

Science and the National Welfare

Our survival depends on our ability to act decisively — and now

by H. Rowan Gaither

It is now just six months since the human race propelled some exciting hardware, and then man's best friend, into outer space. I do not have to remind anyone here that the first successful adventurers into this new age of outer space were not Americans, as we hoped would be the case, but Russians.

Americans have shared outer space with the Russians for only a part of this time. And for that success, delayed though it was by decisions of a non-scientific and non-technical nature, the American people must thank the men of Caltech's Jet Propulsion Laboratory. From the date the job finally was authorized by Washington until the first American earth satellite shot up, and out, and into orbit took only 12 weeks. This is nothing if not remarkable.

Nevertheless, we cannot ignore the fact that the date history will attach to the opening of the age of outer space will be a date written in Cyrillic characters. This is not a belated, dubious, or cynical claim like those we became familiar with several years back—when Russia was telling the world and itself that practically every technical and scientific advance known to man was Russian in origin. This claim on the original penetration of outer space is real—and we cannot afford the luxury of derisive laughter.

From all the confusion that ensued in the wake of Russia's first Sputnik, one might almost think our scientific and technological impulse had ground to an unhappy halt and that the only thing left to wait for was the end itself. One might even conclude from the furor that no one in the scientific community had engaged in responsible thinking about any of our most critical needs.

I think it is fair to point out that some of the loudest critics of the scientific community in recent years may very well have drowned out what the scientists were trying to tell us.

I come neither as a critic nor as a scientist. I should

"Science and the National Welfare" has been adapted from a talk given by Mr. Gaither at Caltech's 21st annual Alumni Seminar on April 12. Mr. Gaither is chairman of the trustees of the Ford Foundation.

like to talk with you about science and the national welfare in the language of one who is himself not a man of science or technology. I would not be so presumptuous as to try to tell you how your job should be done. But in all conscience I can talk with you in terms of what the job ahead is, as I see it.

My premise is simple. Science and the national welfare are linked insolubly.

This is as true for the Russians as it is for ourselves. It is necessary to understand—as now indeed we do—that science and technology are not a monopoly of the free nations.

We face real needs and hard choices. So let us first of all do away with the soft words.

I am convinced of three interrelated propositions:

First, that our national welfare—and to us that means spiritual and political freedom as well as mere physical survival—depends to a preponderant and unmeasurable degree upon the future course of American science and technology.

Second, that American science and technology, which once our people thought to be unquestionably unsurpassed, *has not yet attained the strength and viability necessary to guarantee our welfare and survival in a prolonged period of international crisis.*

Third, the American people and their representatives in government must understand the extent to which their progress and security depend upon science and technology—and must understand what large tasks await us all in this connection. As of this moment, this understanding still has not been fully awakened.

There is evidence that whatever awareness has developed under the impact of recent events may already be receding in the light of our own successful orbiting of satellites. We must guard zealously against any return to complacency. The responsibility for this rests on each of us—on our men of government, on our men of education, our men of industry, on the citizens at large and even on the institutions which already are most responsive to the needs.

America must view its strengths and weaknesses in the

time perspective of the remaining years of the 20th century, in the social perspective of what we want America to be, in the politico-military perspective of the external threats to our values and principles, and in the humanitarian perspective of our acknowledged responsibilities to mankind everywhere.

In this total perspective, the relative strength of the United States is not adequate to these historic responsibilities.

I will not, however, be a prophet of gloom. There is time to repair this situation and to build our relative strength—if we act decisively and act now. The United States is the world's most powerful nation today. If we act now it will remain the most powerful nation in the future.

Let us look forward a few years—to 1975. This is only as far into the future as we already have come from Pearl Harbor; and we know what vast changes have affected mankind in that short span of years.

Let us, for purposes of our discussion, make several assumptions. Let us assume, first, that there will be no general nuclear war during these next two decades. We must base this on the further assumption that our nation will maintain a military capacity for retaliation that will stay the hand of any would-be aggressor.

Let us assume also that the principal communist powers, the Soviet Union and Red China, will remain politically intact and stable.

And let us assume that the political destiny of the newly independent and largely underdeveloped nations of Africa and Asia will largely be determined during these two critical decades.

The communist world

Based on these assumptions, the communist world as we define it today will present in the 1970's the following picture:

It will have a subjugated population of upwards of $1\frac{1}{4}$ billion people;

It will command, as it does today, one-third of the world's land mass;

It will have weapons and weapons systems capable of delivering catastrophic destruction in a matter of minutes to any nation of the world, and a general military capability of engaging in conventional wars in Europe, Asia, the Middle East and Africa;

And the Soviet Union, perhaps alone, will have reached a gross national product at least equal to that of the United States, with all the implications inherent in that for their military expenditures and for their ceaseless economic and political offensives in the non-communist world.

Forecasting the future comparative growths of the U.S. and the U.S.S.R. is, within certain limits, necessarily speculative. There is conservative economic opinion that the likely future rate of Soviet industrial growth will be significantly higher than ours, that the interval for which we will remain the biggest industrial power is 15 to 30

years. But the "cross-over" point in either gross national product or in industrial output is not as meaningful as the fact that today the Soviet Union, with an industrial base roughly two-fifths of ours, maintains a thoroughly modernized and menacing military establishment and prosecutes an increasing program of foreign economic subversion and infiltration.

Russia is currently graduating 500 engineers per billion dollars of GNP while we are graduating about 60. What this portends for the future relative rate at which technological creativity is injected into the Russian economy and military technology, and for the scientific manpower serving the communists' military purposes and economic offensives, is arguable in degree but ominous in total.

These are some of the blunt and awesome facts that come clear as we look at the future in perspective.

We dare not comfort ourselves with hollow hopes.

Key to the future

Our total relative strength is the key to the future. This strength at any given moment is a compound of many factors—populations, economic forces, scientific achievement, military capability, industrial progress, educational commitments. Communism's strength relative to the free world is based on the same factors.

The communist world and the free world are two dynamic systems at work, moving at different rates of speed, taking different turns, and driving ultimately toward ideological goals which are diametrically opposed.

If we are to plan with any degree of hard realism, we must expect the Russians not only will maintain but actually will increase their rate of forward industrial and economic development. And let us not underestimate the potential power of Red China. It is on this basis that I must conclude that our relative strength is ebbing.

There are those who will argue that my assumptions put the communist position in the most optimistic light possible and, by contrast, our position in a pessimistic light. I fervently hope that, in this, history will prove I am in gross error. But I will contend, with all the emphasis at my command, that these assumptions are warranted—indeed compelled—by any objective appraisal and that we cannot lose if we make them and act accordingly.

We will have maintained a constant military readiness to suppress with strength the possibility of nuclear disaster at home and throughout the free world. We will have cut wasteful fat from our economic and social frame and hardened our ideological muscle. Our society will have had the incalculable benefit of research, education and expansion from which so much of our future economic and democratic strength will derive. We will be fully prepared for almost any eventuality of the decades ahead. If time ultimately proves my assumption of communist strength to be grossly overestimated, then the United States and all mankind will be the beneficiary on every count of our expanded effort.

H. G. Wells said that "human history becomes more and more a race between education and catastrophe." We are intimately involved in this race. Science, of course, is but one part of education's total job—important in the extreme, but only one part.

Education must produce enlightened human beings determined to preserve fundamental values and principles. It must produce an informed citizenry able to accept responsibility and to make democratic processes fully effective even in a protracted period of great stress. It must produce political leaders for the management of government, and judicial leaders to uphold the supremacy of law and reason. It must produce leaders for all sectors of our society who place foremost our freedoms and economic strengths, and scholars, scientists and teachers adequate in number and competence to meet the ever-growing demands already confronting our heavily committed educational resources.

The role of education in the decades ahead being as all-encompassing as it is, why do I equate to such a large degree our national welfare with science?

I see three major reasons.

The power to destroy

The first is the inescapable if burdensome call for military technology of the highest order. The nature of Russian and American weapons development is such that when intercontinental missiles with nuclear warheads are operational, the United States and Russia will possess the power to destroy each other.

The second major reason that I equate our national welfare and science is that the security of the United States and the free world depends upon the ability of our nation and our allies to maintain economic strength and viability. We know the counterpull of economic weakness and debility. A strong economy is basic to national welfare—and nothing feeds and invigorates the economy more than science and technology.

The third major reason for equating the national welfare and science is that it is imperative for the industrialized nations of the free world to assist the less-developed nations of the free world in their Herculean task of achieving better standards of living for their peoples and the foundations for economic development with democratic principles. The ultimate course of civilization and freedom may depend on whether they succeed or fail in attaining these goals.

That our communist competitors know their destiny too turns largely on science and technology is abundantly clear. From the very outset of their communist regimes, both the Soviet Union and Red China have made industrialization overriding national objectives. In the pursuit of this, extraordinary emphasis has been put on science and technology in the school systems of those countries.

What then can be done to bolster our scientific and technological strength?

First and foremost, education in science and technology must be improved at all levels.

Our objective must be to produce men and women who are both superbly trained in science and technology and broadly educated. And we need men and women in the humanities and social sciences who are educated in the physical and natural sciences and technology as well. We cannot settle for less.

We must subject ourselves to a searching self-scrutiny as to curriculum content and techniques. We must hold the best science teachers in their honored and vital profession and increase their numbers and competence.

Improving education

The upcoming generation of students must be better prepared for the rigors of advanced study. We must guard against the preoccupation of the day and remind ourselves that boys and girls in our high schools today will be the new scientists and engineers in the most critical period in our history. Not only must they be assured of the best education we can devise, but also they must not be denied that education for economic reasons. We must get on with the task of improving education today—even though we do not find all the solutions for many years to come.

In this connection, those institutions which even now carry the special burden of leadership, institutions like your own California Institute of Technology, the Massachusetts Institute of Technology, and others, have an urgent and weighty responsibility to our national welfare.

In addition, these great institutions must now take on a strong, new role—education of the general public about the role of science and technology as an integral part of our whole social fabric.

Never before has it been so important that there be public understanding of science as a part of our culture and of the essential nature of science to our security and our progress.

Without such widespread understanding there cannot develop the support which is desperately needed.

The classical role of institutions such as those I have named has embraced both education and research. Now additional stress must be put on the improvement of research.

The research function has been augmented, particularly in periods of national peril, to provide scientific assistance to government. This responsibility has been built into the very structure of these institutions, and will remain there, I think, forever—even as such institutions have provided ever-increasing scientific and technological assistance to industry. Both government and industry must now bear in mind the intimate relationship between the establishment of scientific principle and application of that principle, and the order in which these occur.

Pure science, in any field, demands an atmosphere of freedom to seek the truth, wherever it leads. Where we lack the knowledge or the insight to see its ultimate application, if any, then we must have faith. The under-

standing will come later. Even those who underrate basic research must acknowledge in pragmatic terms, if they insist on direct application, that basic research does pay off. It always has.

We dare not overlook, however, the importance of applying the results of our basic research.

The Russians have demonstrated, particularly in weapons technology, great speed and efficiency in telescoping the time interval between discovery and operational use. In the modern world the fastest transition time may carry with it the decisive margin of power.

Aside from the important military aspects, the days and years ahead dictate that scientific knowledge and techniques be brought to bear on all our problems—and that this be accomplished without injury to education as a whole or to basic research.

One important way to pursue this goal is for the academic scientist, the governmental scientist and the industrial scientist to meet on common ground. Such a meeting ground is the technological institute. *The technological institutes must accept this willingly and in doing so must have the full understanding and support of their trustees, staff and alumni.*

All of this is fundamental to the vastly increased understanding which is so necessary if science and technology are to flourish as they must in the interests of our national vigor. And all of this, admittedly, is quite an order. *How do you go about it?* One part of the answer is in terms of dollars.

Uncommitted dollars

Government has dollars, but generally wants specific answers to specific problems for its dollars.

Industry has dollars, and for its dollars generally asks something of the same.

Foundations have dollars, but all the funds available to foundation philanthropy in the United States, however large they may seem, can only serve to point up the needs, to help others seek experimental courses of action, and to challenge still others to share the burden.

Yet the very nature of our problems of science and national welfare transcend any immediate need of any potential participant—government, industry, alumni or whatever.

The easiest money to get is for applied research—where results are often predictable, if not, in fact, specified in advance. This, however, is not general-support money. Yet the ability of institutions to handle applied research rises or falls in direct relation to the soundness of the overall academic structure.

The kind of general financial support that I speak of is imperative in building the overall strength of our institutions of learning. This kind of money—the so-called free or uncommitted money—is unfortunately the hardest of all to get. It also is the most important.

This free money is free only in the sense that it has no strings attached—no *quid pro quo*, no C.O.D. tag for specific research, however important or meritorious. But

it is part of the cost of society's welfare. It is, if you will, an investment in our own faith in freedom's future.

What better purpose awaits our commitment to this faith?

There is particular pertinence for this commitment, in the form of vastly increased support to such institutions as Caltech.

With greater public awareness and knowledge of the role of science and technology, which you yourselves promote, there will come more enlightened governmental policies at all levels that will make federal and state funds more acceptable in the future than many people think they are today.

Science and technology are, as I have said, but a part of the total educational structure with which we must be concerned. In our concern for science we must not lose sight of the essential roles of the liberal arts colleges. From them, again in pragmatic terms, we get most of the men and women who continue on into science.

The scientist's responsibility

The scientific community and all associated with it have a particular responsibility here to the entire educational enterprise—not as scientists or as educators, not as industrialists or as military experts. The responsibility is on each individual as a citizen.

Let me make clear: the scientific community does not hold a monopoly on responsibility for shaping the future; but it does carry a large and inescapable share of that burden.

This responsibility includes specifically the right—the need—to participate in affairs of the community at large.

Saying this, I must also say that as free citizens of a free society, to whose strength their work contributes immeasurably, men of science must accept too the responsibility for any misjudgments they may make. I am speaking at once for the scientist's freedom in the public arena to be as right, or as wrong, as any other free citizen—without damage to his scientific integrity. In matters of science, a scientist is judged by his scientific peers. In all other matters, the scientist will be judged by all men.

This goes both ways. It reinforces my plea that an increased public understanding of the true role of science and technology is fundamental.

While I have discussed the needs for strengthening science and engineering in the face of a prolonged peril, I must make emphatically clear one additional and significant point: I would hold to these very same arguments even in the absence of such a peril!

Realistically, of course, the peril *is* present. We *are* in a period of accelerating change and of prolonged threat. We live in a time when the decisions we make, or fail to make, can affect the freedom of men for all time.

The torch of the national welfare and national survival are very largely in the hands of science. And science needs the massive support of every intelligent citizen to do its job.