

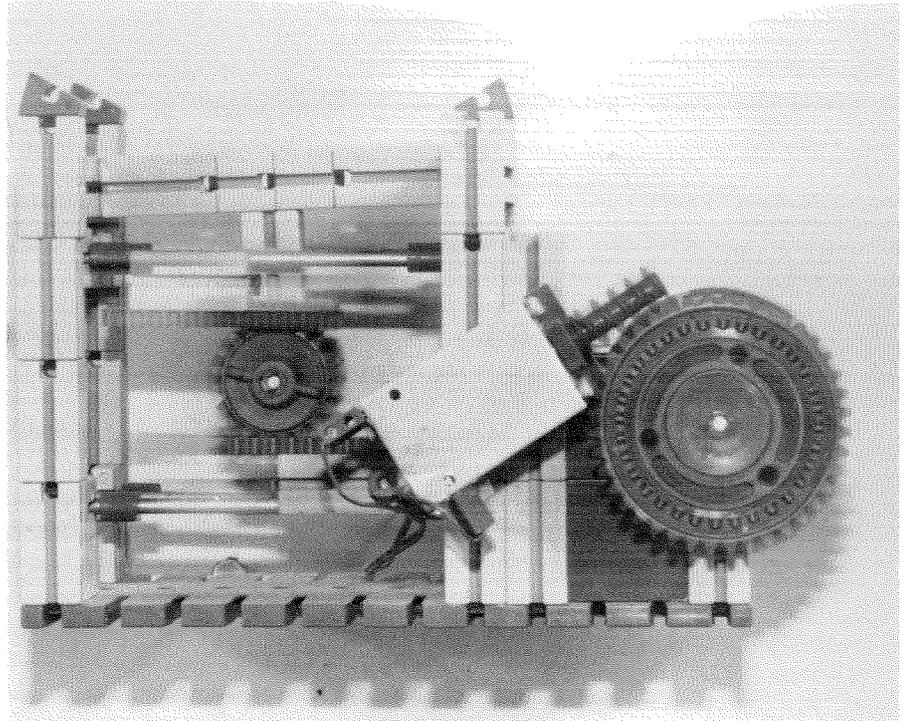
Gods' Gifts or Devils' Doings?

by Simon Ramo

THE HUMAN species has not changed significantly in many thousands of years. No basic alterations have occurred in the inherent designs of the body and brain. If a live baby from 100 centuries ago could be deposited with a similarly rooted family of today, that child might grow up to be shorter in physical stature than the average or have a different susceptibility to certain diseases, but otherwise would exhibit little more deviation from the rest of the community than many of its members would show from each other.

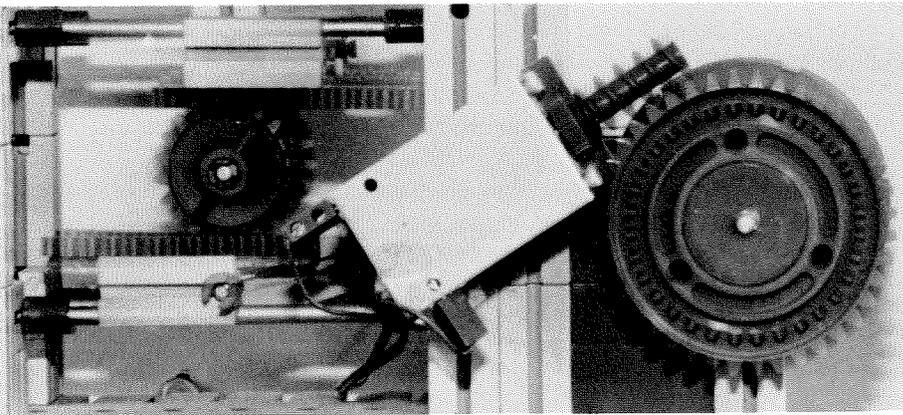
The societies of humans, their organizations for ensuring survival and providing satisfactions, have been modified over the period of deducible history, but not because of changes in *Homo sapiens*. Social variations have resulted from people's accumulation of experience and knowledge about the physical universe and themselves, and from the use to which they have put this learning. Indeed, the know-how that human beings have accumulated up to the present moment can be described, with only mild fear of oversimplifying, by the words "science and technology." There has been disappointingly little progress in fundamental social dimensions.

Is the democracy of today's world more advanced than that of the ancient Greeks? Probably — in some ways. Yet, what about this century's ruthless dictatorships, the tribal wars fought in the midst of starvation, the repressive and inhumane acts inflicted by many existing governments on their own people? Brutality, fear, hatred, jealousy, distrust of the "other tribe" — these characteristics are discernible even among so-called educated and refined humans. Antisocial responses are inadequately contained by the thin veneer of accumulated behavioral advance; with provocation that need not be severe, they can quickly break out.



Thus it was only forty years ago that a major European nation, one highly developed technologically but not in all ways socially, committed mass genocidal horrors. More recently we could observe that after a mere half-hour of psychological pressure some automobile drivers in America, in disputes over their places in line while waiting to purchase gasoline, drew pistols and shot at each other. Speaking more broadly, we can hardly focus better on the limited social progress of humankind than with a contrast of two facts. First, we learned what atoms are made of and invented how to release such enormous amounts of energy from manipulating their constituents that it has become possible to wipe out most of the earth's population 30 minutes after a decision to do so. Second, we have not been able to follow this technological breakthrough, even decades later, with a degree of social progress that would preclude the possibility of such a catastrophe.

If 100 years ago, a thoughtful visionary group had gathered to conjure up a list of future human achievements to be prized as valuable and inspir-



ing, they might have included among others a specific pair: the ability to walk on the moon and permanent peace on earth. To the wiser of those engaged in the discussion, both feats might have appeared overly imaginative and impractical — conceivably realizable, but only a long, long time in the future. Startlingly, we have accomplished one. Not so startlingly, the other still remains as before: conceivably realizable, but only a long, long time in the future.

But if the species has changed physically hardly at all and the allowed behavior of humans, singly and in tribes, has been refined only slightly over a thousand generations, our knowledge of the environment, of the anatomy of our bodies, and of the means to put resources to work for our health, material needs, and comforts has recently exploded. In the past two centuries, our skills and tools have advanced more than in all the millions of preceding years. The first scientific list of the known elements was published by Lavoisier less than 200 years ago. His list included about 20 and, building on his giant step in understanding the basic nature of matter, scientists quickly added recognition of more chemical elements so they now number over 100. Throughout all of earlier recorded history, however, matter was thought to be made up of combinations of four elements: air, earth, water, and fire.

The changes that have occurred during recent centuries in the organizational and behavioral aspects of human society are almost entirely caused by the burgeoning of practical know-how. People and materiel can now be moved in hours from any point of the globe to any other. Electronics can keep the nations of the entire earth in instantaneous communication. We feed, move, inform, entertain, clothe, heal, and kill each other by means that did not exist two centuries ago. Divide the peoples of the world into two groups, one in which science and technology

flourish, and the other in which the scientific approach is unknown and no wide employment of technological know-how takes place, and the societal differences between the two groups will be profound, more significant than the greatest of their dissimilarities owing to race, religion, or geographic location.

Imagine that we were to draw three curves, with time the abscissa for each, stretching over, say, 100,000 years. The ordinate of the first curve is to depict change in the basic makeup of the human species. We would see the curve as virtually flat, the alterations perhaps discernible to a minute degree only by the most expert biologists and anthropologists. The second curve is to measure social advance of the human race — progress in the relationships between individuals and among large and small groups of human beings. Perhaps this curve would have an observable, slightly positive slope designating improvement. But let us get to the third curve, the one that represents scientific discovery, technological change, and the modifications of the way of life and the physical structure of civilization that come from putting science and technological know-how to work. The ordinate would be minuscule, relatively speaking, for all time until a few centuries ago; then, and particularly in the past several decades, the curve would shoot up steeply, almost vertically, and off the chart.

No wonder we are experiencing the malaise, dislocations, and frustrations of an immense, almost uncontrollable imbalance between rapidly accelerating technological advance and lagging social progress. The more socially immature we are, the more difficult is our problem of social adjustment to the still further advance of technology. Our failure to make a harmonious merging of advancing technology with parallel social progress makes us a “disquarant” society. In the theory of logic, a system is disquarant if its definable, separate aspects lack a logical connection. If technological developments are not marching in step with social goals, how can there be logic in our employment of technology?

Today a severe mismatch exists between the high potential of technological advance and the low rate of social-political progress. The reason for this mismatch is not science and technology per se. It is rather that our social organization cannot use these tools to the fullest. Critical and controlling are the interfaces between technology and such non-technological factors as setting goals, examining alternatives, and making balanced decisions. These factors are not now being managed, or they are being handled helter-skelter by people who lack understanding of the process.

In choosing where and how to apply science and technology in America it would be helpful, for example, if we possessed clear national goals. When we find it hard to articulate and decide on what kind of society we want, it is understandably difficult to pinpoint the effective use of science and technology to help build it. Our society is not an assembly of related, essential components integrated into a harmonious whole.

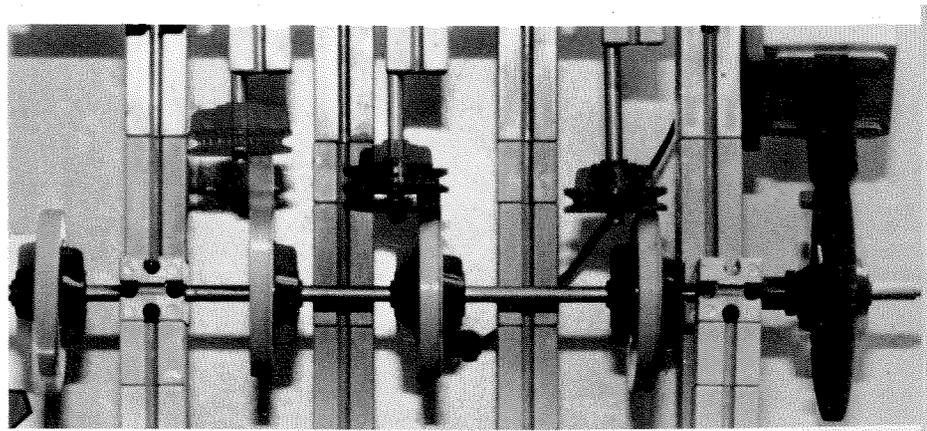
Satisfactory decisions in any society cannot be made without an understanding of tradeoffs and options. For instance, we should be in a position to compare the good or benefit that can come from specific technological advance against its bad qualities or its cost. As to our employment of technology, we can be likened to a group of inept carpenters. Equipped with strong and ever sharper tools, they use them clumsily, often getting their fingers in the saws, hitting each other's heads as they bring their hammers back and their own thumbs as the hammers come down. They are not sure what they are trying to build. Confused, yet sensing an unsatisfactory situation from which they would like to extricate themselves, they meanwhile blame the tools.

A short while ago we were confident that the quickest, surest route to the better life was to acquire more scientific knowledge and expand our technology base. Scientific and engineering advances were regarded as limitless sources of higher living standards. These disciplines of the human brain were on a high pedestal. If scientific research and technological development were not worshipped, at least the highest level of such activity was revered and encouraged. To put science and technology at our service creatively and efficiently, a melting-pot form of Yankee ingenuity, an assumed innate ingredient of all Americans, was envisioned as available and ever growing. From time to time we might have to suffer a depression, some incompetents or crooks in influential places, a penalizing war or an annoying number of persistent social problems, but we Americans believed we could count always on one strong and favorable characteristic of our country: our advancing technology would steadily originate new and better approaches to meeting every requirement of our lives and would furnish us with continuing physical enrichment.

With more science and technology, we believed, we could do anything and ultimately would. And why should we not be so persuaded? In seemingly no time at all we had gone from horse-drawn carriages to automobiles, then to airplanes, with ever higher speeds and comforts such as four-speaker hi-fi in the cars and movies on the airplanes. Radio was invented and soon

advanced to black-and-white TV, then color TV, cable TV, and intercontinental TV by satellites. To the early vacuum cleaners were added electric dishwashers, garbage disposals, and washer-dryers. We have found ways to collect, modify, and put to our use all matter of which we know the universe to be composed and have synthesized superior materials that do not appear in nature. We have created cities of weather-controlled structures and automated the mass production of physical goods. We are used to making low-priced long-distance calls by direct dialing. We have learned to so control insects and fertilize the ground as to grow far more food per acre than we can consume domestically. We have acquired nylon pantyhose, shatter-proof glass, frozen foods, and microwave ovens. A communication satellite weighing one ton now provides more channels of communication than 200,000 tons of cable laid under the oceans. During one year, a widebody airliner now moves more people back and forth across the ocean, at higher speed, than the largest ocean liner a thousand times heavier could carry. One of today's hand-held computers can make complex computations that at mid-century would have required equipment filling a room, with the costs proportionate to the equipment weights.

In not too long a time into the future, we have surmised, every individual will be able to push buttons on a wristwatch transmitter to call out a digital code that will establish radio contact with any other chosen person in the world. Soon our telephones should provide accompanying sight of those speaking, and our home TV should have a 3D picture. With advancing technology continuing to produce more for us with less effort, we should go from a 40- to a 30- or even to a 20-hour workweek. If we could walk on the moon in the '70s, then it seemed Americans should soon be able to visit Mars. If we should find ourselves,



a few decades from now, in contact with intelligent life elsewhere in the universe, this will not be regarded as incredible.

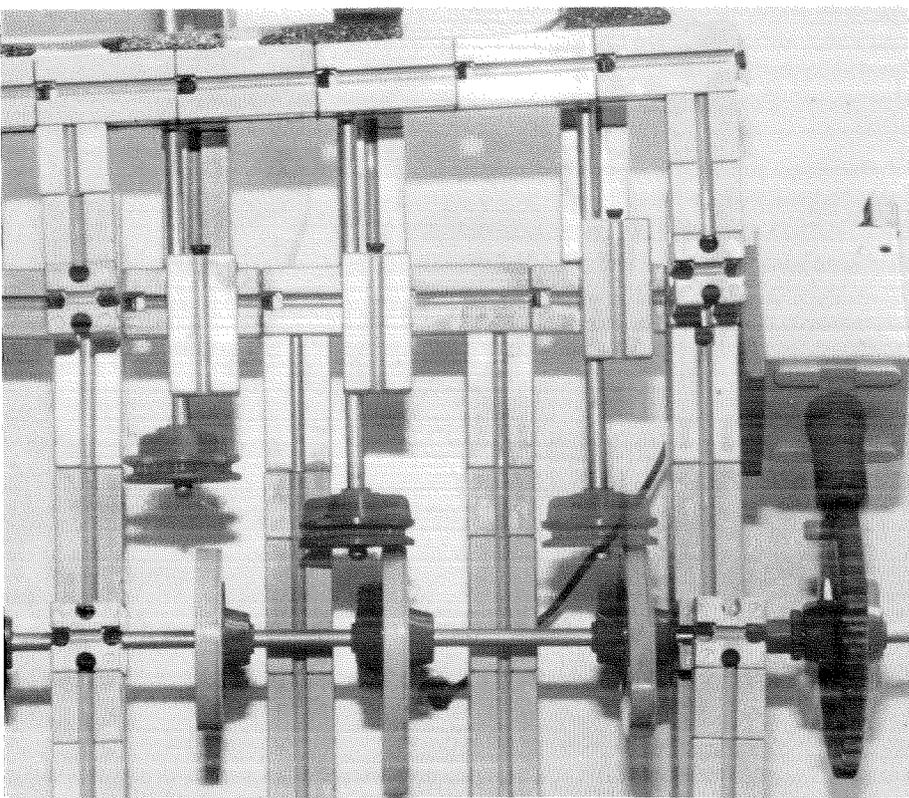
Microbiologists have broken the genetic code and begun pinning down the subtle distinctions between inanimate and living matter. We can overhaul the human heart and provide artificial kidneys. Vaccines have wiped out smallpox and polio while penicillin has curbed other diseases. Surely, then, a crash program to cure cancer ought to be successful, we assumed. Soon we should complete our conquest of disease, learn how to control aging, and perhaps even be able to use science and technology to alter the human species.

But if it was only yesterday when science and technology were adored as deities by the throngs — we could do no wrong no matter how avidly we applied these tools — it is only this morning we discovered the gods may be devils. An anti-technology wave has broken over us. A substantial fraction of our citizens now suddenly equate advancing technology with evil. As they perceive it, mass production jammed us into congested cities before we learned how to live together. To them TV means vapid, violence-loaded programs that miseducate our children. Gasoline refineries, needed to supply the automobiles, ruin the environment; those same automobiles, they note with revulsion, kill 80,000 people a year, foul the air, and force us to spend hours each day in traf-

fic snarls. They now think we wasted money going to the moon. The atom bomb may destroy civilization and the nuclear reactor may poison the earth. We make our soil more productive but insecticides may do us in. The pill makes it easier to control the size of our families, but it promotes promiscuous sex among the young and is destroying the institution of the family. Many believe the computer is creating an automated robot society in which humans become slaves as digitalized signals and taped responses take over the society and personal privacy and freedom are lost.

It is not helpful to judge those holding these views to be a minority of extremists or, at best, careless listers of negatives who foolishly disregard the vast positives of science and technology. It is now clear to everyone that scientific research and technological implementations won't solve every problem and fill all needs. More powerful military weapons do not guarantee a peaceful world. No technological advances have come along to give us a lasting, plentiful supply of cheap, pollution-free energy to replace dwindling domestic petroleum and counter OPEC monopolies. We truly are impairing the environment and running out of certain resources. These and other facts about the present technological society are matters of legitimate concern. The nation is now aware that dis-benefits generally accompany all human efforts to produce benefits. Any country that understands this and yet fails to compare intelligently the gains and the accompanying harms deserves to have its policies protested. Such criticism is not unpatriotic and should be welcomed as a necessary prelude to realizing reforms that will adjust democracy and make it work in our technological era.

The desirability of carrying on large-scale research and development to accelerate further technological advance has become a controversial issue in the nation. Trends previously assumed to be clearly for the betterment of society are being challenged by new value judgments. Lower GNP (gross national product) is justified, some aver, if that goes with fewer cancer deaths, cleaner air, less congestion and noise, and a life with less pressure. In trying to find the right values, we are being forced to realize that there is no single truth to lead us to them. How do we arrive at limits on our rights to alter the world with technology? We interfere with nature when we dam up a stream or provide a heart transplant or drive an automobile and release its exhaust into the atmosphere or build pipelines or buildings or factories or sewer systems. When is what we do with technology a boon to mankind and when a detriment? Even the smartest people can't answer this query with an



all-embracing guiderule. The difference between a wise man and a fool on this question is that the wise man knows that the values on which the answer can be based are not absolute, constant, and unique; they vary with people, situations, and time.

But if the omnipresence of rapid technological development is in part an evil, is it perhaps a necessary evil? Do we have a practical alternative to the technological society? Is it realistic to ban or even to greatly diminish technological advance? Is such a cutback too penalizing to accept for the American society because our values and social structures are so strongly based on a generous availability of the fruits of employing these disciplines? Experienced politicians assure us that no approach to our social and economic problems is politically viable if it contemplates the majority of citizens accepting a significantly reduced supply of goods and services. It is equally unrealistic politically to expect those now disadvantaged to abandon their aspirations for the higher living standards the majority enjoy. If these are political truths, then the tools of science and technology must be kept sharp and applied vigorously because such action is indispensable for a feasible approach to national problems.

While some want less technological development and more rules to regulate and minimize it, others are pointing to the available statistics and agonizing over evidence that America has developed a serious technology slip. They argue that we are realizing too little of what scientific and technological advance could yield. These advocates of more scientific research and speedier technological development consider that survival of the human race requires these extensions and applications. They think we need to choose between two options: one, a reasonably attractive and safe, albeit not perfect, environment with adequate but not infinite provisions for the human beings on earth; or the other, social instability, deep human misery, collapse of national economies, and wars based on scarcity of resources. They think the choice is easy. The real issue to them is how to use science and technology more fully, not whether to do so.

Of course, when we speak here of putting technology to work fully we do not mean the unthinking application of it, the misuse of technology on projects the public does not in the end really want and that are more harmful than beneficial. Problems of selection and organization arise here. Furthermore, even if we were to attain perfection in the choice and implementation of technological programs we still would not be guaranteed a healthy economy and a happy society. If we handle

badly numerous non-technological decisions, we easily can have inflation, recession, high unemployment, wars, and other ills. Without a strong technological foundation, our minimum needs cannot be satisfied. Yet advances in science and technology are not by themselves sufficient. They are merely necessary.

Until very recently, we Americans took for granted that our country is the world leader in technology. This went hand-in-hand with our thinking we have the highest living standards in the world and are first in almost every scientific feat. It is true that some 20 years ago, when the Soviet Union sneakily abandoned the role of a technologically backward nation we had envisaged for it and launched the first Sputnik, our confidence was shaken. However, by sending men to walk on the moon while the Russians were having difficulty merely landing instruments there, we demonstrated to the world we were still champions.

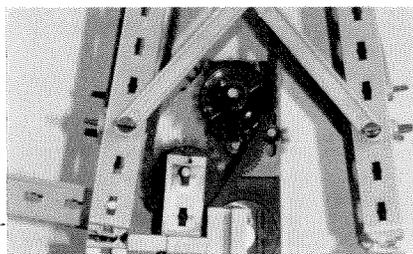
But today we no longer can assume we are ahead. Contrary indications are all about us in the form of European and Japanese cars on our streets and foreign-made television sets and tape recorders in our homes. We are lagging badly in other fields and being overtaken in some areas where we still have a lead. Evidence is building that these trends are the result of some fundamental patterns that cannot be changed overnight. The United States, a country that previously had outstripped the rest of the world in producing goods and services for its citizens, has suddenly become highly concerned about its ability to go on providing a plentiful flow. More than just a handful of pessimists are asking whether the nation's store of resources and systems for deciding and doing things are up to the job of further increasing our living standards or even preserving the present level in the years ahead.

Have we lost our innovative ability and motivation? We enjoyed remarkable advantages over competitive nations in the century now ending. Maybe our organizations and habits of behavior were suited to the past but do not fit the future. Our presently decreased reaping of technological innovations suggests inadequate sowing some years earlier. The total United States expenditures on research and development are a decreasing fraction of our GNP while in Germany and Japan that ratio is increasing. We are investing less in improving our facilities, again as a fraction of our GNP, here off badly from the other developed nations. No wonder our rate of productivity increase has now dwindled to small oscillations around zero and is below that of all other developed countries.

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Some Americans believe the world is changing much too rapidly. Others want more and faster change. Everyone must agree technological advance is a forcing spearhead of change and that we are having great difficulty absorbing it. The rapidity of technological advance — because of our inability to adjust to it, realize its benefits, and minimize its negatives — is presenting us with dilemmas and critical choices. If stopping technological advance is not practical because we need the gains it brings, if curbing it is unacceptable for fear of risking the lowering of living standards and security, if the negatives of technological advance and the growing shortage of resources are real and serious, then we are surely stuck. We need to invent new policy-forming and decision-making techniques.

To illustrate, take the stubborn, ubiquitous problem of inflation. Ask the average American citizen which problem should be rated as worse, inflation or the penalties of rapid technological advance, and inflation would surely be named as the curse we most need to eliminate. But the two phenomena, inflation and advancing technology, are related. Indeed, the strengths of technology can be used to fight inflation. In this instance, inflation is the dragon. Technology, sometimes a positive and at other times a negative force, can serve here as the good knight.

To see how, let us first grant that a sound approach to curbing inflation includes limiting the expansion of the money supply. The government must reduce its spending to make possible politically acceptable conditions for curbing monetary growth and as a political practicality must somehow achieve this reduction without greatly increasing unemployment. But the public insists upon the government's supplying health, education, welfare, and numerous other services, and a strong national defense. This vehemence makes the reducing of government spending a near miracle. Under these circum-

stances, it is hard to exaggerate the importance or the difficulty of arranging for a higher rate of investment in technological innovation. Whether the problem is lowering the cost of national security or increasing productivity, the technological advance route offers real hope for progress. If the voters will not countenance a much lower supply of goods, we must look for ways to increase that supply at the same costs, that is, while using the same human and physical resources. If resources are dwindling, we must learn how to make more resources available economically. There is only one way to have a generally higher standard of living and to enhance the availability of goods and services to those now well below the average partaker. This is by increasing the quantity and quality of what we produce for each dollar of cost to produce it — a natural role for beneficial technological advance.

Scientific research, if avidly pursued, can discover new resources and teach us how to apply the laws of nature more effectively in using all resources. Advanced technology can be employed more broadly to develop economically and socially advantageous products whose manufacture would create new jobs to fight unemployment. Further R&D effort can lead us to superior methods for increasing supply and lowering costs as a counter to inflation, substitutes for materials in short supply, and ways of acquiring raw materials and manufacturing for our needs with less harm to the environment.

Now if, as some say, too much technological development is inundating us with hazards and detriments, then the present United States trend of slowing technology advance compared with some other nations could be a blessing. If we could rightfully equate technological advance to ruination of the environment and to a bad life generally, not a better one, then we should applaud our failure to develop more rapidly technologically. Let the other nations knock themselves out producing more material things, having the mere appearance of gain while actually lowering their real living standards. We, meanwhile, shall rise above such unsophisticated, misconceived, harmful con-

tests. But such extreme rationalizations will not satisfy the majority of Americans. True, we have all become familiar with the word "ecology." We all know the goals of life are not met by high production totals alone. We must protect our en-

vironment and preserve natural resources. On the other hand, we realize we need a plentiful supply of goods, energy, and services. We also feel intuitively that if we lose the ability to provide well for ourselves we are bound to become more dependent on other nations that exceed our performance record. Then both the quality of our life and our freedom to control it will diminish. While we struggle with working out a better match between the potentials of advancing technology and the needs and wishes of our society, inevitable competition with other nations affects us. Total isolation not being practical, our attempts to resolve our dilemmas are influenced by what the rest of the world does.

Imagine for a moment a planet with only two nations, Country A and Country B, each well endowed with human and natural resources. Also assume this two-nation world is a free one — money, products, resources, technology, and labor are allowed to flow freely between the two countries. Suppose that Country A gradually attains a superior, broader understanding of science and technology, is better organized to employ these tools, has greater productivity, and is more innovative. It discovers new ways to use resources, develops substitutes whenever natural resources threaten to run out, lowers the cost of manufacturing and distribution, invents means to diminish pollution of the environment, and continually designs and brings out new products that are socially and economically superior. It is generally more skillful and mature in matching what science and technology make possible to the needs and desires of the population.

With these assumptions, we know what will happen. The citizens of both nations will prefer the products of Country A because they will be cheaper and yet of better quality and more suited to their needs. The industries of Country A will prosper and employment will be high there. The industries of Country B will be in depression and its unemployment will rise. Temporarily, Country B can maintain its standard of living by selling its country's assets, its land and raw material resources, to the citizens of Country A. Country A will amass more capital, some of which will be used for these purchases. Soon Country A will set up, own, and operate plants in Country B. Some of Country B's workers may go live in Country A, where employment opportunities are better. In time, Country B, like an

underdeveloped country, will supply lower wage labor for low technology products, descend to a lower standard of living, and be subservient to Country A.

Let us alter our assumptions somewhat toward political realism. As the trend we described begins to be felt deeply in Country B, its citizens probably will elect a government promising to create protective barriers. These will keep out or tax the products of Country A and restrict foreign investment and takeovers. It will subsidize Country B's industry when it is seen to be failing and charge its citizens high tariffs if they insist on buying the superior, foreign-made products of Country A. Country B can isolate itself as though Country A did not exist. The end result, however, will not be much different. Country A, with its advancing technology, will have a rising living standard. Country B, busily engaged in subsidizing its own backward technology industry, will produce less (and lower quality) products for its citizens to divide up.

Some in Country B may argue, "When all is added up we have not lost. We have benefited by not worshipping technology as has Country A. Yes, we produce less, but we have a simpler and better way of life, one that is less dependent on advancing technology." But if Country A has been properly described as superior technologically, it will use technology in a thoroughly optimum manner and the criterion for what is optimum will meet the value judgments of its citizenry. If Country A moves ahead unthinkingly instead and, in producing increasing volumes of products, spoils its environment and impairs the health of its citizens, then it would have to be reckoned as inferior, not superior, in its use of technology.

Similarly, Country B, defined as inferior technologically, is not automatically superior in another sense: it has carefully avoided employing that technology which provides more detriments than benefits. It is one thing deliberately to produce fewer shoes and thereby gain time to walk barefoot on the sands of a clean beach. It is another to walk barefoot because we can afford no shoes — especially if the beach is filthy. A sound definition of technological superiority is not merely to use *advancing science and technology* aggressively and avidly. It is to select appropriate areas for technological efforts. It is to create approaches that will generate the least negatives and the maximum positives. The objective is not to accumulate the biggest bag of technological tricks,

winning a science olympics of discoveries and breakthroughs over other nations. However, if other nations excel on a broad enough front in science and technology, they will be the ones with the most options to set a society pattern of their choice.

How good and how bad for America is further advance of the technological age? By accelerating scientific research and technological developments in the United States, what do we gain and what do we lose and how do the two compare? Is it inevitable that we become an even more technological society? Can we arrange to reap the positives, or most of them, and eliminate the negatives, or most of those, of further implementation of advanced technology? Must we in the United States strive for a position of technological superiority or else lose out to other nations that move faster technologically?

These questions suggest a summary question. Are we in the United States using science and technology to the fullest on behalf of our society? This is not to ask whether we are following up every clue to nature's undiscovered secrets and are building every machine it is technically possible to build. These latter are very

different and less sensible questions. We seek here rather to inquire whether our scientific and technological know-how is being applied adequately where there is evidence of high economic and social reward for the effort. *If the American society is not now making proper use of science and technology tools, then why not? Are we becoming slower, more timid, and less innovative in applying science and technology? What stands in the way? Is Yankee ingenuity really disappearing? Is there something about the pattern, the rules, the organization of American society that is at fault here? Is our system of applying value judgments, making decisions and implementing them inadequate for the technological society ahead? Should it, must it, be changed?*

In the competitive and highly interactive world society, advancing technology cannot be halted, but the movement can be influenced. If we do not understand and work at properly employing technological advance, our goals as a nation will not be met. We shall also then not make our proper, needed contribution to world social, economic, and political stability. This will be damaging for America. It will be equally bad for the world. □

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