent unless population growth, the demand on resources, and economic growth were brought to a quick halt. Although concentrating on the British situation, the blueprint was directed at worldwide problems and it was a thoroughgoing indictment of current technological and social trends which, they claimed, were leading the world to the brink of environmental disaster.

Only a month later the British scientific doomsayers were reinforced in their prophecies by an international group of systems analysts based at MIT whose study of world trends concluded that society probably faces an uncontrollable and disastrous collapse within one hundred years unless it moves quickly to establish a «global equilibrium» in which growth of population and industrial output are halted. Peering into the future by building a mathematical model of the world system, this study examined the highly complex interrelations among populations, food supply, natural resources, pollution, and industrial production. *The Limits to Growth*,[2] as the preliminary study is called, argues that the limits to human population in relation to our planet's finite resources are very near, and that the day of doom is virtually upon us.

This MIT study, which forms part of the Club of Rome's «Project on the Predicament of Mankind» —a study whose title almost dictates what the results will be—concludes that if we let things go on as they have been, there will be a precipitous drop in population before the year 2100, presumably through disease and starvation, and the complete breakdown of our industrial society.

Frightened and impressed as I am by the predictions of my colleagues engaged in this game of systems analysis, I still remain an historian. Hence I tend to view all such predictions and projections in the light of historical perspective.

Let us remember what Ralph Walso Emerson said in his famous Phi Beta Kappa speech at Harvard more than a century ago, when he gave this advice to the American scholar in times of crisis: «Let him not quit his belief that a popgun is a popgun, though the ancient and the honorable of the earth affirm it to be the crack of doom.»

In trying to determine whether this is merely the snap of a popgun or a crack of doom I have the feeling that we have heard the same arguments before. I derive solace from the fact that people have been crying «Wolf!» for many years, and the wolf did not arrive on the scene. Almost two centuries ago, Thomas Robert Malthus theorized that population grew geometrically while food supply grew arithmetically, so that population would soon outstrip available food supply. Malthus proved to be wrong because he did not foresee the Industrial Revolution, which was just getting started in Britain at that time, and the concomitant transformation in agricultural production.

In the twentieth century the neo-Malthusians arose once again to challenge the ability of technological advancement to meet the material needs of the world's population. Only half a dozen years ago there were dire predictions of global starvation because of the apparent inability to increase agricul-

1. «A Blueprint for Survival», *The Ecologist* (London), Jan. 1972.

2. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, and William W. Behrens III, *The Limits to Growth.* A Report for the Club of Rome's Project on the Predicament of Mankind (New York, 1972).

tural production in relation to the exploding populations. A headline of November 6, 1966 in *The New York Times* read as follows: «Half the World Is Hungry, and Worse Is to Come», and the article, by no less an authority than Drew Middleton, usually a calm and judicious correspondent, predicted that 1985 might well see «man's greatest crisis, a crisis arising out of his failure to perform an elementary task-feeding himself». A book published by William and Paul Paddock in the following year was entitled *Famine-1975! America's Decision: Who Will Survive?*[1] The grim solution offered by the Paddock brothers ran along desperate lines: the developed nations would have to establish a rank order list of priorities among the hungry nations to decide which should be given food and technical help to become self-sufficient countries; the rest were to be abandoned to starvation. In effect, their solution was to have the industrially advanced nations determining which people of the world would survive.

But the new-Malthusians were again confounded. A great transformation, the Green Revolution, by introducing recently developed high-yield varieties of rice and wheat offered new hope to developing nations. New strains of rice and wheat were introduced in the mid-1960s, and by the end of 1966 a production explosion had occurred in the grain bowls of the world. The Philippines, which had imported one million tons of rice annually, became self-sufficient; by 1970, India's wheat production had risen 50 percent, and Ceylon's rice crop had increased 34 percent. In Mexico, wheat yields, which averaged about 500 pounds per acre in 1950, advanced to 2300. Japan, long an importer of rice, produced a huge surplus.

Such evidence does not make the purveyors of doom change their minds; it merely makes them change their arguments. While grudgingly admitting that the spectre of mass starvation has been averted, at least temporarily, the doom-sayers point to the harmful ecological side-effects of the Green Revolution. Growing the new rice and wheat crops requires large amounts of fertilizer and pesticides, with consequent environmental pollution on a massive scale. We have merely exchanged the immediate problem of mass starvation, they say, for the long-range problem of death to humans and other living creatures by destruction of the environment.

Despite the familiarity of their gloomy prophecies, we cannot dismiss the warnings of the Club of Rome lightly. Just because the Malthusians and neo-Malthusians proved wrong in the past does not mean that they might not be correct now in their forebodings. If we compare them to the boy in the fable who cried «Wolf!» we must remember that at the end of that story, the wolf finally did come and made a clean sweep of the lambs. In other words, this might not be another false alarm; this might be the real thing.

Meadows and his associates claim that it *is* the real thing, and they proclaim a sense of urgency. The reason for their concern stems, I think, from the fact that they are experts in the computer sciences; hence they understand the implications of exponential growth. They recognize how, as population and per capita consumption grow, the demand curve suddenly zooms upward.

I can share their concern about the finitude of our planet's resources in relation to continued growth, but I cannot share their alarm. From the perspective of history, I can see no cases where exponential growth continued to such extremes that the entire system broke down.

I am not opposed to the employment of statistical data in historical interpretation; I applaud its use, especially in a systems analysis which recognizes the interrelatedness of many different factors with the feedbacks operating among them.

In brief, I am greatly in favor of the systems analysis methodology used by the study group of the Club of Rome,[2] and I hope that it can be extended and refined to increase our understanding of yesterday, today, and tomorrow. Nevertheless, as an historian concerned with the complex murkiness of human affairs, I find some major omissions and deficiencies in their systems diagnosis and their «no-growth» prescription.

One obvious deficiency in an analysis which relies wholly upon statistics is the fact that we don't have sufficient data about enough things to give us a complete picture of what is happening in the world. Life and society occur in a four dimensional continuum, whereas statistics provide us only with a partial, two-dimensional picture of human activities. Economists have sometimes become so enamored with numbers that they disregard the facts behind the figures and hence are blind to the social components of the economic changes which they believe they are measuring.

John Clapham,[3] the great economic historian,

1. William Paddock and Paul Paddock, Famine-1975! *America's Decision: Who Will Survive?* (New York, 1967).

2. See *The Limits to Growth* (fn. 2), pp. 20-23; see also Jay W. Forrester, *World Dynamics* (Cambridge, Mass., 1971). For a critique of the methodology, see H. S. D. Cole, Christopher Freeman, Marie Jahoda, and K.L.R. Pavitt (eds.), *Models of Doom: A Critique of The Limits to Growth* (New York, 1973; published in Great Britain, 1973, under the title *Thinking About the Future*), particularly pp. 14-32, 108-34.

3. J.H. Clapham, *The Economic Development of France and Germany,* 1815-1914 (14th edn., Cambridge, 1936), and Clap-

skillfully employed production figures in analyzing the economic growth of Western Europe during the nineteenth century. Bedazzled—and perhaps misled—by his carefully constructed statistical syntheses, Clapham achieved the *tour-de-force* of writing the economic history of France and Britain during the nineteenth century without even mentioning the term «Industrial Revolution».

Clapham's myopic view of industrialization still persists. In a recent seminar discussion I happened to mention the phrase «Industrial Revolution». One of academia's most respected statistical economists chided me for using the term, pointing out that production figures for Britain in the century 1760-1860 rose only a few percentage points; this, he said, could scarcely be considered revolutionary. I am certain that his statistics were correct, but I am equally convinced that his conclusion was faulty. For the fact remains that in 1760 the great bulk of Englishmen lived and worked as had their ancestors for thousands of years previously; the hearth and home were the centers of production, and men lived in small rural communities with agriculture as their chief occupation. A hundred years later men had been wrenched from traditional modes of working and living; the factory had become the center of production, and men were dwelling in urban industrial town, not in rural agrarian villages. By almost every social and cultural index one might employ, the old way of life had been destroyed, and new values, institutions, and attitudes had come into being. I call that a revolution, and I call it an Industrial Revolution because technological developments had brought about the industrialization of Britain and had wrought this great transformation in society and culture. By concentrating on only one set of economic indicators, our great academic statistician had lost sight of other factors which would have given him a truer view of what had actually occurred. Similarly, Robert Fogel,[1] in his econometric analysis of the impact of railroads on American history, comes to the conclusion that they had very little effect, thereby ignoring their profound social and cultural and psychological impact, as well as their effect on other industries and technologies.

My complaint against the MIT group is not that they used statistics incorrectly but that they were unhistorical, although they employed going back to 1900 in making up their statistical charts, and hence their systems analysis omitted many parameters of the socio-economic impact of technological developments, as revealed by the history of technology.

Many of the elements which go into making up the technological dynamics of our industrial society cannot be quantified or at least we have not yet found the way to measure them statistically. These include such things as changing value patterns which modify man's technical choices; his technological creativity which will undoubtedly enable him to overcome the obstacles to growth; and the development of institutions for social control of technology that will allow us to avert breakdown and still have economic growth, a higher standard of living, and a cleaner environment, and that will improve the quality of life for all the world's inhabitants for the foreseeable future. Let me be more specific.

First, the story of technology, beginning with the age of industrialism, convinces me that the no-growth formula ignores the historical evidence of man's technical creativity. Meadows[2] claims that a rise in industrial capacity, necessitated by a larger world population demanding more goods, will bring about an exhaustion of natural resources; this will in turn force prices up, thereby leaving less money for reinvestment in the capital goods necessary to sustain our industrial base. The history of technology during the last two centuries, however, is the story of an expanding natural resource base as industrial capacity expended. Two hundred years ago petroleum played no part among productive resources, and fifty years ago uranium was a mineral of interest only to a few laboratory scientists; but changing technology made both essential for new forms of energy. Twenty years ago the iron mines of the Upper Peninsula in Michigan and the Mesabi Range in Minnesota were considered played out; yet the development of processes for making taconite pellets economically has given them a new lease on life and created natural resources out of what were once considered useless mine tailings.

Of course, the Meadows group will tell us that there is only a finite amount of petroleum resources and iron ore in the earth, and, despite recycling, it will not be sufficient to meet man's growing needs. But this ignores the technologists' demonstrated capability for expanding the resource base and for finding substitutes. Indeed, a material which is coming increasingly into use in this connection is one of man's oldest materials; wood, which is both recyclable and a renewable natural resource.

I am also troubled by the fact that Meadows treats industrial production as a monolithic unit and tech-

ham, *An Economic History of Modern Britain,* 1820-1929 (3 vols., 2nd edn., Cambridge, 1930-38).

1. Robert W. Fogel, *Railroads and American Economic Growth: Essays in Econometric History* (Baltimore, Md., 1964).

2. Meadows, *Limits to Growth,* chs. 2,4.

nology as static. But the industrial base can alter its components, and technology is a dynamic variable which might increase production without strain on resources and without increasing pollution, and at the same time meet the growing demands of a growing population.

The gloomy predictions of the Meadows analysis are produced by extrapolating the present rate of consumption of resources by our present industrial system. But suppose the industrial base alters as a result of technological advances making certain resources cheaper, developing processes for utilization of materials not now considered resources, and suppose all of this is done without any appreciable increase in pollution. We are in the process of doing that right now, and Meadows oversimplifies our industrial system by thinking of it in unitary fashion without recognizing that certain elements can be expanded at greater than the predicted rate without the dire results he predicts.

Let me give you an example of how the complex nature of our industrial system tends to blur the impact of singular developments, revolutionary though they might be in one particular field, and, therefore, how Meadows' simplified analysis can lead us astray. Some half dozen years ago, President Johnson set up a National Commission on Technology, Automation, and Economic Progress. There were dire predictions at the time that automation was eliminating 40,000 jobs a week, or 2 million jobs a year, and that this situation would prevail for years to come. There was solid evidence for this view: a recently-introduced machine performed 500 manufacturing functions that formerly took 70 men to perform, and in another industrial installation, 48 men with automated equipment replaced 400 men and turned out the same number of finished products in half the time. There is no doubt that computers result in startling gains in productivity when hitched to machines, and they do displace most of the workers formerly employed in those tasks. Nevertheless, the predictions about large-scale unemployment did not materialize. These predictions were based on statistics, but the statistics measured the wrong thing at the wrong time. The introduction of computer-operated devices in manufacturing processes was just beginning to gather momentum: the unemployment extrapolations were made on too small a base, and the impact of computers on employment was blunted by the boom in other sectors of the economy. The fact is that it would have been impossible to separate the computer's effects from those of other elements of accelerating industrialization going on at the same time.

Meadows, I think, makes his mistake in the opposite direction; he fails to see how improved technical means in certain sectors of industry can alter the very feedback systems upon which he relies so greatly. The Club of Rome study assumes that advancing industrial production necessarily results in greater pollution. This simply is not true. Newer machines and more sophisticated processes—a result of technological advance and, partially, of public pressure against pollution—actually pollute less and produce more than do the older means. When the Environmental Quality Control Act went into force, many industrialists complained that they would be forced out of business by strict enforcement of pollution standards or that the prices of their products would be so high that they could no longer compete effectively. It has not turned out that way, thereby showing the ingenuity of our corporate managers as well as of our engineers. True, some factories have had to close; but if the reports are correct, these were older plants which could no longer compete effectively. They have been replaced by new plants which can produce more efficiently and with less pollution. The point is that we are already making inroads against pollution while at the same time increasing production. And if prices have gone up, it is not because our resources are being depleted, as Meadows postulated, but because of inflationary pressures which have little to do with our technological base.

Despite growing industrial production, we are making headway against pollution. For example, England has been so successful in its fight against pollution that certain fish and birds which had not been seen along the Thames River since the early part of the nineteenth century have reappeared. The air in certain American cities is getting cleaner—even in New York City. We are also learning that while Lake Erie might be dying, she is still not dead, and there are high hopes of scouring it out and making it fresh and clean again within the next two decades. In other words, some effects of pollution are not so irreversible as we once thought, as we gain more scientific knowledge and technical expertise.

Indeed, it is possible to make a strong case counter to the Meadows argument. That is, industrial growth rather than industrial no-growth is essential if we are to have sufficient natural resources in the future, if we are to do away with the pollution created by the present state of society, and if we are to take care of the physical needs and creature comforts of the world's growing population. In other words, if my historical analysis could be fed into a computer, it would lead to conclusions exactly the opposite of Meadow's. The population-resource-pollution crises—which he claims can only be resolved by a stabilization of industrial capacity and a sharp reduction in resource consumption—would actually lead me to the opposite conclusion, namely, that we must, by improved scientific technology, develop our resources base and promote our industrial capacity as never before.

But I digress. Let us return again to our critique of the Meadows analysis. It seems inconceivable to me that any attempt to deal with problems involving population growth, pollution, natural resources, industrial output, and food supply should not have considered energy as one of the major parameters in the systems under consideration. Yet I think that the MIT study dismissed energy in a most cavalier fashion.

At the turn of the century the great American historian, Henry Adams, fascinated by recent developments in the field of physics, attempted to apply the second law of thermodynamics to human affairs. Using this false analogy, he came to the conclusion that civilization would ultimately break down, for our energy resources—which he also considered finite and irreplaceable—would be dissipated. He thought that our industrial society would founder about the middle of the twentieth century. Well, here we are well on our way in the third quarter of the century, and we are still going strong. Instead of having less energy at our disposal than before, we have an almost unlimited amount available through our capability of exploiting the energy within the atom.

There is no doubt that we will require more energy as we deplete some of the natural resources used in our current technology, and as we recycle in order to extend our present resource base. But with exploitation of nuclear energy we have an almost infinite amount of energy for those purposes and also for coverting currently unusable resources into our future resource base.

The entire predictive core of the Meadows systems analysis founders over the fact that it has virtually, though not completely, ignored the essential element in the population-resources-pollution-industrial-food supply equation, namely, the energy factor. The fact is that we possess the scientific knowledge, the technical expertise, the capital requirements, and all the necessary elements required to develop energy production for an indefinite future. Moreover, our plentitude of potential power makes the arguments of Meadows irrelevant in the long run, which is just the point where his predictions are supposed to be effective.

His predictions are also irrelevant in the short run because he has ignored the fact that our technological age is imbedded in a socio-cultural matrix. Although *The Limits to Growth* does take into consideration some non-technical factors, such as the psychological components entering into the birth rate, it ignores the fact that technology functions in a socio-cultural matrix and that we have been developing means for social control and guidance of our technology.

I am not really arguing against *The Limits to Growth* in stressing this point. Professor Meadows, and his mentor, the brilliant and respected Jay Forrester, claim that their purpose is to provoke and stimulate society to institute control over our industrial system. I claim that the social mechanisms are already functioning, some of them in an embryonic stage, and that they neglect these mechanisms in their analysis.

As an historian of technology, I am particularly offended because they seem to regard technology as an autonomous force, completely separated from man and society. Technology is an integral part of man and society. As a product of human imagination, ingenuity, skill and expertise, it responds to human wants and social needs, and at the same time, it helps shape our wants and needs. In other words, it is in a very interdependent relationship with society.

Although society has established certain institutions and mechanisms for the guidance and control of its technology, *The Limits to Growth* virtually ignores this fact and simply assumes that technology functions as an independent variable without reference to social norms and institutional control. Indeed, one of the goals of their study is to have us adopt institutional mechanisms to control technology. I claim that we already have these and that we are developing still more. Some of the mechanisms for social control of our industrial base are represented by governmental legislation and administrative agencies. Examples would be the anti-trust laws, safety laws, and laws governing the employment of women and minors. Nongovernmental institutions also exercise a certain degree of social control over our industrial system, labor unions being the obvious mechanism.

In the nongovernmental sector we have the price system. It is a very delicate mechanism, especially when coupled with the profit motive, which is the hallmark of our capitalist society. Indeed, some of the economists who have criticized *The Limits to Growth* place great reliance upon the price mechanism to correct the imbalances which the MIT group envisages. These economists claim that as certain raw materials become scarce, their price will go higher, so that it will no longer be economic to use them—and hence there will be a search for replacements. Thus, the price system will itself suffice to delay or prevent altogether the exhaustion of natural resources.

While recognizing the value of the price system, I submit that it is not sufficient by itself to avert the dangerous future predicted by *The Limits to Growth.* The price system has two major defects in controlling our technology: first, it sacrifices long-range interest to short-range profits; and second, these profits tend to benefit a few and need not necessarily rebound to the benefit of the community as a whole. We have long ago learned that what is good for General Motors might not be good for the rest of the country.

Other social controls are developing, however, and these do not inhibit the good features of the price mechanism. We are now in the process of developing social and institutional mechanisms which will provide effective control and guidance of our technology so that it will be used for the benefit of a wider group in society, preserve our natural environment, and develop the treasure which we leave to posterity. These new socio-political mechanisms go under the general heading of «Technology Assessment», which attempts to evaluate the social and human consequences of the application of science and technology before these are applied.

Man has always assessed the effectiveness of his technology, but his past assessments were confined to seeing if it would murder his enemies more effectively or bring him greater profits. Now we are trying to extend this assessment to second-order and third-order social and human consequences.

You are already familiar with some of the manifestations of this technology assessment movement. They go under the headings of environmentalism, consumerism, and accountability. For example, the public is beginning to demand that scientists, engineers, business corporations, and government officials be held accountable for the environmental, human, and social consequences of their actions. The passage of the Environmental Quality Control Act and the establishment of the Environmental Protection Agency are demonstrations of the public's concern, as is the stiffening of the Food and Drug Administration, and the recent discussion of a bill for a Consumer Protection Board. The simple fact is that the public is increasingly aroused by the spectre of damage to the ecology and environment and the public is furious about the shoddiness and inadequacy of the consumer products offered by American industry. The legislative and executive arms at all levels of government have been increasingly responsive to this public and consumer sentiment; they are competing with one another to introduce stronger legislation for environmental and consumer protection.

Although technology assessment is still in its infancy, Congress in the Fall of 1972 established an Office of Technology Assessment, thereby providing the beginnings of some kind of governmental mechanism for evaluating the social and human consequences of technical applications. Scientists, engineers, and social scientists are already working on the problems of methodology of technology assessment. We can anticipate that such assessments will eventually be applied to scientific discoveries and technical inventions before these are introduced and receive wide-spread use.

Technology assessment should reaffirm our faith in man and strengthen our faith in democracy. At a time when the Club of Rome implies that we have allowed technology to run amok and ruin our future, technology assessment insists that man is still in control of his destiny. Technology assessment says that man can control the use of his own technology, that human skill imagination, and creativity can help bring man a better life, and that we are not the playthings of a mindless technology which crushes us underfoot. It means that man is master of his own machine, not its slave.

Technology assessment is also democratic. It does not mean that a group of technocrats or meritocrats, or a scientific and technological elite, or the Club of Rome, will make decisions for us. These will be made by the political process, and that, in a democratic system, is where such decisions belong. Democracy allows us the privilege of making mistakes. Technology assessment, however, tells us the options open to us and their possible and probable consequences.

Technology assessment is already being done on a fragmented and piecemeal basis in relation to environmental quality and drug safety. It will soon become a widespread and pervasive activity in American society. As an historian, I view this as part of a great historical current which goes under the heading of «participatory democracy». Much as we might disapprove of some of the manifestations of this trend, the fact is that democracy is extending itself to meet the ideals set forth in our great American Revolution. People are demanding a greater voice in their destinies, and since technology represents an important element in our human experience, they will inevitably demand—and, in a truly democratic society, they will obtain—greater control of their technology. Technology assessment provides a rational means for democratic control and guidance.

I place great faith in technology assessment. If we can utilize it properly, I think that we can avoid the evil consequences which Meadows and his colleagues foresee for our industrial system. This does not mean that the path of the future will be smooth and easy. We will have to cope with environmental blight and ecological difficulties and social maladjustments and resource and energy problems as inevitable and continuing consequences of industrial advance. But it is better to cope with the problems than run away from them, to deal with them rather than ignore them. Above all, we must realize that these problems cannot be resolved by stopping all sources of change, by a moratorium on technological innovation and the cessation of economic growth. Problems caused by our past use, abuse, and misuse of technology cannot be resolved by rolling backward the technological clock.

Ours is a society of so-called «high» technology. We may be no more happy or no more secure than our ancestors, but this is an exciting age in which to live. *The Limits to Growth* has pointed out some of the dangers which might confront us. But I recall the dictum of Alfred North Whitehead: «It is the business of the future to be dangerous». We can accept the risks with composure and confidence if we do not let ourselves be frightened by false alarms which turn us away from growth, if we strengthen our science and technology to meet the challenges of the future, and if we carry on with the task of developing mechanisms and institutions for the control of our technology along socially beneficial lines.

> We simply can no longer afford to hurtle blindfolded toward super-industrialism. The politics of technology control will trigger bitter conflict in the days to come. But conflict or no, technology must be tamed, if the accelerative thrust is to be brought under control. And the accelerative thrust must be brought under control, if future shock is to be prevented.
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> Alvin Toffler, *Future Shock,* Bantam Books, Inc., New York, 1970