Liquid Propulsion Sym. CPIA, Los Angeles, Calif.
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RESEARCH AND DEVELOPMENT ECONOMICS

J. J. Phillips, Jr., NASA, Washington, D.C.

[redacted]

Eighteen hundred engineers were drawing unemployment compensation in California in June 1964.[1] How serious is this symptom for the American technical community? I think that it is safe to say this is a warning. Changes are occurring which, if properly understood and managed, need not have serious consequences for most of us. In fact, for many these will be times of dangerous opportunity.

There is a crisis in the R&D community, but this is only one of several upheavals. The United States is also involved in a number of revolutions. These include reapportionment, civil rights and cybernation. The legislative reapportionment revolution is of small interest to many. The civil rights revolution is well publicized. The cybernation revolution is less well known. And there is a crisis in the R&D community with which most of us are familiar. The fact that these are all coming at the same time indicates that an era is ending--and a new one beginning. Change will pose increasingly difficult problems to our economic and political systems Certainly all citizens need to be concerned about these revolutions.

The reapportionment revolution threatens the stability of present concentrations of political power, moving power further toward urban centers. If present trends continue, over 80 per cent of our population will be living in urban centers by 1975. Most of the people living in urban centers are wholly dependent upon jobs--working for others--for their livelihood. This makes jobs pretty important.

A part of the civil rights revolution is of economic origin. A minority group is laying claim to higher status jobs. It is less well known that the impact of cybernation, the use of automatic machines in conjunction with computers, is tending to eliminate many of the jobs, (clerical, sales, accounting, drafting and design) to which this group is laying claim.

The capability of our economy to provide jobs is currently in question. During the period 1957 to 1963, private demand was a relatively minor source of new jobs.[2] Public demand, mainly from state and local governments was a major source.[3] Generally there are fewer and fewer jobs in places where people used to find them.

The cybernation revolution, use of automatic machines in conjunction with computers, is not stopping with the production phase of industrial enterprise. It is moving into clerical, middle management, design and service functions as well. I believe that reducing the human work content of jobs is something of which the engineers and scientists of this country should be justly proud. It is one of the goals of the affluent society. But, at the same time, let us all recognize that what we are doing has broad social, economic, and political implications. For example, cybernation

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appear to remove some of the weaknesses of centralized control. Does this foreshadow centralized economic planning? In this connection, of more than passing concern, is the USSR's heavy investment both in cybernation research and in a multiplicity of computer centers for planning and controlling their economy. This program is said to have the same priority as the development of nuclear weapons.(3)

Incidentally, advances in technology are having severe impacts on our political institutions. Shifts in power incident to technological change cause considerable frustration in Congress. For example, the discussion on the Communications Satellite Corporation created so much turmoil that cloture was invoked in the Senate for the first time in 35 years to limit debate and force a vote.

If we can understand the nature of the changes, the underlying forces, and the possibilities for the future, and if we can apply the intelligence and initiative which helped us achieve our economy of plenty, we will be able to shape an even better world. But of one thing you may be sure; it will be a different world! Change is in the wind.

R&D has been a major cause of change. What has been happening to American R&D and what does this portend for its future? For over 200 years R&D has been growing at an exponential rate of about 10% per year. At any time during the past 200 years there were more scientists alive than in all recorded history.

You may be interested to know that a great many parameters associated with R&D plot up nicely as straight lines on semi-log graph paper. These include the number of American men with scientific and technical degrees, the number of scientific journals, the number of men cited in editions of American Men of Science, USSR's scientific journals, China's scientific journals, operating energy of particle accelerators, and U.S. orbital payload capability.

Many of our economic parameters also do so, although some of them exhibit discontinuities. These generally reflect changes in economic or political policies.

If the present long term trends of Gross National Product (GNP) and R&D expenditures continue, R&D will absorb the entire economy before 2000 A.D. This is improbable. More likely is a cessation of this kind of growth. Our first American R&D crisis could be signalling a change in trend. I think it is.

The source of the crisis is clearly indicated in Table I. This shows that Federal R&D expenditures have risen substantially over the past 30 years, both in absolute value and as a percentage of total Federal expenditures. If they continue to rise it will not be long before everybody in Government will be in the R&D business. I am sure that this will not happen in the foreseeable future. But, in any case, politics and national economics are clearly intertwined with R&D management.

TABLE I

FEDERAL RESEARCH AND DEVELOPMENT EXPENDITURES AND TOTAL FEDERAL EXPENDITURES
($ Millions)

FY	R&D	TOTAL	R&D as % total
1930	24	3,000	0.8
1940	69	9,100	0.8
1950	1,100	39,500	2.8
1960	7,700	76,500	10.0
1964 (est)	15,000	98,800	15.0

Since Congress is showing a growing reluctance to increase Federal support, the prospects for future growth of the American R&D community will depend mainly on the willingness and ability of other sectors of the economy to provide the necessary funds. There are past trends and recognizable future needs which clearly indicate that the R&D community will continue to grow. But is it likely that past, rapid exponential growth trends will continue? The crucial question is: Will private industry assume a greater share of the support of our national R&D effort? The magnitude of the problem is indicated in Table II:

TABLE II

FEDERAL RESEARCH AND DEVELOPMENT EXPENDITURES AND TOTAL RESEARCH AND DEVELOPMENT EXPENDITURES
($ Millions)

FY	Total R&D	Federal R&D	Federal as % total
1930	166	24	14
1940	345	69	20
1950	2,900	1,100	35
1960	12,700	7,700	68
1964 (est)	20,000	15,000	75

There are a number of reasons for expecting a lowering of the growth rate of the R&D community: There is evidence that the supply of people capable of becoming scientists and engineers is limited and that we are coming close to full utilization of this supply; it is obvious that total costs of R&D investments have been rising and there are indications that returns on R&D investments have been diminishing; there is a possibility that the capital required to exploit R&D results may be a limitation at present levels of R&D support.

Not everyone is intellectually or emotionally fitted to be a scientist, engineer or technician. Some people want to be trial lawyers, some want to be salesmen, some want to be managers--Messrs Johnson and

There is a rule of thumb which says that each $1 of R&D investment requires $10-15 of venture capital for exploitation(9) On this basis, if 3% of the GNP is invested in R&D, then 30-45% of the GNP should be required in the form of venture capital to exploit this. Currently, there is something like $63 billion of capital coming to industry from depreciation, profit after taxes, new security flotations and the like. $63 billion is about 10% of the GNP and corresponds with the 1% which industry is said to be investing in R&D for its own account.

Assuming that all this is true, what is the shape of things to come? If R&D follows the same S-shaped growth curve as most living things and a great many economic factors, the possibilities are pretty clear. Exponential growth will fall away to linear for a time, and then the rate of growth will decline, exponentially, until full maturity is reached.

If you buy this hypothesis, something more can be said. The period from the end of exponential growth to the end of linear growth is approximately 6 times the doubling period in the exponential growth phase. This means that the future trend of R&D support for the next 60 years may be established in this generation.

This growing to maturity cannot help but change the management of the process itself. During exponential growth, providing for this growth is essential. It is necessary for managements to build up an inventory of human raw material and to plan for continually expanding facilities and continually increasing cash flows. When exponential growth ends, the emphasis must shift toward more effective utilization of existing resources. "Alms for the love of science" will cease to be an effective plea. "What have you done for me today?" will become a more common question. R&D will have to take its place as an integral part of the economy as returns on R&D investment diminish and investments to achieve new breakthroughs increase. The incident changes, or crisis, will have far reaching impacts particularly on scientists, engineers and R&D administrators. The future of our country will depend on how well these crisis are managed.

Of course, everyone is interested mainly in his own welfare. What of the security of your jobs as members of managements and research organizations in the aerospace industry? Two important components of any calculations of the future of this industry are the prospects for DOD and NASA.

After speaking with usually well informed sources in Washington, I come away with the impression that we do not intend to stop def nding ourselves. Ignoring the 1960-1964 Kennedy hump, the most likely trend in total DOD expenditures is level ± 5% into the foreseeable future. Of course this is based on planning figures which are pretty tentative as they approach 1970. The basic assumption is for no substantial change in the international climate. The probability is high, but the confidence factor is low.

Dangerous new international threats, or dramatic new technological developments which might obsolete important weapon systems would stimulate Defense spending and R&D support.

A drastic lessening of international tensions could cause a substantial drop in total Defense expenditures, but over a period of years. And, even in this case, military R&D would remain high.

If a real disarmament pact were consummated, the inspection requirements are likely to provide work for a whole new industry.

In the past 4 years, the value of military prime contracts has increased by $5.5 billion from the level of $23.7 billion in FY 60. Preliminary figures for FY 64 indicate a total of $29 billion, within $600 million of the FY 63 peak and about the same as the FY 62 total. This reflects the accelerated effort since 1960 (known as the Kennedy Hump) to eliminate deficiencies in the defense posture and strengthen our nuclear and non-nuclear forces.

There is a noticeable downtrend in DOD weapon system development effort which may not be counterbalanced until late FY 66 by the TFX and/or other systems. This means that the mix of fundamental and applied research, early and late development, will be quite variable in the DOD programs over the next few years. However, DOD support of R&D is likely to be steadier than its overall expenditures.

As for NASA, the prospects are for a leveling of expenditures. The meteoric rise of the past few years has halted, and barring presently unforeseen events, NASA will probably grow, but much more slowly.

There may be dips in total Federal support of R&D but the long term prospect seems to lie between a relatively constant level of total dollar support and a slow growth perhaps ultimately paralleling growth of the GNP. However, please take careful note that the areas of Government interest are likely to shift markedly as time goes by.

The role of both DOD and NASA in-house laboratories will probably be strengthened in the future. In 1964 DOD's $7.2 billion total RDT&E was distributed between industry, Government laboratories and non-profit organizations in the approximate ratios: 67:25:8. NASA's distribution in propulsion was more heavily weighted in favor of industry: 94:5:1.

A major advantage of research by in-house laboratories is that it provides a nucleus of expert talent capable of judging the merit of R&D and production proposals, and administering resulting contracts. The Bell report recommended that the in-house laboratories be improved and strengthened--made attractive to high caliber talent. DDR&E's Dr. Brown is implementing these recommendations. NASA will continue to emphasize up-grading of its in-house laboratories.

Recently increased Government salaries seem likely to counterbalance the differentials which have in the past caused loss of experienced Civil Service personnel to industry. This will help the up-grading process.

Goldwater want to be President. There is some limit to the number of people who have the capacity to handle R&D work. And not all of these have the inclination and opportunity to enter the field.

According to Dr. Derek Price,(4) we are approaching a maximum utilization of our intellectual elite which will prevent much more economical expansion of our investments in science. He assumes that we will continue to under-utilize women, and that the proportion of intellectual elite who elect careers in science will not change much. If you buy his judgement that an Army General Classification Test score of 130 is the cut-off point for good R&D work, then only about 7% of our total labor force is capable of being productive in this field. The facts that engineers and physical scientists now comprise over 2% of our labor force, and R&D scientists and engineers almost 1%,(5) indicates that we may be close to a limit. (However, this does not mean that we should stop producing engineers. As I will show later, there are reasons for educating as many engineers and scientists as we can.)

It would be hard to prove beyond any shadow of a doubt that R&D is becoming a less productive investment. But it is common sense to believe that the relationship between GNP and national R&D expenditures should be an indicator of profitability of R&D investments, if product obsolescence is high, which is the case in our economy. Since R&D expenditures have been increasing at a higher rate than GNP for over 40 years, the indication is that R&D investments are encountering diminishing returns. But there are many other than purely economic reasons for R&D investments--national security and increasing life span being among these.

The decreasing profitability of additional R&D investments may be related to the increasing cost of R&D per professional technical man-year. This, of course, includes a number of elements. For example salaries have increased, but these do not seem out of line with wage rates considering the relatively heavy investments professionals make in their education. (However, it is true that many of the aerospace industry's 10% of the technical labor force do have pretty high salaries.)(6)

Dr. Price infers that the total number of scientists increases as the square of the number of outstanding scientists. It is interesting that Dr. William Farrington recently showed that the total cost of American R&D increases as the square of the number of PhDs in engineering, mathematics and physical sciences.(7) This probably means that, as the total effort expands, less capable people are drawn in and scientific output tends, on the average, to drop off. Perhaps we are beginning to need a measure of productivity in R&D. So far as I know, nobody has a good one.

National R&D expenditures of 3% of GNP don't look as unmanageable as 15% of the Federal budget. Why doesn't industry take on more of the load? After all it is claimed that returns on R&D investments are high.(8) The keys to this enigma may be the availability of venture capital and the courage to invest.

With the overall view in mind, let us now turn to propulsion R&D.

Following the establishment of NASA in 1958, as you all know, the support of rocket propulsion R&D effort began a redistribution process which, in FY 65 is still continuing. The space agency, being responsible under the Space Act for our peaceful exploration of space and for providing the DOD with the underlying technology for potential military operations, has properly assumed a major role in developing the things which are necessary for our national space effort.

To accomplish this NASA expanded its basic NACA nucleus, relying heavily on DOD established resources. To mention only a few: the Army provided the Von Braun team, Redstone and Jupiter missiles and facilities at Redstone Arsenal and JPL; the Air Force provided Atlas and Agena missiles; the Navy provided ships, planes and personnel for recovery operations. All of the services have graciously loaned experienced managers to make our achievements in space truly national accomplishments.

Considering that, in relation to our principal competitor, we have been booster limited, a major portion of NASA's resources have been devoted to the development of space boosters. Recent history indicates that our money has been well spent. The fantastic operational success of the Saturn program is the evidence. With guarded optimism, we feel that we may have stolen a march on the USSR.

The Air Force's Titan III, which has certain advantages over the Saturn concept for military purposes, plus our current solid booster development program, offers some insurance against a Soviet propulsion leap frog.

NASA's current Gemini and Apollo Programs support a tremendous amount of propulsion system development effort. This includes work on the F-1, the largest liquid engine in the free world, the J-2, our largest hydrogen engine, storable systems for the Apollo command and service modules, systems for the LEM descent and ascent stages, small reaction and orbital attitude control motors for spacecraft and ullage motors for Saturn. About 10 of these are in the 25 to 100 pound thrust class.

The fact that our efforts to catch up with the USSR have met with some success, although we certainly cannot duplicate all of their achievements as yet, has given us a chance to take stock and peer into the future. The results of this stock taking, barring unforeseen events, indicate that we will be over a hump in propulsion by the end of FY 66. By this time we hope to have completed development of propulsion systems for Saturn boosters and Gemini and Apollo spacecraft.

This means that the dollars available for NASA supported propulsion R&D might go into a downtrend between FY 66 and FY 70. However, there are several factors which could eliminate this potential dip. These include approval of applications for the M-1 engine, new missions for

Saturn IB and Saturn V, success of the current FLOX program, new missions for Apollo, approval of a large solid motor application, and possible new starts arising from the investments in advanced technology which have been made over the past several years.

On balance, I look for a slight uptrend of the order of 5% per year in NASA's propulsion R&D program.

The DOD propulsion Research, Development, Test and Evaluation program is likely to hit a downtrend in this same period unless DOD establishes a larger role in space. Of course, the services are still planning program increases, but the Department of Defense Research and Engineering, Bureau of the Budget and the Congress have ways of altering many service plans. It seems likely that the completion of production of major missiles systems and the reported absence of worthwhile new projects, will decrease the availability of dollars for DOD's propulsion RDT&E.

DOD and NASA propulsion R&D effort in 1964 was approximately distributed as shown in Table III. It is likely that both agencies will support increasing effort in the earlier phases of the process at the expense of engineering and system development for the next several years.

TABLE III

DISTRIBUTION OF FY 64 EFFORT AND TRENDS

Total DOD RDT&E and NASA Propulsion Expenditures

Category	Total DOD % Budget	R&D Trend	NASA % Budget	Propulsion Trend
Research	5	Up	4	Up
Exploratory Development	15	Up	9	Up
Advanced Development	10	Mixed	11	Up
Engineering and System Development	70	Down	76	Down
	100		100	

Current DOD rocket propulsion R&D favors solids. With completion of Minuteman and Polaris, a shift towards fundamental and applied research on both solid and liquid systems for possible space and tactical applications is highly likely.

NASA's propulsion R&D favors liquids. While NASA now supports the technology of large solid fuel motors, it seems unlikely at this reading, that these will play a major role in the Civilian space program for several years. And their reliability must be acceptably proven before they can be used.

In an overall sense, it appears that the total of DOD and NASA support of propulsion R&D is likely to shift toward fundamental and applied research and away from engineering and system development because new technology is needed for future systems. This effort will be mainly in chemical propulsion as we approach 1970. At this reading a downtrend seems probable between now and FY 70 unless somebody is able to sell something new and enticing.

Beyond this 5-10 year period, R&D on chemical propulsion is likely to give way to more intensive R&D on nuclear systems. These developments will be more expensive than chemical propulsion developments. New skills and new facilities will be needed in these new fields. Obsolescence of existing industry-owned facilities and personnel may become a heavy burden in some cases.

Electric propulsion systems are in a different category. While there is a possible near term application for stabilization of spacecraft in orbit for longer than one year, manned interplanetary travel applications are still years away.

The change from relatively rapidly increasing Government support of R&D to a relatively constant level of support will end a "way of life" for the aerospace industry unless the industry can generate other sources of business. While there is no reason for hysteria or panic, there is good reason for concern.

The runout of Polaris and Minuteman developments compound the problem for some companies in the short run. Over the longer term, however, many firms and many, many key employees will have to be redirected--reoriented. Some companies which are large now may have to grow smaller, merge or sell out. Some highly trained high status people may have to be retrained for lower paying jobs while shortages for even more highly trained people develop. These changes, these company and personal crises, will burden and challenge local communities. The Federal Government will have to give more attention to easing these local burdens by improving its own planning and management of change. It is already moving towards this objective with DOD and Disarmament Agency studies.

Those companies which intend to exploit their knowledge of Government contract work will have to be flexible and resourceful. As previously mentioned, Federal emphasis will shift between areas of interest. Support will probably move toward public service programs. For example, Dr. Holloman's Department of Commerce civilian technology effort is starting in a small way and is likely to grow bigger. The communications satellite effort--cooperative between industry and Government--is growing. Similar Government-private industry joint ventures are likely in the future. Then there is the water desalinization program which seems to be going international, and assistance to the underdeveloped nations of the world. This last is likely to emerge as a major new area of R&D.

State and local Governments are also coming into the R&D business. They are interested in highway systems, mass transportation facilities, automation and cybernation of their own activities, etc.

Of course, there is always the opportunity to use the backlog of advanced technology and the skills already in the aerospace industry for commerical purposes, for example, to obsolete existing aircraft. It is my understanding that a meeting sponsored by the Air Force Association will discuss this very subject in the near future. Trips to Europe for $50 by 1975 seem well within reach via applications of advanced technology to commercial airliners, according to some. If this is so, a substantial aircraft market could develop for those who have the resources to invest.

Now what are the prospects for individual scientists and engineers?

The market for scientists and engineers appears to respond to classical economic forces. As salaries go up, companies use fewer scientists and engineers on a given job. In the short run, the supply is inelastic because of the long lead time for production except that there is a relatively easy movement into and out of R&D.

Several forecasts of shortages and gluts have been made since World War II. No serious shortages or gluts occurred. This indicates that the market has a high elasticity--that is the demand increases relatively rapidly as salary levels decline and vice versa. Consequently, even if there is some unemployment among scientists and engineers as a result of a down-trend in defense spending, this is not likely to last very long unless accompanied by a substantial change in trends for the rest of the economy.

Recent reports forecast such large increases in requirements, between 1960 and 1970,(5,10) that, in the unlikely event that the aerospace industry disappeared, its scientists and engineers should still be able to find positions in other parts of the economy in a reasonable time. After all, less than 10% of the technical labor force works in this industry. Again, there is no cause for panic, but there is reason, I feel, to develop interest in the country's employment policy.

The fact that the level of Federal R&D spending triggered our first crisis mainly in the aerospace industry is not materially important. The prognosis is for more crises to follow as industry reaches the limit of its human resources. What is important is to lessen the impact of this and succeeding crises on the individuals, companies, communities, and states and to protect the future of the nation.

Taking a very long view of the future, it seems clear that American industry will be operating in an increasingly competitive world.

As you know, this country has been a net importer of raw materials for years. Our dependence on foreign sources will increase although this is relatively small dollarwise now. Therefore, we will have to become more dependent on trade, and tariff barriers will be less useful to us.

We are already meeting severe competition in domestic and foreign markets from our friends in Western Europe, Japan, and Hong Kong. As the USSR increases its GNP, it will enter the international lists. It is reasonable to believe that the USSR will use its productive capacity as an instrument of national policy. Economic warfare in the form, not of embargoes or tariffs, but of competitive pressures is not outside the realm of possibility. With the Soviet Government artificially controlling prices, this might be difficult for our private industry to handle.

During the past two decades we have encouraged economic development of Europe and the formation of the European common market. The latter has increased demand sufficiently to permit European manufacturers to take advantage of economies of scale. They are becoming mass producers of finished goods and are beginning to exert pressure on domestic industries. Many of these have come to the tariff commission for protection. But tariffs and voluntary export restrictions are not satisfactory long term answers to competitive pressures. These pressures will ultimately force American businessmen to become more innovative and alert. After all, if the free enterprise system is as good as we say it is, our businessmen should be able to respond to challenges of international competition with new products and more efficient processes. This need for innovation and efficiency could represent a source of new business for the advanced technology companies. In fact Aerojet General's Atlantic Division appears to be trying to exploit just this kind of opportunity.

In such a competitive world, efficient production machinery, a high quality labor force, and an effective R&D community will be priceless assets. The first two for effective production, the third to insure low cost production processes and new products.

Presently, we are well ahead of our most unfriendly competitor, the USSR, in our productive capacity, but there is some evidence that we may not be far ahead of him in quality of labor force and size of R&D community. The clear implication is that we had better preserve and enhance our stock of scientists and engineers or risk falling behind in what promises to be a deadly race--per Nikita Khruschev.

The Soviet Union is producing college trained engineers at far higher rates than we are. In 1962 they produced 123,000 college trained engineers[11] while we produced about 35,000.[12] They also produced 31,000 agricultural specialists and 18,000 natural scientists, while we produced about 31,000 scientists. The quality of their engineers may be lower than ours, but some of them must be reasonably good judging from Soviet exploits in nuclear technology, missiles and space.

Of course heavy internal demands for their trained people will exist for some years. They plan very large investments in physical plant, development of agricultrual output and natural resources. They just naturally need more engineers than we do at this time. They started from pretty far behind. However, what are the implications for the future of a larger supply and increasing production rates in relation to our smaller supply and possibly decreasing production rates? What is likely to be our position when, as and if, the USSR matches our per capita GNP with a higher quality labor force and a larger R&D community?

The challenge of our time is to manage our economy of abundance effectively. This means, among other things, preventing starvation in the midst of plenty and providing adequate opportunities for all to partake in the benefits of our technologically generated progress and to provide for its preservation.

The traditional ability of the market place to distribute the products of our economy in a wage based society is being questioned. (12) It is hard to justify unemployment rates of 5% when many Western European countries are able to keep a larger proportion of their total populations employed with less than 3% out of work. You members of management and the American R&D community have a responsibility for what is happening. If you do not accept this challenge and make contributions to the solutions of the difficult solial, political, and economic problems now facing the country, you may soon find yourselves, by default, operating in an environment which is not to your liking.

Of peculiar importance to you here today is the issue of whether or not we should have a highly centrallized direction of the bulk of our R&D activities. We have this now. If you believe we need a change, you should be thinking about how the alternatives might be made to work. And you should be making your thoughts known to your elected representatives.

A forum for your views on subjects of this kind is being provided by Senate Bill S.2623, introduced by Senator Philip A. Hart, which establishes a National Commission on Automation and Technological Progress. The purpose of this commission is to evaluate the impact of technological change on the nation, define unmet needs in our society, identify means for channeling new technologies in promising directions and recommend actions to be taken by the Federal Government. You should interest yourselves in the work of this commission.

The basic strategy for prospering amidst rapid technological change is the same for both the individual and the company; prevent technological obsolescence and retain mobility.

It is becoming necessary for most scientists and engineers to avoid being narrow specialists. The dinosaurs are said to have become extinct because they couldn't adapt. Some say we should be spending 20% of our day training ourselves for our next jobs; others that we should concentrate on improving our proficiency on our present jobs. In either case there is a premium on avoiding obsolescence. In this connection a recent investigation indicates that there are advantages to both the company and to himself when a scientist or engineer broadens his activities.(13)

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Companies will have to use considerable initiative and be willing to accept large risks to stay on the crest of economic waves of the future. Their managements will probably have to be retrained from time to time for new specialties. Those who want to market technical progress to Uncle Sam will have to maintain a stock of continually changing scarce resources and redirect their efforts from time to time towards new and different kinds of problem solving. And don't expect Sam to start you off and eliminate all your difficulties by writing checks.

Communities will have to do more to help their citizens adapt to change. More schools and teachers and teaching equipment will be required to handle the job of preparing youngsters entering the labor force, and to retrain older workers who need new skills. Thus, a reduction in Federal tax rates is likely to be accompanied by increases in state and local taxes.

You gentlemen here today will help to shape the future of our country for the next hundred years. God grant you the wisdom to know how, and the courage to do it well!

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