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U.S. SCIENCE POLICY

TALKING POINTS

- 0 Science plays a very important role in the Bush Administration. The most important reasons for this are the President's recognition of the influence of science on national and international policy and the President's receptivity, and the receptivity of his top officials, for the best information and advice in this area.
- 0 President Bush has a strong belief that research and development are a vital investment in our future. This is reflected in the increase in the total R&D budget by 7 percent to \$71.2 billion and an 8 percent increase in the basic research spending.

Underlying Themes in the Administration's Science and Technology Policy

- 0 There are several themes underlying the Administration's science policy.
- 0 First, to preserve the initiative, independence, and creativity of American scientists through a stable multiyear pattern of funding for basic research and continued real growth in federal R&D funding.
- 0 Second, to foster a more efficient and effective coupling between R&D and commercialization efforts.
- 0 Third, to maintain the integrity of science advice and to ensure that the best scientific advice is an integral part of all policy decisions on the environment.
- 0 Fourth, to contribute to international cooperation through support of large science projects and cooperation on a wide range of other scientific endeavors.
- 0 Fifth, to improve national literacy in science and mathematics and meet future requirements for trained people in science and engineering. This is essential for our future economic prosperity in an increasingly technological and competitive world.

Federal R&D Budget Priorities

- 0 Three principles are followed in prioritizing agency requests for R&D funding:
- 0 First, support is required for programs that address national needs and concerns.
- 0 Second, there must be adequate support for basic research. Basic research -- and particularly university-based, individual-investigator and small group research -- constitutes the heart of our science and technology enterprise.

- o Third, we must ensure an adequate level of funding for the scientific infrastructure and facilities in this country, including large facilities.

Development of Science Policy in the Administration

- o One of the most important developments in science policy in the United States is the reorganization and revitalization of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET).
- o The FCCSET is an interagency group within the Executive Office that is charged with reviewing, integrating, and coordinating the R&D activities of the federal government that cut across the missions of more than one federal agency.
- o The best example of how the FCCSET works is in the field of global change research. The FCCSET Committee on Earth Sciences took all of the disparate research being done by federal agencies on the global environment and organized it into a U.S. Global Change Research Program--a coherent, government-wide approach to the scientific understanding of global change.
- o I expect FCCSET to provide this type of coordination to other important areas of science and to be a powerful influence in helping to shape and implement federal science policy.
- o FCCSET will also help to develop and review, in close cooperation with the Office of Management and Budget, annual and long-range federal budget plans in selected cross-cutting areas of science.
- o The FCCSET will receive input from the private sector through a newly formed President's Council of Advisors on Science and Technology. This is a group of 12 distinguished scientists and engineers that report to the President. Because I chair both the FCCSET and PCAST, I have the opportunity to coordinate actions of the two groups so that they can benefit from each other's activities.

International Science Policy

- o In the area of international science policy, the U.S. government seeks to ensure that science is an integral part of U.S. foreign relations and that science issues are adequately considered in the development of foreign policy. For example, we seek to encourage international participation in a number of large, world-class science projects such as ITRE and global change research. Finally, we seek to coordinate and we have participated in a number of multilateral and bilateral efforts to improve the infrastructure for science and technology around the world and to strengthen science and technology cooperation.

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As our depth of knowledge increases, effective communication among scientists in different disciplines becomes ever more critical. The U.S. Government will continue to play an important role in facilitating the necessary cross-fertilization among scientific communities.

INDUSTRIAL COMPETITIVENESS: THE FEDERAL RESPONSE

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Empowering America's Industrial Competitiveness

Fairfax, Virginia

May 30, 1990

Last week the President's Council of Advisors on Science and Technology met in Washington, and during that meeting we had a very interesting discussion about the problems of industrial competitiveness. Harold Shapiro, the president of Princeton University and a distinguished economist, made the very good point that the term "competitiveness" has become firmly established in the national consciousness; one study found, for example, that the term appeared 5,700 times in the titles of newspaper and magazine articles between 1983 and 1987. Yet there is still much uncertainty surrounding the **definition of competitiveness**. To some people it means a positive balance of trade. To others it means the ability for firms to compete in global markets. Because of this uncertainty, it is still possible to argue whether America has a competitiveness problem at all.

I tend to take a broader view of competitiveness. **I would define it as the President's Council on Competitiveness did two years ago: as the ability of a nation to produce a high and rising standard of living for its citizens. If a nation is to do so, it must continually improve its productivity. And in today's economies, nothing is so important to productivity as scientific and technological progress.**

Viewed in this broader light, the federal government has no more important task than to create an environment in which private industry can remain competitive. If private industry cannot remain competitive, the federal government will be unable to achieve all of its other goals in areas of national concern -- in defense, in health care, in education, in the protection of the environment. Economic productivity is the foundation on which we build our national policy, and we ignore that foundation at our peril.

Private industry is the driver of productivity in this country. **The federal government therefore needs to make it possible for American industry to do what it does best: to innovate, to compete, and to excel in national and global markets.** In many cases, this requires simply leveling the playing field for American firms and

getting out of the way. The challenge to the federal government is to decide what kinds of actions are appropriate.

I will be talking today about a wide range of actions that the federal government has been taking and will be taking to help industries maintain their competitive edge. These actions range from broad macroeconomic policies to specific programs designed to address immediate concerns. At first glance, these efforts may appear relatively unrelated. But together I believe that they represent a comprehensive, long-range, responsible approach to the challenges facing American industry. It is an approach that will ultimately result in a stronger, more stable industrial base, one that is well equipped to meet the challenges of the 21st century.

MANUFACTURING MATTERS

I want to begin by talking about an important aspect of industry in the 21st century, an aspect that is too often ignored: manufacturing. We in this country are the victims of what I would describe as a dangerous myth: that the United States has moved, in a rather leisurely fashion, from an agricultural economy to a manufacturing economy to a service economy. Nothing could be farther from the truth. To say that we have moved beyond manufacturing would be as absurd as saying that we have moved beyond agriculture. Unfortunately, this myth has begun to permeate our culture, with very harmful effects.

One is that in science and technology we tend to focus on the revolutionary types of discoveries, the ones for which people are awarded Nobel prizes, rather than on the evolutionary developments. Yet these evolutionary advances are the ones that allow companies to bring products to the market a little faster, a little cheaper, and a little more reliably. It is extremely distressing to note that at MIT, one of our most distinguished engineering schools, fewer than 4 percent of its engineering graduates demonstrate even the slightest interest in production or manufacturing.

Much of this problem is a cultural one, and like many of the problems I'll be discussing it will be solved only through simultaneous efforts on a number of fronts.

We have to reemphasize the importance of manufacturing on many levels, from the boardroom to the classroom. The federal government has instituted a number of policies that affect manufacturing. These policies also have an important indirect effect: they focus attention on this important component of our national competitive stance.

STRUCTURAL PROBLEMS IN THE ECONOMY

This renewed focus on manufacturing and production is all for the better, and we should welcome it. But our problems in competitiveness do not reside entirely in manufacturing. They may show up there, but many of them originate in much deeper structural problems that are not going to be easy to resolve. **These problems include:**

- o The cost of capital
- o A reduced willingness to take technological risks
- o Inequitable trading policies
- o The quality of the technical workforce
- o And a general wariness about cooperation among various entities in government, industry, and universities

The federal government clearly has a role to play in addressing these problems. But before I turn to this federal role, I want to make another very important point. The response of the federal government must be built on more than just correcting deficiencies. A successful strategy must also exploit the strengths and advantages unique to the United States.

Undoubtedly the United States' greatest strength is our infrastructure for research and development. Since World War II, the generous support provided by the federal government, and by the American taxpayer, has given the United States the strongest scientific and technological enterprise that the world has ever seen. It is a national and global resource; it is essential for our standing in the world.

The United States has several other great strengths of which we can justifiably be proud.

- o We have a university system that is the envy of the world and that routinely attracts the brightest young people from around the world.

- o We have an open and hospitable society, so that students and professionals who come to this country often stay here and make major contributions to our economy and culture.

- o We have a business climate that encourages new companies and allows successful companies to grow quickly into major businesses.

- o And we have a culture that continues to prize and reward innovation, which has become the keystone of modern economies.

The United States needs to maintain these strengths if we are to remain a world economic leader. Both the public and the private sectors need to increase their support for research and development in universities and industry. These activities are responsible for the strength of our science and technology base, and we must not ignore them as other concerns are addressed.

But strong technology is not always enough. Our strength in technology has not prevented a steady erosion in market share in many industries. As an industry matures, companies cannot afford to rest on past achievements, because in today's economy a static company is a declining company. Rather, they must continue to innovate and enhance the application of technology throughout the production process. U.S. firms are increasingly learning this lesson, and as they do they are starting to gain back some of the ground that has been lost to foreign competitors.

THE MACROECONOMIC CLIMATE

As I said at the outset, the federal government must make it possible for firms to innovate and compete. Thus its most important responsibility is to help create the macroeconomic climate in which industrial innovation can flourish. I am not an economist, so I do not speak with absolute authority on these issues. But I do believe that without a business climate that encourages innovation, the other efforts I shall be discussing will have only marginal effects.

The single most important factor in the business climate is the ability to invest, which in turn is related to the availability, cost, and patience of capital. Many have pointed out that the cost of capital in the United States is higher than it is for our major competitors, and the emphasis in this country is on short-term returns on investments. In contrast, the most important factor behind Japan's success as a producer is its persistently high rate of investment and its willingness to take long-term risks.

Several factors contribute to making capital more expensive here than it is elsewhere. The federal budget deficit, tax provisions, low savings rates, and uncertainty about the future can all drive up the cost of capital.

The Bush Administration is firmly committed to lowering capital costs in this country. We are working to reduce the budget deficit, most immediately through the budget summit initiated by the President. We are also working to reduce the capital gains tax to promote risk taking and encourage a long-term focus for investors. We have proposed, most recently in the 1991 budget document, several actions that would increase domestic savings and thereby promote investment.

More general regulatory concerns also have an influence on competitiveness. Many of these concerns are being addressed by the Council on Competitiveness, which the President established under the leadership of the Vice-President. For example, the Council has developed a strategy to reform the existing maze of product liability laws. The Bush Administration has also recently proposed changing antitrust laws to allow companies to enter more easily into joint production ventures.

A proposal that focuses specifically on research and development is the research and experimentation tax credit. The President has proposed changes to the present tax credit to encourage U.S. industry to invest in long-range research. These changes include making the tax credit permanent and extending it to cover expenditures by startup firms. The intention is to encourage rapid growth of research and development as well as sustained commitments for R&D support.

Trade policies are also a major part of the competitiveness equation. The U.S. government has a duty to ensure fair trade treatment for U.S. industry in the global marketplace. Dumping and other unfair trading practices must not and will not be tolerated. U.S. companies must have access to world markets free from tariff and nontariff barriers. And our intellectual property rights must be protected.

This Administration is working to reduce barriers to fair and free trade through bilateral negotiations and the ongoing round of GATT talks. The U.S. representative to those talks is forcefully promoting the opening of world markets and the creation of fair trading rules. Intellectual property issues are also being addressed both in GATT and bilaterally.

EDUCATION AND COMPETITIVENESS

Governments at all levels have another fundamental responsibility in ensuring industrial competitiveness. They have an obligation to provide young Americans with the education they will need to be productive and successful workers in the American economy.

I'm sure you are all aware of the studies showing American students last or almost last in international comparison of scientific and mathematical achievement. But what we should keep in mind is that ten years from now, or twenty years from now, those scores are going to translate into competitive advantages among nations. We are shortchanging our children's futures by providing them with an inferior education.

Precollege education will remain largely a state and local responsibility. But the federal government must assume an appropriate role in supporting the states and localities, particularly in mathematics and science education.

I have recently helped to set up an interagency committee on science and mathematics education chaired by Admiral Watkins, the Secretary of Energy, and I have very high expectations for that committee. The federal government already spends a substantial amount of money for science and mathematics education -- over \$1.5 billion in five Federal agencies. The challenge is to coordinate the various programs and expenditures of the federal government so that they have the optimum effect.

FEDERAL SUPPORT OF TECHNOLOGY

I would like to turn now to the more specific question of the government's development of technology. We tend to think of the federal government as the supporter of basic research in this country, and in fact it does fund over half of this research. But the federal government supports more applied research and development than it does basic research, even if you look only at commercial R&D.

Traditionally, the federal government has supported these activities for two reasons: to meet its own needs in such areas as defense and space, and to meet broader national needs such as new and better means of providing health care, agricultural productivity, and pollution clean-up.

The government relies to a great extent on its own laboratories and on private industry to undertake this applied research and development. Furthermore, it encourages these activities to be managed in such a way as to optimize the commercial applications of this research and development.

Approximately \$15 billion is proposed in the FY 1991 budget for civilian applied research and development. Over \$1.5 billion of this amount would be allocated to developing advanced technologies such as robotics, high performance computing, and semiconductor technologies. On the defense side, the budget requests

nearly \$5.6 billion for basic, applied, and developmental research that supports our future national security.

It is therefore clear that the federal government already supports a great deal of technology development. Many of these previous investments have been very successful in developing technologies that have important civilian applications, such as agriculture, health, and aeronautics.

GENERIC, PRECOMPETITIVE TECHNOLOGIES

The Bush Administration believes that the federal government should continue to participate with the private sector in developing technology. Furthermore, the Administration has made a commitment to support generic, precompetitive technologies that are important in both the public and private sectors. These are technologies where no single company can capture enough of the benefits to justify investing an adequate amount of R&D in them. The rationale for investing in these technologies is essentially the same as that for investing in basic research: individual companies cannot bear the cost and risk of such investments given the diffuse nature of the benefits. Examples include certain materials technologies (such as superconductivity), information technologies (such as high performance computing), and biotechnologies (such as scaled-up bioprocesses).

In a speech to the American Electronics Association on March 7, President Bush pointed specifically to the importance of these precompetitive technologies. He said, "This Administration is committed to working with you in the critical precompetitive development stage where the basic discoveries are converted into generic technologies that support both our economic competitiveness and our national security. Here again we can help to level the international playing field on which you operate."

This is a policy that I wholeheartedly support, and I shall do my best to assist in its execution. One of the four Associate Directors in my office, William Phillips, is specifically in charge of industrial technology, and he and I will be working closely

with the rest of the Administration, with the Commerce Department, and with the Defense Department to promote the federal government's development of commercially important technologies.

POOLING RESOURCES TO TAKE ON PROBLEMS

In addition to directly funding the development of technologies, the federal government can make it easier for industry to develop commercial technologies. One way to do this is by catalyzing the formation of consortia or networks of industries, such as SEMATECH, along with federal laboratory and university participants. Particularly for small and medium-sized businesses, such consortia make it possible to pool resources and specialize on problems, so that each individual firm does not have to reinvent the technological wheel.

Already, we are starting to see the kinds of collaborative arrangements that I believe will be much more common in the future. DuPont, Hewlett-Packard, and Los Alamos National Laboratory have established an \$11 million joint venture that is exploring applications for the new high-temperature superconducting materials. The University of Illinois, an Agriculture Department laboratory, the state of Illinois, and six different U.S. companies have set up a consortium focused on biotechnology products. Roughly 200 cooperative R&D agreements between federal laboratories and private companies are now ongoing.

In general, the hundreds of laboratories funded by the federal government embrace an astonishing breadth and depth of the best science and technology to be found. This base of knowledge represents one of our most valuable national assets. Federal laws and policies now in place make it the responsibility of every federal technology manager -- defense or civilian -- to consider the commercial ramifications of the work they are supporting and to try to encourage its commercial potential. We will be building on these previous laws and policies to develop mechanisms that will expedite the diffusion of the results of federally supported R&D to industry. These mechanisms will include active licensing of inventions and removal of barriers to

commercial development, as well as marketing of federally developed computer software.

It is also important that this transfer of technology be guided by the potential users. The federal government has a relatively poor track record where it has invested in civilian technology without close involvement at the outset from potential users. If U.S. industry wants government assistance and is willing to coinvest, there is some hope for success. But if industry does not perceive the need or is not interested, there is little point in the government's engaging in technology push.

THE ROLE OF THE DEPARTMENT OF COMMERCE

In addition to the national laboratories, the Department of Commerce is going to be heavily involved in working with industry on the development of industrial technologies. I will be working closely in this area with Robert White, the new Deputy Under Secretary for Technology at Commerce, as well as with Tom Murrin, who is here today.

In particular, we expect the National Institute of Standards and Technology to be a major player in technology development. I might single out two new programs as examples. The Advanced Technology Program is aimed at assisting businesses in developing precompetitive, generic technologies that will widely benefit the private sector. This program will support joint ventures and other research arrangements that have been suggested and developed by industry.

Another promising program involves the Manufacturing Technology Centers, which are designed to disseminate new manufacturing technologies within industry, and particularly within small business.

I see both of these programs as experimental. If they meet with the success that I and my colleagues in the Commerce Department believe they will, we hope that they will substantially expand in the future.

STATE ACTIVITIES

I know that you have just heard a talk about technology transfer at the state level, so I am not going to dwell on that subject. But I should point out that the federal government has the opportunity to leverage state initiatives in ways that can greatly increase their effectiveness. To take just one example, the federal government has the opportunity to convey information about local success stories to other areas that could benefit from similar initiatives. Again, I expect the Department of Commerce to be a central player in this effort.

CONCLUSION

This has been a long list of federal initiatives, but I hope in this way to have demonstrated an important point. The federal government holds the issue of industrial competitiveness to be among its highest priorities. Not only is the federal government involved in the development of technology. It is also seeking to influence the other factors -- economic, educational, fiscal, regulatory, and even cultural -- that affect the position of U.S. firms in world markets.

Of course, the federal government cannot go it alone. Other institutions and individuals need to get involved -- and most particularly the leaders of industry in this room. The primary responsibility for the nation's competitiveness must, in the final analysis, rest with the private sector.

But the federal government can do a great deal. It can establish a strategic vision, emphasize the importance of our nation's competitive position, catalyze the activities that will make a difference. This is what the Bush Administration has been seeking to do, and it will continue to do so in the future.

final
11 April
8:00 P.M.

~~PROPOSED~~ REMARKS

BY

WILLIAM H. WEBSTER

DIRECTOR OF CENTRAL INTELLIGENCE

BEFORE THE

WORLD AFFAIRS COUNCIL OF BOSTON

BOSTON, MASSACHUSETTS

APRIL 12, 1990

IT IS ALWAYS A PLEASURE TO VISIT MASSACHUSETTS. I LOOK FORWARD TO RETURNING IN MAY FOR MY 45TH COLLEGE REUNION. ACTUALLY, THE WAR DELAYED MY GRADUATION UNTIL 1947. IN BETWEEN THOSE TWO DATES, WINSTON CHURCHILL VISITED WESTMINSTER COLLEGE IN MY HOME STATE OF MISSOURI, AND DELIVERED HIS NOW FAMOUS "IRON CURTAIN." SPEECH. FOR THE NEXT FOUR DECADES, THE SOVIET UNION MAINTAINED RIGID CONTROL OF THE SATELLITE STATES FORMING THE WARSAW PACT. ON ONE SIDE OF THE IRON CURTAIN LAY THE EUROPEAN DEMOCRACIES; ON THE OTHER A MONOLOTHIC FORM OF TYRANNY. OUR SOVIET EXPERTS LISTENED WITH STETHOSCOPES FOR ANY SIGN OF HICCUPS THAT WOULD SUGGEST SIGNIFICANT CHANGE IN SOVIET INTENTIONS AND CAPABILITIES. BY 1961, THE BERLIN WALL WAS UNDER CONSTRUCTION. MY YOUNGER DAUGHTER KATIE WAS BORN AS IT WAS GOING UP. SHE HAD LIVED HER ENTIRE LIFE IN THE SHADOW OF THAT SYMBOLIC STRUCTURE. AND THEN LAST YEAR, THE YEAR HER FIRST CHILD WAS BORN, IT CAME DOWN. A NEW LIFE, AND IN MANY

RESPECTS, NEW OPPORTUNITIES IN A RAPIDLY CHANGING WORLD. NO MORE LISTENING FOR HICCUPS. TODAY WE CONFRONT A PACE OF CHANGE THAT IS UNPRECEDENTED IN MODERN HISTORY. MUCH OF THE CHANGE HAS OCCURRED WITHIN JUST THE PAST SIX MONTHS. BUT ALTHOUGH THEY MAY BE RECENT, THESE CHANGES HAVE ALTERED MANY OF OUR EXPECTATIONS FOR COUNTRIES -- EVEN REGIONS -- AROUND THE WORLD.

THEY HAVE ALSO TESTED US AND I THINK THEY HAVE PROVED HOW DIFFICULT AND HOW IMPORTANT IT IS TO STAY AHEAD OF THE CURVE.

THIS EVENING I WOULD LIKE TO FOCUS ON SOME OF THE RECENT CHANGES IN EASTERN EUROPE AND THE SOVIET UNION, AND THE INTELLIGENCE ISSUES THAT WE WILL FACE IN THE NEW DECADE. TWO OF THOSE ISSUES, WEAPONS PROLIFERATION AND GLOBAL ECONOMICS, WILL, I BELIEVE, GROW IN IMPORTANCE AS WE APPROACH THE NEXT CENTURY. FOR NOW, MUCH OF WHAT CONCERNS OUR POLICYMAKERS IS AFFECTED BY EVENTS UNFOLDING IN EUROPE -- ELECTIONS, THE PROCESS OF TRANSITION, AND PROSPECTS FOR THE FUTURE.

THE POLITICAL LANDSCAPE IN THE SOVIET UNION AND EASTERN EUROPE IS CHANGING DRAMATICALLY. BY MID-JUNE, SEVEN NATIONS OF EASTERN EUROPE WILL HAVE HELD LOCAL OR NATIONAL ELECTIONS. FOR MOST OF THEM, THESE ARE THE FIRST MULTI-PARTY ELECTIONS SINCE WORLD WAR II. ELECTIONS ARE BRINGING KEY ISSUES TO THE FORE, BUT THEY DO NOT GUARANTEE AN EASY TRANSITION FROM COMMUNISM. THEY WILL HAVE TO BE ACCOMPANIED BY TOUGH REFORMS -- REFORMS THAT ARE GOING TO BRING HOME THE HARDSHIP OF UNEMPLOYMENT, HIGHER FOOD PRICES AND INFLATION. WE ARE SEEING THIS ALREADY IN POLAND, WHERE THE GOVERNMENT HAS MOVED AHEAD WITH COMPREHENSIVE REFORM. THE COSTS ARE QUICKLY MOUNTING. UNEMPLOYMENT HAS JUMPED FROM 55,000 IN JANUARY TO MORE THAN 250,000, AND IS EXPECTED TO REACH A MILLION BY THE END OF THE YEAR.

THERE IS NO PERFECT MODEL FOR TRANSITION IN EASTERN EUROPE. WHAT IS HAPPENING THERE IS UNPRECEDENTED. BUT WHILE

THESE COUNTRIES FACE SIMILAR PROBLEMS, EACH WILL GO THROUGH A DIFFERENT TRANSITION PROCESS THAT REFLECTS ITS UNIQUE HISTORY AND ITS INDIVIDUAL TIES TO THE WEST.

PROFOUND TRANSFORMATION IS TAKING PLACE IN EAST GERMANY, HUNGARY, POLAND AND CZECHOSLOVAKIA, WHERE THE COMMUNIST PARTIES ARE IN FULL RETREAT. PROGRESS IN THESE "NORTHERN TIER" COUNTRIES HAS ALREADY BEEN BREATHTAKING -- FREE SPEECH, A RAPIDLY DEVELOPING FREE PRESS, STRICT LIMITATIONS ON THE FEARED INTERNAL SECURITY SERVICES. AND NOW, NEW POLITICAL PARTIES ARE TAKING CHARGE AND PUSHING FORWARD WITH FURTHER CHANGE.

THE FIRST OF THE FREE ELECTIONS THIS SPRING WAS A RESOUNDING VOTE FOR NON-COMMUNIST RULE. THOSE ELECTIONS, WHICH WERE HELD IN EAST GERMANY LESS THAN 4 WEEKS AGO, MARKED AN IMPORTANT STEP FORWARD FOR GERMAN UNIFICATION AND A MARKET ECONOMY. THE NEW POLITICAL LEADERS HAVE AGREED TO A COALITION GOVERNMENT THAT WILL MOVE AHEAD WITH UNIFICATION TALKS. THE

NEW GOVERNMENT IS EXPECTED TO BE PRESENTED TO THE NEW PARLIAMENT FOR APPROVAL TODAY.

THE COMMUNISTS ALSO FARED POORLY IN HUNGARY. IN THE FIRST FREE ELECTIONS SINCE WORLD WAR II, COMPLETED IN A SECOND ROUND THIS PAST WEEKEND, THE VOTERS WERE ABLE TO CHOOSE FROM A DOZEN POLITICAL PARTIES. THE PARTY MOST LIKELY TO LEAD THE COALITION GOVERNMENT IS STRONGLY NATIONALISTIC AND HAS PLEDGED TO MOVE AHEAD WITH ECONOMIC REFORM.

IN THE BALKANS, THE PROCESS OF TRANSFORMATION IS MORE COMPLICATED. POLITICAL OPPOSITION IS NOT WELL-DEVELOPED IN MANY OF THESE COUNTRIES. IN BULGARIA, FOR EXAMPLE, COMMUNISTS STILL STAND A GOOD CHANCE OF PLAYING A MAJOR ROLE IN THE GOVERNMENT, EVEN AFTER THE ELECTIONS WHICH ARE SCHEDULED TO TAKE PLACE IN JUNE. AND IN ROMANIA, SOME -- PARTICULARLY THE INTELLECTUALS AND STUDENTS -- ARE CONCERNED THAT THE NATIONAL SALVATION FRONT WILL SIMPLY REPLACE THE COMMUNIST PARTY AND NOT

OFFER THE HOPED-FOR CHANGE. WE HEAR MURMURINGS LIKE "THE REVOLUTION HAS BEEN HIJACKED." IN ETHNICALLY TROUBLED YUGOSLAVIA, A FIRST ROUND OF ELECTIONS WERE HELD THIS WEEKEND IN THE REPUBLIC OF SLOVENIA -- THE FIRST MULTI-PARTY ELECTIONS TO BE HELD IN THAT COUNTRY SINCE WORLD WAR II. THE RESULTS SO FAR INDICATE STRONG SUPPORT FOR SECESSION -- A THEME THAT IS LIKELY TO SPILL OVER INTO ELECTIONS LATER THIS MONTH IN THE NEIGHBORING REPUBLIC OF CROATIA. IN OTHER AREAS OF THE COUNTRY, THE POTENTIAL FOR ETHNIC UNREST REMAINS HIGH.

ETHNIC STRIFE PRESENTS OBSTACLES TO REFORM THROUGHOUT THE BALKANS. IN ROMANIA, STRAINS BETWEEN THE NEARLY TWO MILLION ETHNIC HUNGARIANS AND THE ROMANIAN MAJORITY IN TRANSYLVANIA HAVE ERUPTED INTO VIOLENCE. AND INDEED THAT VIOLENCE PLAYED A ROLE IN THE HUNGARIAN ELECTIONS, WHERE THE NATIONALIST PARTIES PROBABLY GAINED MORE VOTES THAN THEY WOULD HAVE BUT FOR THE VIOLENCE BEING EXPERIENCED BY THEIR COUNTRYMEN IN ROMANIA.

A KEY FACTOR FOR ALL OF EASTERN EUROPE HAS BEEN THE REMARKABLE CHANGE IN THE SOVIET UNION. THE SOVIET UNION SHARES THE CHALLENGES OF REFORM THAT THE EAST EUROPEAN COUNTRIES ARE FACING, AND IT TOO HAS ENTERED A NEW ERA OF ELECTIONS THAT ARE BRINGING UNPRECEDENTED CHANGE. GIVEN ITS TREMENDOUS SIZE AND CULTURAL DIVERSITY, ITS HISTORICAL AND POLITICAL EXPERIENCE, THE CHALLENGES FOR THE SOVIET UNION ARE EVEN GREATER.

THE CRISIS WE NOW SEE IN THE USSR WILL LIKELY BE DEEP AND PROLONGED. GORBACHEV'S REFORMS HAVE UNDERMINED THE STALINIST SYSTEM THAT HE INHERITED AND HAVE PUT THE SOVIET UNION ON THE ROAD TO A NEW POLITICAL SYSTEM, BUT THE NEW SYSTEM THAT HE IS TRYING TO CREATE IS NOT YET READY TO TAKE THE PLACE OF THE OLD ONE HE HAS DISCARDED. ECONOMIC CONDITIONS HAVE DETERIORATED. CRIME IS INCREASING. ETHNIC TURMOIL IS ESCALATING. AND NOW MOSCOW FACES PERHAPS ITS GREATEST CHALLENGE -- ATTEMPTS BY INDIVIDUAL STATES TO SECEDE FROM THE UNION.

WHAT WE SEE IN LITHUANIA IS A REPUBLIC THAT HAS TAKEN SPECIFIC STEPS TO SECEDE, AND IS STRUGGLING WITH MOSCOW IN PURSUIT OF THAT GOAL. THE SOVIET GOVERNMENT HAS RULED LITHUANIA'S DECLARATION OF INDEPENDENCE TO BE ILLEGAL, AND HAS MOVED TO ASSERT ITS CONTROL OF THE TERRITORY AND THE PRIMACY OF ITS LAWS. THE BATTLE FOR CONTROL OF KEY INSTITUTIONS ESCALATED LAST WEEKEND WHEN LITHUANIANS FORMED A HUMAN CHAIN TO PREVENT SOVIET TROOPS FROM ENTERING THE CENTRAL PRESS BUILDING IN VILNIUS. AND EARLIER THIS WEEK, GORBACHEV'S PRESIDENTIAL COUNCIL CALLED FOR FURTHER -- BUT UNSPECIFIED -- MEASURES TO BE TAKEN AGAINST THE REPUBLIC.

THE SITUATION IS TENSE, AND COOL HEADS ARE NEEDED ALL AROUND. THE FACT THAT THE EVENTS ARE BEING PLAYED OUT BEFORE AN INTERNATIONAL AUDIENCE CREATES ENORMOUS PRESSURE, ESPECIALLY FOR MOSCOW, AS THE WORLD WAITS TO SEE EXACTLY WHAT MEASURES MOSCOW WILL TAKE NEXT. THE WHITE HOUSE HAS URGED, AND

CONTINUES TO URGE, BOTH SIDES TO ENGAGE IN PEACEFUL NEGOTIATIONS.

ON THE ECONOMIC FRONT, PRESIDENT GORBACHEV HAS FOLLOWED UP PROMISES TO REDUCE DEFENSE SPENDING AND TO TRANSFER RESOURCES TO CONSUMER GOODS. AND FOR THE FIRST TIME SINCE THE 1920S, PRIVATE CITIZENS CAN NOW OWN SMALL FACTORIES AND BUSINESSES.

BUT THE QUESTION REMAINS WHETHER THESE STEPS AND OTHERS TO FOLLOW WILL SATISFY THE SOVIET PEOPLE. SO FAR ATTEMPTS TO HEAD OFF CONSUMER DISCONTENT HAVE MET WITH VERY LITTLE SUCCESS. GORBACHEV HAS SOME VERY UNHAPPY CONSUMERS ON HIS HANDS. SOME STATE ENTERPRISES HAVE GONE PRIVATE, BUT THEY CANNOT OBTAIN NEEDED SUPPLIES. THE PROBLEMS OF GETTING FOOD AND GOODS TO THE PEOPLE USING OUTDATED DISTRIBUTION SYSTEMS HAVE ONLY GOTTEN WORSE. WE BELIEVE THAT AT TIMES THE SOVIETS LOSE UP TO 40 PERCENT OF THEIR PERISHABLE AGRICULTURAL PRODUCTS ON THE POOR TRANSPORTATION NETWORK. TRAINS ARE DELAYED, AND HUNDREDS OF SHIPS WAIT IN THE HARBORS TO UNLOAD GRAIN.

ALL OF THIS UNDERSCORES WHAT THE REAL CHALLENGE FOR GORBACHEV WILL BE -- TO CREATE AN ECONOMIC ORDER AND A POLITICAL SYSTEM THAT WILL SATISFY CONSUMERS AND GIVE REPUBLICS AN INCENTIVE TO STAY IN THE UNION.

FOR THE INTELLIGENCE COMMUNITY, THE IMMEDIATE TASK IS TO LOOK AT THE DECREASE IN THE SOVIET AND WARSAW PACT THREAT TO EUROPE. OVER THE LAST YEAR THE SOVIETS HAVE UNILATERALLY REDUCED THEIR FORCES IN EASTERN EUROPE, AND BY MID-1991 SOVIET TROOPS WILL HAVE WITHDRAWN COMPLETELY FROM HUNGARY AND CZECHOSLOVAKIA.

WE ARE GOING INTO A NEW WORLD OF SECURITY CONCERNS, AND PRESIDENT BUSH HAS ASKED US TO LOOK AT THE CHANGING NATURE OF THE THREAT AND TO DETERMINE JUST HOW IT AFFECTS OUR NATIONAL SECURITY. THE SOVIET UNION REMAINS A NUCLEAR SUPERPOWER, ABLE TO REACH ALL ITS TARGETS. STRATEGIC FORCES CONTINUE TO BE MODERNIZED, AND THEIR MILITARY RESEARCH AND DEVELOPMENT

PROGRAMS CONTINUE TO RECEIVE GENEROUS FUNDING. UNDERSTANDING SOVIET INTENTIONS AS WELL AS SOVIET CAPABILITIES WILL REMAIN A MAJOR INTELLIGENCE PRIORITY.

AND IN THE 1990S, THE SOVIET UNION IS NOT THE ONLY COUNTRY POSSESSING LETHAL TECHNOLOGY. NATIONS AROUND THE WORLD ARE BUILDING UP THEIR OWN ARSENALS. THE PROLIFERATION OF NUCLEAR, CHEMICAL, AND BIOLOGICAL WEAPONS POSE SERIOUS DANGERS TO REGIONAL STABILITY AND TO THE INTERESTS OF THE UNITED STATES.

THE INTELLIGENCE COMMUNITY HAS BEEN PLAYING A VITAL ROLE IN PROVIDING OUR POLICYMAKERS WITH INFORMATION ABOUT THE PLANS, INTENTIONS, AND CAPABILITIES OF COUNTRIES INVOLVED IN PROLIFERATION. IN FACT, I THINK WE HAVE BEEN WELL AHEAD OF THE CURVE IN THIS RESPECT. WE HAVE BEEN IN A POSITION TO HELP IDENTIFY ILLEGAL SHIPMENTS OF PRECURSORS, EQUIPMENT, AND TECHNICAL ASSISTANCE BETWEEN COUNTRIES.

THIS HAS MADE IT POSSIBLE TO IDENTIFY COUNTRIES WE BELIEVE POSSESS CHEMICAL WEAPONS PROGRAMS. IT HAS ENABLED OUR GOVERNMENT TO BE ALERT TO ATTEMPTS BY NATIONS TO CIRCUMVENT INTERNATIONAL LAW AND COMPACTS AND OBTAIN MATERIALS TO PURSUE THEIR OWN PROGRAMS.

THERE IS A GREAT NEED FOR INTERNATIONAL COOPERATION TO CONTROL THE SPREAD OF LETHAL TECHNOLOGY. COUNTRIES ARE AGGRESSIVELY SEEKING TO OBTAIN WHAT THEY NEED BY CLANDESTINE MEANS, MAKING THE PROCUREMENT PROCESS EXTREMELY COMPLEX. THEY ARE USING FRONT COMPANIES, FALSIFICATION OF EXPORT DOCUMENTS, AND MULTIPLE TRANSSHIPMENT POINTS. WE ARE ALSO FINDING THAT REGULATIONS ARE BEING CIRCUMVENTED BY ORDERING EQUIPMENT OR MATERIAL THAT IS JUST BELOW THE EXPORT GUIDELINES BUT WHICH, IN THE AGGREGATE, WOULD BE SUBJECT TO CONTROLS.

IN ITS EFFORTS TO BRING AN END TO CHEMICAL WEAPONS, THE U.S. GOVERNMENT HAS BEEN VERY ACTIVE IN PROMOTING A GLOBAL BAN

ON THESE WEAPONS. PRESIDENT BUSH GAVE THIS BAN MOMENTUM WHEN HE PROPOSED IT BEFORE THE UNITED NATIONS GENERAL ASSEMBLY LAST SEPTEMBER. ALSO IN SEPTEMBER, SOVIET FOREIGN MINISTER SHEVARDNADZE AND SECRETARY OF STATE BAKER SIGNED A MEMORANDUM OF UNDERSTANDING FOR CHEMICAL WEAPONS DURING THEIR MEETING AT JACKSON HOLE. THIS M.O.U. ALLOWED FOR THE EXCHANGE OF INFORMATION ON STOCKPILING AND LOCATION OF CHEMICAL WEAPONS IN BOTH THE UNITED STATES AND THE SOVIET UNION.

THE M.O.U. WAS ALSO SIGNED AS AN IMPETUS FOR ALL THE NATIONS WHO HAVE CHEMICAL WEAPONS TO JOIN THE DRIVE FOR A GLOBAL TREATY. THERE ARE ABOUT 20 NATIONS TODAY WHO ARE DEVELOPING THESE WEAPONS BUT ONLY A FEW HAVE ACKNOWLEDGED POSSESSION.

THE U.S. AND THE SOVIET UNION ARE ALSO UNDERTAKING ANOTHER BILATERAL INITIATIVE. THIS TIME IT IS FOCUSED ON ELIMINATING ADDITIONAL CW STOCKPILES IN BOTH COUNTRIES. THE OBJECTIVE,

AGAIN, WOULD BE BUILDING CONFIDENCE IN A WORLDWIDE TREATY.

BUT EVEN IN THE EVENT SUCH AN ACCORD IS REACHED, THE MONITORING OF THIS TREATY FOR VERIFICATION -- LARGELY AN INTELLIGENCE ROLE -- WILL POSE UNIQUE PROBLEMS. MUCH OF THE TECHNOLOGY THAT IS USED IN THE PRODUCTION OF CHEMICAL AND BIOLOGICAL WEAPONS HAS DUAL-USE -- IT CAN BE USED IN THE LEGITIMATE PRODUCTION OF COMMERCIAL GOODS. FOR THAT REASON, MUCH OF THIS MATERIAL IS NOT DIFFICULT TO OBTAIN AND IT IS MORE DIFFICULT YET TO ASSESS THE INTENTIONS OF THOSE WHO ARE TRYING TO ACQUIRE IT.

LET ME TURN TO ANOTHER INTELLIGENCE ISSUE THAT HAS GLOBAL IMPLICATIONS FOR THE FUTURE.

MUCH OF WHAT IS HAPPENING IN THE WORLD DERIVE FROM ECONOMIC FORCES THAT INFLUENCE POLITICAL, MILITARY, AND ENVIRONMENTAL DECISIONS AND ATTITUDES IN A WORLD OF INCREASINGLY INTERRELATED COUNTRIES. THE ECONOMIC SYSTEMS THAT ARE DESIGNED TO DEAL WITH

THIS PHENOMENON INCREASINGLY GENERATE ISSUES OF NATIONAL SECURITY DIMENSIONS. THE INCREASING INTEGRATION OF THE WORLD'S FINANCIAL MARKETS, FOR EXAMPLE, IS A REVOLUTIONARY STRUCTURAL CHANGE IN THE GLOBAL ECONOMY. TRADITIONAL DISTINCTIONS HAVE BEEN BLURRED BETWEEN DOMESTIC AND INTERNATIONAL MARKETS, BETWEEN THE DIFFERENT KINDS OF FINANCIAL TRANSACTIONS, AND BETWEEN WHO IS A MARKET PARTICIPANT AND WHO IS NOT.

THE TRANSFORMATION OF INTERNATIONAL FINANCIAL MARKETS IS CLEAR WHEN YOU LOOK AT THE NUMBERS: THE NUMBER OF INTERNATIONAL BANKS IS NOW IN THE HUNDREDS, AND FOREIGN EXCHANGE TRANSACTIONS EXCEED 300 BILLION DOLLARS PER DAY. ONE WEEK OF FUNDS TRANSFERRED ON THE INTERNATIONAL MARKET IS LARGER THAN THE SIZE OF THE THIRD WORLD DEBT.

THIS "GLOBALIZATION" OF FINANCIAL MARKETS HAS CREATED A HIGHLY FLUID SITUATION IN WHICH POLITICAL AND ECONOMIC DEVELOPMENTS IN ONE AREA CAN QUICKLY INFLUENCE FINANCIAL

DEALINGS AROUND THE GLOBE. AND WITH IT HAS COME THE GREATER USE OF THE FINANCIAL SYSTEM BY GOVERNMENTS AND GROUPS WHOSE OBJECTIVES THREATEN OUR NATIONAL SECURITY INTERESTS. NARCOTICS MONEY LAUNDERING, TERRORIST ACTIVITIES, GRAY ARMS PURCHASES, AND TECHNOLOGY AND EQUIPMENT NEEDED FOR PROLIFERATION ACTIVITIES ARE INCREASINGLY FUNDED THROUGH THE WORLD'S FINANCIAL MARKETS, WHICH OFFER THEM SPEED, EASE, AND ANONYMITY.

AS THE 21ST CENTURY APPROACHES, IT IS CLEAR THAT ECONOMIC CONSIDERATIONS ARE INCREASINGLY TIED TO NATIONAL SECURITY ISSUES. THERE IS NOW UNIVERSAL RECOGNITION THAT ECONOMIC STRENGTH IS KEY TO GLOBAL INFLUENCE AND POWER.

OUR POLICYMAKERS ARE VERY INTERESTED IN THE COMPETITIVENESS OF THE UNITED STATES IN THE GLOBAL MARKET. IN RECENT YEARS, JAPAN AND OTHER ECONOMIC COMPETITORS HAVE MADE GREAT STRIDES IN HIGH-TECH INDUSTRIES IN WHICH THE UNITED STATES HAS LONG HELD THE LEAD. TELECOMMUNICATIONS AND DATA PROCESSING ARE JUST TWO

OF THE AREAS IN WHICH OTHER INDUSTRIALIZED NATIONS HAVE GROWN INCREASINGLY COMPETITIVE.

IN HIGH TECHNOLOGY AND VIRTUALLY EVERY ECONOMIC AREA, U.S. POLICYMAKERS ARE LOOKING AT THE STRATEGIES OF OUR ECONOMIC COMPETITORS AS WELL AS EFFORTS BY FOREIGN GOVERNMENTS TO TARGET MARKETS AND FINANCE RESEARCH, DEVELOPMENT, AND PRODUCTION. THEY ARE WORKING THROUGH GATT AND BILATERAL TALKS TO IDENTIFY PROTECTIONIST MEASURES AND OTHER BARRIERS TO REDUCING TRADE IMBALANCES. AND INCREASINGLY, THEY ARE RELYING ON INTELLIGENCE TO ILLUMINATE THE PLAYING FIELD -- AND TO UNDERSTAND THE RULES OTHER NATIONS ARE PLAYING BY.

THROUGHOUT THE NEXT DECADE, WE WILL CONTINUE TO SEE AN INCREASED EMPHASIS ON ECONOMIC COMPETITIVENESS AS AN INTELLIGENCE ISSUE. BUT I WANT TO MAKE THE POINT THAT ECONOMICS IS NOT A NEW AREA FOR INTELLIGENCE BUT WE ARE TAKING SIGNIFICANT STEPS IN COLLECTION AND ANALYSIS TO STAY AHEAD OF

THE CURVE. WHAT WE ARE SEEING NOW IS A GROWING RECOGNITION THAT ECONOMIC SECURITY IS PART OF OUR NATIONAL DEFENSE.

AS WE EXAMINE THE ISSUES OF THE 1990S, FLEXIBILITY WILL BE THE KEY. INTELLIGENCE SUPPORT FOR CURRENT DEVELOPMENTS AND EVEN CRISIS MANAGEMENT WILL BE CRITICAL. FINITE RESOURCES AND TECHNOLOGY, INCLUDING OUR PRECIOUS HUMAN RESOURCES, MUST BE ADAPTED AND APPLIED IN THE MOST EFFECTIVE MANNER TO PROTECT AND ENHANCE OUR IMMEDIATE NEAR-TERM AND LONG-TERM REQUIREMENTS AS WE HELP THE POLICYMAKERS REACH WISE DECISIONS BASED ON SOUND INTELLIGENCE. BOTH THE PRESIDENT AND CONGRESS RECOGNIZE THIS NEED AND ARE WORKING WITH US TO ENSURE THAT WE HAVE THE MEANS.

LAST SUMMER -- BEFORE THE MAJOR CHANGES OF THE LAST SIX MONTHS -- I CREATED A NEW OFFICE UNDER A DEPUTY DIRECTOR TO COORDINATE OUR STRATEGY FOR IDENTIFYING AND COPING WITH CHANGING REQUIREMENTS FOR INTELLIGENCE IN A CHANGING WORLD. ALL OF OUR SENIOR MANAGERS ARE INVOLVED. INTELLIGENCE

COLLECTION WILL NOT CONTINUE TO HAVE VALUE, UNLESS IT IS
TIMELY, USEFUL, AND OBJECTIVE.

THIS STRATEGIC PLANNING WILL REACH INTO ALL LEVELS OF THE
INTELLIGENCE BUSINESS AND WILL BRING TOGETHER THOSE WHO
IDENTIFY THE ISSUES WITH THOSE WHO ARE ASKED TO COLLECT THE
INFORMATION. IT WILL ALSO HELP US IDENTIFY WHAT THE KEY ISSUES
ARE LIKELY TO BE IN THE 1990S, NOT ONLY WITHIN OUR OWN
ORGANIZATION BUT FOR THE POLICY COMMUNITY.

WE HAVE , FOR INSTANCE, ALREADY BROUGHT PEOPLE TOGETHER IN
A TASK FORCE ON INTERNATIONAL ECONOMICS AND ANOTHER ON
PROLIFERATION -- THE TWO TOPICS I SPOKE TO YOU ABOUT TODAY.

WE HAVE ALSO BEEN MOVING TO COMBINE EXPERTISE FROM
THROUGHOUT THE INTELLIGENCE COMMUNITY TO ADDRESS COMMUNITY
ISSUES. THE CENTERS WE HAVE ESTABLISHED IN COUNTERTERRORISM,
COUNTERINTELLIGENCE, AND COUNTERNARCOTICS ARE INTELLIGENCE
COMMUNITY CENTERS AND COMBINE THE ANALYTICAL AND OPERATIONAL

EXPERIENCE OF A NUMBER OF DIFFERENT AGENCIES, BROUGHT TOGETHER TO ADDRESS A KEY CONCERN.

WE HAVE A SAYING THAT WORLD CONDITIONS ARE MOST DANGEROUS WHEN THEY ARE LEAST PREDICTABLE. THAT IS WHAT INTELLIGENCE IS ALL ABOUT. WE WILL NOT ALWAYS KNOW. WE WILL NOT ALWAYS PREDICT CORRECTLY. SOMETIMES OUR ANTAGONISTS DO NOT KNOW THEIR OWN INTENTIONS. BUT TO THE EXTENT WE CAN APPLY OUR EXPERTISE IN COLLECTION AND ANALYSIS -- TO THE EXTENT WE CAN APPLY OUR RESOURCES ON THE EARTH, IN THE SEA, AND IN THE SKY -- TO DETECTING AND UNDERSTANDING CHANGE, WE WILL REDUCE THAT DANGER AND HELP TO MAKE THIS A BETTER AND SAFER WORLD.

I WONDER WHAT MY GRANDAUGHTER WILL BE ABLE TO TELL HER CHILD ABOUT WHAT HAPPENED AFTER THE WALL CAME DOWN. THESE ARE MOMENTOUS TIMES. I HOPE HISTORY WILL RECORD THAT WE WERE EQUAL TO THE CHALLENGES AND THAT WE DID INDEED STAY AHEAD OF THE CURVE.

**TESTIMONY OF THE HONORABLE
D. ALLAN BROMLEY**

**DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT**

BEFORE THE

**COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE
WASHINGTON, D. C.**

Wednesday, May 23, 1990 -

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DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
BEFORE THE
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Mr. Chairman, I am pleased to have this opportunity to appear before your committee to discuss this Administration's views on U.S. industrial competitiveness and the Administration's policy regarding technology and competitiveness. The whole issue of the competitiveness of our national industrial base is of paramount concern to me, as it is to many others in the Administration and our respected associates in Congress. There are few issues more important for us to address jointly than U.S. economic competitiveness. On any number of occasions, I have stated clearly my intentions to work cooperatively with Congress on such matters.

There is general agreement today that global competitiveness and national security are tightly interwoven in that our national defense posture depends on our continuing economic vitality. We are in an era when international economic competition poses a formidable challenge, and the Administration is taking a number of actions to respond to that challenge. We, in this Administration, believe it is essential that we recognize and use the strengths of our economic system more effectively to remain competitive while at the same time refraining from actions that might distort our basic system of free enterprise which is our ultimate strength.

One of our greatest strengths is our infrastructure for research and development. We have a culture that prizes innovation, a university system superior to all others, an open and hospitable society that attracts the best scientific minds and inventive talents of the world, a business climate that encourages innovative enterprises, and a financial system that provides the opportunity for such new enterprises to grow quickly into major businesses. Historically, private industry in this country has proved itself the best in the world at converting the results of basic research into commercially successful products. Thus, it is not surprising that our technology base is the strongest in the world. We lead wherever innovative technology is more critical than production efficiency.

Important as the role of technology may be, however, a successful national strategy in industrial competitiveness cannot be based on it alone. Our strength in technology has not prevented a steady erosion in our market share in many industries. **As each segment of these businesses matures, the advantage quickly shifts from the innovator to the efficient producer.** Many people would argue that the Japanese are the most efficient producers in the world today. Many factors have contributed to Japan's success as a producer, but none is more important than its persistently high rate of investment. Nor is Japan the only example where a high rate of capital investment pays off. The U.S. is also being seriously challenged in the

high technology sectors by ascendent Pacific Rim countries and by a rejuvenated Europe. However, with its proven human resources and successful tradition in manufacturing, the U.S. can meet this challenge. But, to do so, all elements of our society must be willing to recognize that while we possess many strengths and assets, problems do exist, and that we must, and can, mobilize our resources and solve them.

Many analyses imply that our problems in competitiveness reside entirely in the areas of manufacturing and process. They don't. They may show up in these areas, but they originate in much deeper structural problems that are not going to be easily resolved. Some of the weaknesses--some perceived and some real--of the U.S. system in international competition would include:

- o The cost of capital in the United States is higher than for our major competitors, and there is an emphasis on short-term returns on investments;
- o There is a reduced willingness to take technological risks, especially in large corporations and in the financial community;
- o Other countries are outperforming the United States in transforming research discoveries into high-quality products and into processes for designing, manufacturing, marketing, and distributing these products;
- o Our international trade policy does not require reciprocity in market access or government treatment of private companies between the U.S. and its primary foreign competitors;
- o The quality of the technical workforce is declining in terms of education, training, and the flexibility to adapt to technological change;
- o There is a lingering wariness of antitrust measures that inhibits company-to-company cooperation, as well as a negative attitude in some U.S. corporations toward technologies developed elsewhere; and
- o The coupling between federal laboratories and industry is weak, particularly with small- and mid-sized companies that could benefit most from federal assistance, and too often, an attitude of mutual distrust exists that inhibits any effective cooperation between industry and government.

As you can tell from this partial list, there will be no facile, short-term solutions to our competitiveness challenge. The problems are multifaceted and complex. If these problems are to be solved, actions must be taken on many fronts

involving all components of our society. For the Federal Government, the challenge is to develop and exercise intelligent and visionary leadership emphasizing the long-term economic vitality of the nation.

Incentives for the Private Sector

The Federal Government faces a wide range of options in moving to bolster our economic competitiveness that do not necessarily fall into the stark categories of massive government subsidies of favored industries on the one hand and a total "hands off" approach by the Federal Government on the other. At OSTP, we strongly believe that the real choices lie in another direction, and we have been working within the Administration to promote some of these options.

First and foremost, on the broadest level the government has the responsibility to foster a macroeconomic climate that makes it possible for industry to invest in the technology development and manufacturing processes that it needs to remain competitive. This means bringing down the federal budget deficit and reducing the cost of capital. This has been a top priority of the Bush Administration and remains so today.

Fiscal and monetary policies can be used in other ways to encourage private R&D investment. For example, the Bush Administration is working to reduce the capital gains tax and make permanent and enhance the tax credit for research and experimentation. Appropriate taxing policies for investments in equipment and instrumentation can also provide important incentives for our industries.

A more favorable legal environment is another important factor. The Bush Administration, for example, has recently proposed changing antitrust laws to allow companies to enter more easily into joint production ventures and to abolish punitive damage awards which increase, immeasurably, the financial risk to companies entering into such ventures. These collaborations, from R&D through joint precompetitive ventures, provide a means for companies to share risk and pool resources, and they are common in other countries. Ironically, they are also common between U.S. firms and foreign firms. But this country has been slow in adjusting to the new reality that we are now competing in a global marketplace, and new mechanisms need to be found that allow companies and the Federal Government to work together to better meet this competition.

Similar legal changes can be made in patent law, where better international protection of intellectual property will allow more benefits to be recovered from R&D investments made in the United States. Government regulation can shape not only a company's domestic markets, but also its international markets through the degree of harmonization between regulations here and abroad.

Education and Training

The second area where the Federal Government is a major player is education and training. We need to strengthen our entire educational process to ensure that those entering the workplace will have the necessary knowledge, comprehension, and problem solving skills for the highly technical content of the daily living and working environment of the future. We also need to ensure that industry will have a plentiful supply of talent at all levels. Critical among industry concerns is the anticipated shortfall of scientists, engineers, and technicians.

The President's Education Summit was intended to catalyze a national consensus on improving education, including science and mathematics education. One of the national goals that emerged from this summit states that: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement." Achieving such a goal will require a broad-based approach involving business, academia, educational organizations, and state and local governments.

The Federal Government, itself, must assume an effective and appropriate role in supporting the states, localities, and universities as they improve science and technology education. In this effort, a particular emphasis must be placed on improving our educational capabilities related to manufacturing technology. The Administration's current budget proposal to Congress for fiscal year 1991 would result in direct expenditures of over \$1.5 billion for science and mathematics education activities in five Federal agencies. These programs are in addition to the training provided to thousands of graduate students supported through Federal competitive R&D grants programs.

Federal R&D Responsibilities

Investments in research and development (R&D) provide both direct and indirect productivity benefits for society. R&D yields new knowledge, processes, technologies and products that, over the long term, result in economic growth and improved quality of life for all Americans.

Traditionally, the Federal Government has supported R&D for two reasons: first, to meet its own direct needs -- where it is the principal consumer -- such as defense and civil space related R&D; and, second, to meet broader national needs such as new and better means of providing health care, agricultural productivity, and pollution clean-up.

In the first case where the Federal Government is the ultimate consumer for the R&D results, funding levels and decisions are made on the basis of Government objectives, needs, and requirements. However, the Government relies principally on the private sector to undertake the development process and encourages these activities to be managed in such a way to optimize commercial applications of the R&D as well.

The second category of R&D requires Federal support either in the interests of the public welfare or because the private sector is without sufficient incentives to capture enough of the benefits to make private R&D investments worthwhile. Federal support for basic research, especially at universities, is the prototypical, essential investment in the Nation's scientific and technological future, including its future scientists and engineers. This Administration has proposed increasing support for basic research by \$1 billion, or 8 percent, to over \$12 billion in FY 1991. Indeed, the Administration's budget proposes to allocate a total of over \$71 billion for all R&D, including basic research and research facilities in FY 1991, an increase of \$4.5 billion or 7 percent over FY 1990 levels. Within this total, civilian R&D would increase by 12 percent and defense related R&D would increase by 4 percent.

In particular, of the approximately \$15 billion proposed for civilian applied research and development support, over \$1.5 billion would be allocated to developing advanced technologies such as robotics, high performance computing, and semiconductor technologies. On the defense side, the Department of Defense technology base budget proposal including the DARPA budget (\$1.1 billion) but excluding SDI funding, requests nearly \$5.6 billion for fundamental basic, applied and developmental research that underpins our future defense systems. The major areas of defense funding include high definition display technology, manufacturing and materials technology, artificial neural network technology, and support for SEMATECH which focuses on electronics technologies. Thus, it is clear that the Federal Government currently supports a great deal of technology development; and it should also be recognized that previous Federal R&D investments have been very successful in developing technologies required for defense, space, and other important civilian applications related to agriculture, health, and aeronautics.

This Administration believes the federal government should continue to participate with the private sector in developing generic, enabling technologies that are important in both governmental and commercial applications. These technologies have a wide variety of commercial applications; however, no single company can capture enough of their benefits to justify investing an adequate amount of R&D in them. The rationale for investing in these enabling technologies is essentially the same as that for investing basic research: individual companies cannot bear the cost and risk of such investments alone. Examples include certain materials technologies (such as superconductivity), information technologies (such as high performance computing), and biotechnologies (such as scaled-up bioprocesses).

In a speech to the American Electronics Association in March, President Bush pointed to the importance of these technologies. He said, "This Administration is committed to working with you in the critical precompetitive development stage where the basic discoveries are converted into generic technologies that support both our economic competitiveness and our national security. Here again we can help to level the international playing field on which you compete."

Transfer of Federally Funded Technology

Technology development by the federal government is one contributor to our international competitiveness, but of course it is far from the only one. Even the other federal actions I mentioned earlier cannot guarantee our international industrial standing. Only industry itself, can do that. However, technology transfer from our Federal laboratories to the private sector, particularly to small and medium sized businesses, can also make a contribution to our economic growth.

Technology transfer has become part of the international vocabulary; but that label is fundamentally misleading. It suggests that a specific technology can be identified, isolated and packaged at one place; e.g., where it was developed--then transferred to an entirely different place where it can be unpackaged, implemented and exploited in an entirely different environment. Nothing could be farther from the truth.

Technology is only transferred from, by and to adequately trained persons and it is essential that our technology transfer system have an adequate base of trained personnel prepared to move with the technology, and to accept and implement it at the receiving end.

The United States has created and nurtured the finest research and development establishment in the world through its combination of government, university and industrial laboratory systems. The Federal Government's laboratories, in particular, embrace an astonishing breadth and depth of the best science and technology to be found. This base of knowledge represents one of our most valuable national assets. However, a technology base is unlike many other assets: it must be put to use in order to be valuable. This Administration believes the Government must make R&D activities at Federally-supported laboratories more relevant and accessible to the private sector, and, that such efforts should be guided by the potential users.

The Federal Government has a relatively poor track record where it has invested in civilian technology without close involvement at the outset from potential users. If U.S. industry wants government assistance and is willing to co-invest, there is some hope for success. But if industry does not perceive the need, or, is not interested, there is little point in the government's engaging in technology push. That is a lesson we have learned from past history [and we should try to avoid similar mistakes in the future.] Thus, in order for industry-government cooperation--that we have been talking about for years--to become a reality, we need articulate and statesmanlike leadership from industry to set appropriate objectives for the cooperative endeavors of industry-Federal Laboratory-university consortia.

The Federal government, in turn, will actively promote and encourage the formation of industry-Federal and industry-Federal-university consortia as well as facilitate the access by U.S. industry to Federal Laboratories within the broad, flexible Federal guidelines established by previous legislation and will develop

mechanisms to expedite the diffusion of the results of Federally supported R&D to industry, including active licensing of inventions and removing barriers to commercial development and marketing of Federally developed computer software.

Technology transfer is, and will continue to be, an integral part of every Federal laboratory's mission regardless of the specific research projects undertaken. Many Federal research programs are undertaken primarily to meet Federal program needs, not to develop technology, per se. However, Federal laws and policies now in place make it the responsibility of every Federal technology manager--defense or civilian--to consider the commercial ramifications of the work they are supporting and to try to encourage its commercial potential. Obviously, some research has more technology development/transfer potential than others. Examples include research to promote alternative sources of energy, biomedical research, space exploration, robotics, superconductivity, and semiconductor research.

A particular example of a mission-oriented technology transfer initiative is the Department of Energy's (DOE) Precision Manufacturing Technology (PMT) Program. This program will transfer back to U.S. industry modern technological methods and skills for precision fabrication of discreet parts made from metals and advanced materials. In return, DOE will then have the ability to procure from U.S. sources products requiring such advanced technologies for manufacture.

Each of the Federal agencies also has a variety of directed initiatives in mission areas already underway and are planning others. For example, today we have roughly 200 active cooperative research and development agreements between the Federal laboratories and private companies which indicates that the companies involved believe in the potential commercial viability of the technology they are co-developing. We are also beginning to see some remarkable collaborative arrangements: the \$11 million DuPont/Hewlett-Packard/Los Alamos National Laboratory joint venture in high temperature superconducting materials and applications, in which the two companies are investing over \$7 million, is a good illustration of these new arrangements. Another unusual joint research effort is the Biotechnology Research and Development Consortia involving the University of Illinois, a U.S. Department of Agriculture laboratory, the State of Illinois, and six different U.S. companies.

Other Federal programs are explicitly designed and undertaken with private sector interests clearly in mind. A number of these are managed by the National Institute of Standards and Technology (NIST) which has a mission to support programs serving business and industry. NIST research programs with substantial civilian technology development/transfer potential include a measurements, reference data, standards research and services program as well as a new Advanced Technology Program aimed at assisting business in developing precompetitive, generic technologies; and an Advanced Manufacturing Program intended to increase the dissemination of new manufacturing technologies within industry, particularly small business.

NIST's measurement and standards program is particularly valuable to the nation's high technology businesses because they rely for commercial success on the existence of a common technological infrastructure which includes test methods, measurements, evaluated data, and standards of execution and performance. The fundamental research conducted by NIST in collaboration with industry provides this reference base.

The high technology industry's requirements for new measurements and standards, however, are changing at an ever increasing pace so that there now no longer only exists industry without adequate measurements and standards, but there also exists entirely new technologies for which there is no standards base at all. Without these common national standards, U.S. firms will continue to struggle to compete with foreign firms that are producing high quality products embodying new technology at competitive prices. The Federal government should, therefore, manage the measurements and standards process of the National Institute for Standards and Technology in such a way as to promote the integration of a new technological infrastructure with the existing U.S. industrial infrastructure. Then, our high technology industries can compete more effectively in the international arena.

State Activities

Technology outreach and technology transfer initiatives at the state and regional levels are playing an increasingly important, cost-effective role in helping U.S. businesses--especially small businesses--regain their competitive edge. Unlike the Federal Government, the states can pick specific industries to support, based on their own histories, policies, and local goals. These state activities take a variety of forms, including direct technology transfer programs, university-based research programs, R&D grant programs, research parks, financial assistance programs, technical and managerial services, incubator facilities, R&D tax incentives, and worker training assistance.

The Federal Government should be aware of these activities and should assist and encourage states to develop programs that take into account the individual state characteristics. Federal programs in such areas as education, training, the national infrastructure, and regional generic technology centers should, where appropriate, leverage state initiatives in a timely way to optimize their effectiveness.

The Federal Government should also bring together state, private, and academic elements to solve problems and take advantage of opportunities where they occur. In some instances, this will require funding (often matching) and other services for problems and opportunities that transcend state boundaries. And, finally, the Federal Government should provide a focus for information from the highly successful local programs that could be transferred to areas in other states that need to initiate similar activities.

Currently, there are three major Federal programs, implemented through the Department of Commerce that interact directly with state and local technology initiatives. The Boehlert-Rockefeller Extension Program provides technical assistance to state technology outreach programs throughout the U.S. to help small and medium-sized businesses identify, access, and apply appropriate Federal technology to the solution of their technological problems.

The new Advanced Technology Program (ATP) will assist U.S. businesses in accelerating the early to mid-stage development of generic technologies that have the potential to modernize manufacturing or to commercialize more rapidly significant new scientific discoveries. It will aide and leverage companies entering into contracts, cooperative research agreements and joint ventures, and, when appropriate, help involve specific Federal laboratories in such agreements.

The Regional Manufacturing Technology Centers (MTC) program is designed as a technology transfer operation designed to breakdown the barriers faced by small and medium-sized manufacturers in adopting new technology by working with individual local manufacturers, community colleges, and technical institutes to determine individual technology needs, develop technology upgrade plans and train the local workforce in the use of these new manufacturing tools and methods.

Finally, the Department of Commerce is currently developing a plan to make available through its Clearinghouse on State and Local Initiatives in Productivity, Technology and Innovation all information it has obtained on the various state and local initiatives relating to technology. Future plans involve a more efficient and wide-spread collection and dissemination of such information as well as more efficient means for interested parties to access this data base.

This completes my prepared statement. However, I would like to reemphasize that I believe investing in new technologies is a necessary, but not a sufficient condition for achieving international industrial competitiveness. As we get further into developing effective policies and programs for technology advancement in this nation, we should frequently remind ourselves of that fact. I believe we must all keep in mind other factors – economic, educational, fiscal regulatory, and cultural – that we must influence at the same time if we are to maintain our current position in world markets as well as return, in the not too distant future, to the more dominant position that this nation has enjoyed for so many years.

At the risk of repeating myself, I want to reiterate that the challenge for the Federal Government at this time is to develop, stimulate, and exercise intelligent and visionary leadership that emphasizes long-range U.S. economic vitality over special interests. And, above all, by its words and actions, the Federal Government must make clear to all, and particularly to the U.S. industrial community, that the issue of U.S. industrial competitiveness is among the very highest of its priorities for the 1990's.

ORAL STATEMENT OF THE HONORABLE
D. ALLAN BROMLEY
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
BEFORE THE
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE
WASHINGTON, D. C.

May 23, 1990

Mr. Chairman, I am pleased to have this opportunity to appear before your committee to discuss this Administration's views on U.S. industrial competitiveness and the Administration's policy regarding technology and competitiveness. The whole issue of the competitiveness of our national industrial base is of paramount concern to the Administration as well as to you in Congress. There are few issues more important for us to address jointly than U.S. economic competitiveness.

There is general agreement today that global competitiveness and national security are tightly interwoven in that our national defense posture depends on our continuing economic vitality. We are in an era when international economic competition poses a formidable challenge, and the Administration is taking a number of positive actions to respond to that challenge. We, in this Administration, believe that it is essential that all the actions the Federal Government takes, recognize and use the strengths of our economic system more effectively to remain competitive while at the same time refraining from actions that might distort our basic system of free enterprise which is our ultimate strength.

One of our greatest strengths is our infrastructure for research and development. We have a culture that prizes innovation, a university system superior to all others, an open and hospitable society that attracts the best scientific minds and inventive talents of the world, a business climate that encourages innovative enterprises, and a financial system that provides the opportunity for such new enterprises to grow quickly into major businesses. Thus, it is not surprising that our technology base is the strongest in the world. U.S. companies lead wherever innovative technology and a fast response time is the critical feature of business success.

Important as the role of technology may be, however, a successful national strategy in industrial competitiveness cannot be based on it alone. Our strength in technology has not prevented a steady erosion in our market share in many industries. As each segment of these businesses matures, the advantage quickly shifts from the innovator to the efficient producer. Many people would argue that the Japanese are the most efficient producers in the world today. Many factors have contributed to Japan's success as a producer, but none is more important than its persistently high rate of capital investment.

Many analyses imply that our problems in competitiveness reside entirely in the areas of manufacturing and process. I do not believe they do. They may show up in these areas, but they originate in much deeper structural problems that are not going to be easily resolved. To mention a few weaknesses of the U.S. system in international competition:

- The cost of capital in the United States is higher than for our major competitors due to low investments and high Federal budget deficits;
- There is an emphasis on short-term returns on investments by U.S. firms and a reduced willingness to take technological risks, especially in large corporations and in the financial community;

- The quality of the technical workforce is declining in terms of education, training, and the flexibility to adapt to technological change;
- There is a lingering wariness of company-to-company cooperation brought about by antitrust legislation, as well as a negative attitude in some U.S. corporations toward technologies developed elsewhere.

As you can tell from this partial list, there will be no facile, short-term solutions to our competitiveness challenge. The problems are multifaceted and complex. If these problems are to be solved, actions must be taken on many fronts involving all components of our society. For the Federal Government, the challenge is to develop and exercise intelligent and visionary leadership emphasizing the long-term economic vitality of the nation.

My prepared statement covers a number of the activities that the Bush Administration has supported over the past 16 months which we believe can enhance U.S. economic competitiveness. I will not go through them all today - except to say that they cover the spectrum of activities usually associated with an appropriate role of the Federal Government in technology areas.

The Federal Government faces a wide range of options in moving to bolster our economic competitiveness that do not necessarily fall into the stark categories of massive government subsidies of favored industries on the one hand and a total "hands off" approach by the Federal Government on the other. This Administration strongly believes that the real choices lie in other directions.

First and foremost, on the broadest level the government has the responsibility to foster a macroeconomic climate that makes it possible for industry to invest in the technology development and manufacturing processes that it needs to remain competitive. I have called this "Incentives for the Private Sector". This means bringing down the federal budget deficit and reducing the cost of capital. This has been a top priority of the Bush Administration and remains so today.

Fiscal policies can be used in other ways to encourage private R&D investment. For example, the Bush Administration is working to reduce the capital gains tax and make permanent and enhance the tax credit for research and experimentation. In my statement I have detailed for you all of the other areas in which this Administration is trying to work with Congress and our trading partners to provide the economic climate in which U.S. industries will thrive.

The second area where the Federal Government is a major player is "Education and Training". As we have discussed many times, the U.S. needs to strengthen our entire educational process to ensure that those entering the workplace will have the necessary knowledge, comprehension, and problem solving skills for the highly technical content of the daily living and working environment of the future. Achieving such a goal will require a broad-based approach involving business, academia, educational organizations, and state and local governments.

The Administration's current budget proposal to Congress for fiscal year 1991 would result in direct expenditures of over \$1.5 billion for science and mathematics education activities in five Federal agencies. These programs are in addition to the training provided to thousands of graduate students supported through Federal competitive R&D grants programs.

Clearly, "Federal R&D support" plays a major role in economic competitiveness. Investments in research and development (R&D) provide both direct and indirect productivity benefits for society. R&D yields new knowledge, processes, technologies and products that, over the long term, result in economic growth and improved quality of life for all Americans.

Traditionally, the Federal Government has supported R&D for two reasons: first, to meet its own direct needs -- where it is the principal consumer -- such as defense and civilian space related R&D. Funding levels and decisions are made on the basis of Government objectives, needs, and requirements. However, the Government relies principally on the private sector to undertake the development process and encourages these activities to be managed in such a way to optimize commercial applications of the R&D as well.

The second category of R&D requires Federal support in the interests of the public welfare where the private sector is without sufficient incentives to capture enough of the benefits to make private R&D investments justifiable. Federal support for basic research, especially at universities, is the prototypical, essential investment in the Nation's scientific and technological future, including its future scientists and engineers. This Administration has proposed increasing support for basic research by \$1 billion, or 8 percent, to over \$12 billion in FY 1991. Indeed, the Administration's budget proposes to allocate a total of over \$71 billion for all R&D, including basic research and research facilities in FY 1991, an increase of \$4.5 billion or 7 percent over FY 1990 levels. Within this total, civilian R&D would increase by 12 percent and defense related R&D would increase by 4 percent.

In particular, of the approximately \$15 billion proposed for civilian applied research and development support, a significant percentage -- in the billions -- would be allocated to developing advanced technologies such as energy technologies, robotics, high performance computing, and other technologies. On the defense side, the Department of Defense technology base budget proposal including the DARPA budget (\$1.1 billion) but excluding SDI funding, requests nearly \$5.6 billion for fundamental basic, applied and developmental research that underpins our future defense systems. The major high technology areas of defense funding include high definition display technology, manufacturing and materials technology, artificial neural network technology, and support for SEMATECH which focuses on semiconductor

technologies. Thus, it is clear that the Federal Government currently supports a great deal of technology development; and it should also be recognized that previous Federal R&D investments have been very successful in developing technologies required for defense, space, and other important civilian applications related to agriculture, health, and aeronautics.

This Administration believes the federal government should also continue to participate with the private sector in developing generic, enabling technologies that are important in both governmental and commercial applications. President Bush pointed out to the American Electronics Association in March, "This Administration is committed to working with you in the critical precompetitive development stage where the basic discoveries are converted into generic technologies that support both our economic competitiveness and our national security. Here again we can help to level the international playing field on which you compete."

The rationale for investing in these enabling technologies is essentially the same as that for investing basic research: individual companies cannot bear the cost and risk of such investments alone. Examples include certain materials technologies (such as superconductivity), information technologies (such as high performance computing), and biotechnologies (such as scaled-up bioprocesses).

The "Transfer of Federally Funded Technology" to industry can also help make U.S. firms more economically competitive. Technology transfer has become part of the international vocabulary; but that label is fundamentally misleading. It suggests that a specific technology can be identified, isolated and packaged at one place; e.g., where it was developed -- then transferred to an entirely different place where it can be unpackaged, implemented and exploited in an entirely different environment. Nothing could be farther from the truth.

Technology is only transferred from, by and to adequately trained persons and it is essential that our technology transfer system have an adequate base of trained personnel prepared to move with the technology, and to accept and implement it at the receiving end.

This Administration believes the Government must make R&D activities at Federally-supported laboratories more relevant and accessible to the private sector, particularly through collaborative agreements. We also believe that all such efforts should be guided by the potential users.

If industry does not perceive the need, or, indeed is not interested in co-investing with the government, there is little point in the government's engaging in technology push. That is a lesson we have learned from past history. Thus, in order for industry-government cooperation -- that we have been talking about for years -- to become a reality, we need industry to set appropriate objectives for the cooperative endeavors of industry-Federal Laboratory-university consortia that would be profitable for them to engage in.

The Federal government, in turn, will actively promote and encourage the formation of industry-Federal and industry-Federal-university consortia as well as facilitate the access by U.S. industry to Federal Laboratories within the broad, flexible Federal guidelines established by previous legislation and will develop mechanisms to expedite the diffusion of the results of Federally supported R&D to industry, including active licensing of inventions, and removing barriers to commercial development and marketing of Federally developed computer software.

Each of the Federal agencies also has a variety of directed initiatives in mission areas already underway and are planning others. For example, today we have roughly 200 active cooperative research and development agreements between the Federal laboratories and private companies which indicates that the companies involved believe in the potential commercial viability of the technology they are co-developing. We are also beginning to see some remarkable collaborative arrangements: the \$11 million DuPont/Hewlett-Packard/Los Alamos National Laboratory joint venture in high temperature superconducting materials and applications, in which the two companies are investing over \$7 million, is a good illustration of these new arrangements.

Other Federal programs are explicitly designed and undertaken with private sector interests clearly in mind. A number of these are managed by the National Institute of Standards and Technology (NIST) which has a mission to support programs serving business and industry. NIST research programs with substantial civilian technology development/transfer potential include a measurements, reference data, standards research and services program. NIST's measurement and standards program is particularly valuable to the nation's high technology businesses because they rely for commercial success on the existence of a common technological infrastructure which includes test methods, measurements, evaluated data, and standards of execution and performance. The fundamental research conducted by NIST in collaboration with industry provides this reference base.

The final area where the Federal government can make a contribution involves "State Activities".

Technology outreach and technology transfer initiatives at the state and regional levels are playing an increasingly important, cost-effective role in helping U.S. businesses -- especially small businesses -- regain their competitive edge. These state activities take a variety of forms, including direct technology transfer programs, university-based research programs, R&D grant programs, research parks, financial assistance programs, technical and managerial services, incubator facilities, R&D tax incentives, and worker training assistance.

The Federal Government should be aware of these activities and should, where appropriate, leverage state initiatives in a timely way to optimize their effectiveness. The Federal Government should also provide a focus for information from the highly successful local programs that could be transferred to areas in other states that need to initiate similar activities.

Currently, there are three major Federal programs implemented through the Department of Commerce that interact directly with state and local technology initiatives. The Boehlert-Rockefeller Extension Program provides technical assistance to state technology outreach programs throughout the U.S. to help small and medium-sized businesses identify, access, and apply appropriate Federal technology to the solution of their technological problems.

The new Advanced Technology Program (ATP) will assist U.S. businesses in accelerating the early to mid-stage development of generic technologies that have the potential to modernize manufacturing or to commercialize more rapidly significant new scientific discoveries. It will aid and leverage companies entering into contracts, cooperative research agreements and joint ventures, and, when appropriate, help involve specific Federal laboratories in such agreements.

Finally, the Department of Commerce's Regional Manufacturing Technology Centers (MTC) program which you are very familiar with Mr. Chairman, is designed as a technology transfer operation designed to breakdown the barriers faced by small and medium-sized manufacturers in adopting new technology by working with individual local manufacturers, community colleges, and technical institutes to determine individual technology needs, develop technology upgrade plans and train the local workforce in the use of these new manufacturing tools and methods.

This completes my prepared statement. However, I would like to reemphasize that I believe investing in new technologies is a necessary, but not a sufficient condition for achieving international industrial competitiveness. As we get further into developing effective policies and programs for technology advancement in this nation, we should frequently remind ourselves of that fact. I believe we must all keep in mind other factors -- economic, educational, fiscal regulatory, and cultural -- that we must influence at the same time if we are to maintain our current position in world markets.

At the risk of repeating myself, I want to reiterate that the challenge for the Federal Government at this time is to develop, stimulate, and exercise intelligent and visionary leadership that emphasizes long-range U.S. economic vitality over special interests. And, above all, by its words and actions, the Federal Government must make clear to all, and particularly to the U.S. industrial community, that the issue of U.S. industrial competitiveness is among the very highest of its priorities for the 1990's.

SUPPORT FOR BIOMEDICAL RESEARCH: A FEDERAL PERSPECTIVE

D. ALLAN BROMLEY

Assistant to the President for Science and Technology

Executive Office of the President

Forum on Supporting Biomedical Research:

Near-Term Problems and Options for Action

National Academy of Sciences-Institute of Medicine

Washington, D.C.

June 27, 1990

Three years ago was the hundredth anniversary of the National Institutes of Health, and a couple of the books published to celebrate that event paint a remarkable picture of how far the biomedical sciences have come in the past century. A little over a hundred years ago, the leading cause of death in the United States was tuberculosis. Children and adults routinely developed typhoid fever, dysentery, cholera, and a host of other illnesses. Of all the people born in the United States, a quarter were dead by the age of 25, and about half had died by the age of 50.

Today, fully 97 percent of all people live past their 25th birthday, and over 90 percent live to be more than 50. We also live healthier lives, because many of the diseases that afflicted our parents and grandparents have been eliminated, both through better sanitation and nutrition and through biomedical research. Science and technology have caused a large number of changes in human society, but I don't think any is so profound -- or as underappreciated -- as this gift of longer and healthier lives.

I fully believe that we will see changes in health care over the next 30 to 40 years that are as dramatic as the changes that have occurred over the past century. We may not gain all that much more in life span, but we will make great progress toward the conquest of the large number of illnesses and injuries that continue to take a heavy toll on human health and well-being. Many advances will emerge from clinical investigations of the kind that have proven so successful in the past. But an increasing number of advances will emerge directly from basic research, from investigations of the structure and functioning of living things at the most fundamental levels.

If these advances are to occur expeditiously -- and if they are to occur in the United States -- this country must have a healthy and stable biomedical research system. I do not believe that the system can be called healthy today. There is much good news about the NIH budget: it doubled in current dollars from 1982 to 1990, and increased approximately 40 percent in purchasing power. During that time, the

total number of research project grants increased from 15,500 to 20,300, and the average size of those grants likewise increased.

Yet the signs of stress on the system are everywhere. Research teams are breaking up, established investigators are losing funding, young people are being scared away from careers in biomedical research, and calls for change -- as evidenced by meetings like this one -- are increasing. I know what a field in stress looks like, because many of the same things happened in physics in the early 1970s -- even as I was engaged in a survey of the field for the National Research Council -- and it took a number of years for the field to recover.

NATURE AND SOURCE OF THE PROBLEM

Harold Varmus has already done a fine job of laying out the dimensions and roots of the problem. But there are a couple of things that I want to add to that analysis. First, the problems that have befallen individual investigators are not limited to NIH. At NSF, the success rate for research proposals fell below 30 percent in fiscal year 1988, a year before it happened at NIH. For some directorates or institutes, or for some groups of applicants -- such as young applicants -- the success rate is appreciably smaller.

These low success rates could not be coming at a worst time for the research enterprise. We are sending a message to young researchers that they are not wanted and are driving them from these fields, even though in a few years they will be wanted a great deal. By the mid-1990s the number of young investigators coming through the educational pipeline is expected to drop, as college-age populations continue to decline. But at about that same time, the demand for young Ph.D.'s is going to swell, as the generation of Ph.D.'s trained during the 1960s reaches retirement and as undergraduate enrollments begin to turn around. Several analyses have predicted that severe shortages of scientists and engineers will develop by the turn of the century, and the actions we take today will do much to lessen or exacerbate those shortages.

As Harold Varmus has explained, there are several interacting reasons for the low award rates of the last few years. One reason in particular has drawn considerable attention -- the extension of grant durations in the mid-1980s. In my opinion, that change was sorely needed. Several years ago, as part of a report done by the White House Science Council on the Health of U.S. Colleges and Universities, we found that young faculty members in many of our first rank colleges and universities were spending an average of 30 percent of their time either applying for grants or justifying what they had done with their grants. It was an inordinate time to spend away from research, and I commend NIH for taking steps to reduce it.

The problem with extending grants is that it creates an out-year mortgage that tends to reduce the pool of money available for new and competing proposals. This mortgage becomes especially significant if the growth rate of funding slows, as has happened at NIH in the past few years. The pressures will eventually ease, as a new equilibrium is established with a longer grant duration. But in the meantime adjustments must be made, and they can be very painful.

There are a few other statistical points I would like to make, because they greatly influence how we view the situation. One is that -- while it is true that the number of grant applications has increased, rising about 30 percent over the past 10 years -- trends within the community may be inflating that number. For one thing, part of the growth in the number of grant applications has been due to submissions of amended applications. The resubmission rate has increased from a historical rate of about 8 percent to 30 to 35 percent.

Also, the number of multiple applications submitted by investigators has gone up. Currently about 10 to 12 percent of researchers are submitting more than one application in a fiscal year, compared to a historical rate of about 3 percent. In the NSF, for example, a very recent analysis shows that among those whose projects have gained support -- that is, have been successful in the case of one proposal -- the average number of proposals submitted to NSF by the same investigator was 1.9. Moreover, on average these individuals had a success rate not of 100 percent, as you might think, but rather 150 percent. Multiple proposals pay -- and also distort the statistics.

Current practice also raises troubling questions about the ability of the peer review system to choose among research projects. When study sections approve 95 percent or more of the applications, whereas the corresponding figure only a few years ago was less than 70 percent, it is not entirely a reflection of changing quality of the proposals; rather, it may also reflect the difficulty of getting grants and an attempt on the part of the reviewers to tilt the balance toward the investigator. This is well-meant, but in the long run it is counterproductive.

A new interagency group under the Federal Coordinating Council for Science, Engineering, and Technology has been established to consider some of these issues. It is named the Working Group on the Structure of the Support of Science and is chaired by James Hayes of NSF. Its initial task is that of obtaining reliable statistical data and evolving more effective indices for policy purposes than the currently used "success rates," which for many reasons, some of which I have just noted, are open to manipulation. If we are to address what I still believe to be a very important problem in responsible and realistic fashion, it is essential that we have such information for the major support-granting agencies such as NIH and NSF.

With all this said, let me emphasize again that I am fully aware of the level of pain that now exists in the community. It is very real; it is understandable, and both I and the Bush Administration are committed to responding in positive and concrete fashion to it. The statistics may complicate the picture, but they do not change the overall situation: the budget for biomedical research has not grown as rapidly as the number and the cost of meritorious projects competing for funds. A significant amount of excellent science is not being funded.

INVESTMENTS IN RESEARCH AND DEVELOPMENT

The most immediate solution to the problem is clearly a higher level of federal support, and the prospects for that support are not as grim as the current budget situation might suggest. But there are also broader structural changes -- I will return to these in a moment -- that may influence future support for biomedical research.

First, regarding funding: I have said many times that individual investigators and small groups of investigators are the heart and backbone of American science. This opinion is widely shared in the Bush Administration. The problems of the individual investigator are going to be taken very seriously as we work on the preparation of the fiscal year 1992 budget. We see it as our responsibility to ensure that this fundamental strength is not undermined nor allowed to erode.

In general, there is a growing recognition in the Administration and in Congress that we are underinvesting as a nation in our science and technology base. The United States now spends about 1.8 percent of its GNP on nondefense research and development. West Germany spends about 2.6 percent, and Japan spends about 2.8 percent. Support for research and development is one of the most important investments we can make in our national future, and if we do not make those investments, we place both our future economic prosperity and our national well-being at risk.

This is a message that the President's Council of Advisors on Science and Technology has brought directly to the President and his top advisors. In the area of biomedical funding, both Daniel Nathans and Bernadine Healy are members of PCAST, and they have made a strong case for increased support for biomedical research.

THE NEED FOR ADVOCACY

But of course the efforts of the Executive Branch are just one part of the overall funding process. As I have reminded many groups this spring, the President proposes, but the Congress disposes. There is a great deal of pressure on the Congress for a limited pool of funds, as there is on the White House. So unless Congress can be convinced to respond to the President's request in the 1991 budget, we will find ourselves with significantly less funding than has been requested. We will then face the very difficult problem of allocating the reduced funds among areas that

may have very vocal, effective constituencies -- far more vocal and effective than the constituency represented by the biomedical research community.

You and the five million other scientists and engineers in this country have a responsibility to make the case for research and development directly to Congress. It is no longer enough for those of us who have spent most of our careers in science and technology to expect, perhaps subliminally, that sooner or later someone in Washington is going to recognize that what we're doing is so worthwhile that they will support it. It won't happen.

The biomedical community has for a number of years joined into groups to address these issues, and I commend those actions, because that is an important way to get things done in Washington. But you should not forget that the most effective way to get your point across to anyone in government is to contact that person directly. Massive letter writing campaigns using form letters do not have a significant impact. But carefully prepared, well-thought-out, personal letters -- letters that deserve a reply -- can make a real difference, particularly when they focus on matters of national concern rather than the specific desires of the writer.

STRUCTURAL CHANGES IN BIOMEDICAL SCIENCE

We must also keep in mind that there are changes going on in biomedical research that may influence the way that the system is supported. One of the most important of these changes involves the role of industry. In 1979, industry funded 29 percent of all health research and development. By last year, that percentage had risen to 45 percent. Employment growth for biomedical scientists has been growing twice as fast in industry as in universities, and in the immediate future most new positions in biomedical science will be located in industry rather than academia.

Furthermore, in a survey of biotechnology firms conducted by the NRC's Office of Science and Engineering Personnel, it was found that four out of five firms plan to maintain or increase current levels of hiring, particularly for people with postdoctoral

training. Moreover, more firms surveyed reported having problems hiring scientists this year than last.

Industry is going to continue to play a larger role in biomedical research and development. We must prepare students for that option -- not just for pursuing careers in academic research. This also argues for more cooperative ventures between industry and universities, to prepare students for academic or industrial careers and to increase funding for academic research. Under Jim Wyngaarden's leadership, nearly 150 cooperative research and development agreements were put into place between NIH researchers and private industry, and Jim expects this number to grow.

This broader involvement of industry is representative of a number of long-term trends in biomedical research, and these trends require careful analysis. Because of the one-year appropriations cycle in Congress -- and more broadly because of the relatively short time horizons in government -- long-range planning has never been a major component of federal activities. But this long-range planning is desperately needed.

There are many important questions that need to be answered.

- o NIH already represents 40 percent of the federal budget for nondefense R&D and accounts for half of all federal support for basic and applied research in this nation's colleges and universities. In the absence of greatly increased funding, how can NIH justify a larger share of the pie?

- o Are we training enough biomedical scientists to meet the future needs of both academia and industry?

- o How can we manage to upgrade the facilities and major equipment needed for biomedical research without cutting into support for research?

- o How can we recruit young scientists when their mentors are worried about future research funding?

- o Will increased federal investment in any particular aspect of biomedical research shift nonfederal support away from those areas?

- o How can we convey to Congress and to the public the great additional potential of biomedical research to improve human health and well-being?

I understand that a committee of the Institute of Medicine chaired by Floyd Bloom has been looking into many of these questions, and that the committee's report is now in review. Several other activities bearing on this subject are also under way. The Office of Technology Assessment is working on a large study of basic research in the 1990s, including biomedical research, which should appear early next year. The FCCSET Working Group on the Structure of Scientific Support should also produce a valuable analysis.

Finally, there are the proceedings of this forum. I very much look forward to your discussions today and to the conclusions you draw. Alicia Dustira is working on these subjects in my office; I encourage you to get in touch with her if you have specific materials that you think would be of use to us.

TESTIMONY OF D. ALLAN BROMLEY
CHAIRMAN, NATIONAL CRITICAL MATERIALS COUNCIL
BEFORE THE HOUSE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS
JUNE 26, 1990

National Critical Materials Council's work agenda

It is a pleasure to be with you today to testify on our plans for the National Critical Materials Council (NCMC) in the coming year. First, however, I must point out that we have not had a meeting of the Council yet. We have scheduled an initial meeting for July 9, 1990. The slowness in forming the Council is not an indication that materials issues are viewed as a low priority by the Administration. The new, larger role that has been given to my office, namely that of Assistant to the President for Science and Technology, requires increased responsibility in many areas. The Council will be an integral part of the Administration's increased focus on science and technology, particularly with its role in materials science and engineering policy and related activities.

I am pleased to chair the Council because I believe this will help us to better coordinate activities on materials with the Federal Coordinating Council for Science Engineering and Technology (FCCSET), which I also chair. Therefore, in addition to the specific mission of NCMC as it relates to the enabling legislation, I want to discuss the role of NCMC in relation to FCCSET and the enhanced coordination of Federal materials research programs that this will promote.

There are three general areas that are of concern to the NCMC: The first area is critical materials, the second is advanced materials, and the third is superconductivity. The responsibilities of NCMC in the first two areas are detailed in the Critical Materials Act of 1984. The responsibilities of NCMC in Superconductivity are detailed in the Omnibus Trade and Competitiveness Act of 1988. I will describe a general program for each of the three areas.

Critical Materials

The examination of critical materials is an area of key importance in the dynamic setting of today's world. By critical materials I mean the conventional metals and other materials that have played such an important role in the defense and industrial base of this country. These include such metals as chromium, platinum, manganese, and cobalt; as well as the large-volume metals so important to the economy such as copper and aluminum.

In 1988, NCMC produced a Critical Materials Report. We will review and update that report. However, we do not think that it is a wise use of our resources, at this time, to repeat that entire report. Rather, it is better to chose specific topics of focus in the area of critical materials than to examine the whole broad field. The Bureau of Mines has ample information on all aspects of the field. We will work with the Bureau to fill in specific gaps in analysis that they may have identified, and provide for cross-agency coordination of critical materials issues. Possible topics could include: the impact of new clean air regulations on demand for precious metals used as automobile catalysts and the

possible impact of the reauthorization of the Resource Conservation and Recovery Act (RCRA) on the recycling of materials. We anticipate that recycling of materials will become increasingly important, and that it has the potential to increase the efficiency of production operations, and reduce the total volume of solid wastes that need to be sent to landfills and other disposal sites.

Advanced Materials

Advanced materials constitute the cutting edge of materials technology. They tend to be low-volume, high value-added materials. Many advanced materials are created for niches in the defense and aerospace industries -- where government's role is obviously prominent. We will review the Advanced Materials Program Plan that was produced by the previous Council in 1989 and determine the areas meriting particular emphasis. This review is especially important in light of the seminal 1989 study by the National Research Council, Materials Science and Engineering for the 1990's: Maintaining Competitiveness in the Age of Materials. I have asked that the regional meetings, which are an outgrowth of this report, consider recommendations for specific actions that can be taken to bolster materials science and engineering (MS&E) at a national level. Specifically, materials synthesis and processing has been identified as a key area of materials science and engineering needing increased attention. We anticipate that this will be one area of focus for the Council.

Recent reports by the Department of Defense and the Department of Commerce on critical technologies have included advanced materials. For this reason, the Council will

be providing an input to the OSTP report on critical technologies which will use the DoD and DoC reports as a starting point. While we still lead the world in basic research for many advanced materials technologies, many experts in the field acknowledge that many products are not commercialized quickly enough to compete in the global marketplace.

The Council will examine the issues that pertain to advanced materials and attempt to identify actions to help create a better environment for materials commercialization. For example, one area that comes to mind is the setting of standards for the testing of composite materials and parts. However, we are moving more slowly than our European and Japanese counterparts in developing testing standards for the industry. Facilitating the development of standards is a legitimate role for government, so we need to work with industrial groups to promote leadership in this area.

Superconductivity

As you know, superconducting materials in particular have captured the public's imagination. This is due to the discovery in 1986 of a new class of ceramic superconducting materials that lose electrical resistance at relatively high temperatures. The Council has been given the responsibility of staffing and coordinating the National Commission on Superconductivity. The Commission had their first meeting in October of last year. Since then they have met several times in order to produce a report and recommendations to the President and Congress. The work of the Commission will be finished sometime later this summer. I anticipate that the report of the Commission will

be a significant and influential contribution on superconductivity, and I believe that this Committee will find it to be of considerable interest. The Council will help coordinate any needed updates of the Commission's report.

As was the case last year, the Council will also work with OSTP in updating the National Action Plan on Advanced Superconductivity Research and Development. This update will be a primary function of the Superconductivity Subcommittee of the Committee on Materials (COMAT), which is part of our FCCSET structure.

Coordination with FCCSET

As noted earlier, I also have the privilege of chairing the Federal Coordinating Council for Science Engineering and Technology (FCCSET). By orchestrating the efforts of the NCMC and FCCSET we hope to achieve a level of coordination that will strengthen the materials program of the Federal government.

Let me briefly review the recent changes in the FCCSET structure. One of my major initiatives as Assistant to the President for Science and Technology is to revitalize and reorganize the FCCSET structure. I am very pleased and encouraged by the response and support of those Cabinet Secretaries and heads of independent agencies who are giving FCCSET their personal attention. We are proposing seven umbrella committees which will comprise the basic structure of FCCSET -- linking the full FCCSET council to the working level committees such as COMAT. Tom Murrin, Deputy Secretary of the Department of Commerce, chairs the Committee on Technology and Industry where

COMAT will reside. Dr. William Phillips, the OSTP Associate Director of Industrial Technology, is the OSTP representative to this umbrella committee. Dr. Phillips has an extensive background in materials and will provide valuable expertise in this area.

COMAT is embarking on a cross-cutting analysis of Federal research efforts in materials. We anticipate that this analysis will provide valuable information to decision-makers inside and outside the Government as to the deployment of resources in the pursuit of materials R&D.

The President's Council of Advisors on Science and Technology (PCAST)

In February of 1990 the Administration announced the appointment of the President's Council of Advisors on Science and Technology (PCAST), comprised of very distinguished scientists and engineers from the private sector. This is the first Presidential scientific advisory group in many years to provide high-level advice on a wide range of important issues. It reflects the commitment to further strengthen Federal science and technology policy and a recognition that advances in science and technology contribute in a major way to increased economic competitiveness. Some members have expertise in the materials science field and, where appropriate, their thoughts will be a contribution to our deliberations within the Government.

Providing the Proper Environment

The most important role that government can perform is providing the proper environment for the development of advanced materials technologies. This is

accomplished by supporting a vital basic research infrastructure, facilitating development of generic, enabling technologies where appropriate, and allowing the market to function efficiently when these technologies reach the commercial stage. As regards the conventional critical materials, we have to make sure that we safeguard the natural environment at the same time we ensure the strategic interests of the United States.

Conclusion

In conclusion, I know that I speak for the rest of the Council members when I say that we look forward to working with Congress in the areas of critical and advanced materials. Perhaps we will not always agree on what are the best policies to pursue; however, I am sure that we share a mutual interest in working together in a non-partisan manner to help to ensure the health of our Nation in critical materials and their related technologies.

FOR IMMEDIATE RELEASE:
FRIDAY, JUNE 22, 1990

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TORRICELLI CALLS HEARING, QUESTIONS THE ADMINISTRATION'S COMMITMENT
TO ADVANCED MATERIALS POLICY

WASHINGTON, D.C. -- Fantastic new materials that could revolutionize automobile engine design, allow construction of lifelike artificial limbs, enable aircraft to withstand the intense heat of hypersonic flight, and produce the next generation of super-fast computer chips have failed to impress the Bush Administration, according to Rep. Robert Torricelli (D-NJ).

Torricelli, Chairman of the Transportation, Aviation and Materials Subcommittee, will chair an oversight hearing on the President's National Critical Materials Council on Tuesday, June 26, 2-5 p.m., in 2325 Rayburn House Office Building.

"Despite a tremendous challenge to this country's technological leadership, the resulting threat to our national security, and blistering competition from Japan and Germany, the Bush Administration has failed to pay even the slightest attention to developing an overall policy for this country on critical materials," Torricelli said.

Torricelli has called the President's Science Advisor, Dr. Allan Bromley, to testify before his subcommittee on the Administration's failure to adopt a long-term strategy for promoting the research and development of critical materials.

Critical materials include advanced ceramics used in superconductors and advanced, featherweight, composite materials that have proven stronger than steel.

"Congress created the National Critical Materials Council in 1984 specifically to set a course for policy on critical materials," Torricelli said. "Yet the Reagan and Bush Administrations have turned away from the future in their rush to avoid anything that might resemble a coherent, thoughtful and effective industrial policy. In the meantime, our foreign competitors are rapidly moving to push forward the boundaries of science and use their discoveries to commercial advantage."

The list of technologies advanced due to critical materials includes the outer skin for the National Aerospace Plane, magnets and superconducting wire for the Superconducting Supercollider, advanced, high-heat, automobile engines that can burn fuel with fantastic efficiency, and an entire new generation of computer chips.

The Subcommittee on Transportation, Aviation and Materials is one of seven subcommittees of the Committee on Science, Space and Technology. Rep. Robert Roe (D-NJ) is the committee chairman. Rep. Tom Lewis (R-FL) is the Transportation subcommittee's ranking Republican.

A witness list appears on the reverse side of this release.

TESTIMONY OF

D. ALLAN BROMLEY

Director, Office of Science and Technology Policy,

Executive Office of the President

before

the Subcommittee on Transportation, Aviation and Materials

of the House Committee on Science, Space and Technology

on

the National Action Plan for Superconductivity Research

and Development

Washington, D.C.

February 21, 1990

Mr. Chairman, it is a pleasure to be here to testify on the National Action Plan on Superconductivity Research and Development. The Plan, which was publicly released in December 1989, was prepared with the help of staffs of the National Critical Materials Council (NCMC) and the OSTP Committee on Materials (COMAT) as well as the help of other experts. It is based on the precept that the United States must maintain its position at the forefront of superconductivity R&D and be ready to translate basic scientific knowledge into viable applications.

While the Plan is a formal response to a legislative requirement, its preparation also reflects the tremendous promise of superconductivity. Superconductivity already has important commercial applications, and with certain breakthroughs it could become an enabling technology leading to a wide range of new products. In general, superconductivity is one of a number of critical technologies in which the United States has a vital stake in remaining on the cutting edge of R&D.

THE PROMISE OF SUPERCONDUCTIVITY

Before proceeding with a discussion of the Action Plan, it would be useful to discuss briefly the current R&D as well as commercial status of superconductivity and its promise for the future.

Superconductivity was discovered in 1911 when a Dutch physicist observed that the electrical resistance of a mercury rod dropped virtually to zero when it was cooled to 4.2 degrees above absolute zero (4.2 degrees Kelvin or 4.2 K). Over the next 75 years, researchers gradually found or fabricated materials with higher critical temperatures (the temperature below which a material becomes superconducting). However, by 1985 the highest known critical temperature was still only 23 K. It is a well-established rule of thumb that for reliable operation, superconductors should be used at less than 75 percent of their critical temperatures. Therefore, low temperature superconductors (LTS) have to be cooled well below 20 K, which requires complex cooling systems generally based on liquid helium or liquid hydrogen.

Despite these limitations, a number of companies have developed commercial applications for low temperature superconductivity, particularly in nuclear magnetic resonance imaging (NMRI), particle accelerators and electronic instrumentation. As of 1987, annual sales of superconducting devices, worldwide, amounted to about \$400 million; of this amount, NMRI devices and electronic instrumentation each accounted for roughly \$150 million.

The Superconducting Super Collider (SSC) will be a large-scale user of state-of-the-art low temperature superconducting magnets. The facility, with a 54-mile circumference, will require over 10,000 magnets containing some 2,000 tons of actual superconductors costing roughly \$320 million.

Commercial development of low temperature superconductivity continues, despite the relatively long history of R&D in this area. Future commercialization, while it will probably not be rapid in any given year, will nonetheless be a steady and continuing process. I am convinced that the future result of this cumulative process will be quite impressive.

For example, superconductivity will very possibly find eventual applications in computers, where zero resistance of conductors could significantly increase computer speeds and increase the packing density on a semiconductor chip. The ever shrinking size of electronic microcircuitry and the corresponding need for increased current densities and signal speeds are inexorably leading to ever more serious heat removal problems and strongly suggest an important future role for superconductivity in computers. Other possible applications for superconductors that have been studied include underground electrical transmission cables, electrical energy storage, magnetically levitated trains, and ship propulsion systems.

HIGH TEMPERATURE SUPERCONDUCTORS

In January 1986, two researchers at the IBM laboratory in Zurich, Switzerland, reported that they had found a ceramic material with a critical temperature above 30 K. Within the next two years, materials containing either bismuth or thallium were fabricated with critical temperatures above 100 K.

The discovery of high temperature superconductivity (HTS) was one of the greatest surprises in several decades of modern physics. These materials have critical temperatures above the temperature of liquid nitrogen (77 K), thereby significantly increasing potential commercial applications in cases where refrigeration is an important factor in cost or ease of use. Liquid nitrogen costs about \$0.22 per gallon in the United States as compared to about \$5.50 per gallon for liquid helium.

Before the discovery of high temperature superconductors, critical temperatures had increased more or less linearly with time. Extrapolation of the 75-year history of superconductivity would have suggested a critical temperature of 90 K would not be attained until something like the year 2190!

We are still at a very early stage in understanding high temperature superconductivity and in determining its technological possibilities. Rapid technical progress and unexpected breakthroughs can continue to be anticipated. The applications of the new superconductors are likely to be similar to those for low temperature superconductors, at least initially. But in the long term, the most important applications may be those that cannot yet be foreseen.

Two critical challenges posed by the new superconducting ceramic materials are achieving high electrical current densities without losing the superconducting properties and developing superconducting ceramics flexible enough in a mechanical sense to fabricate into wires and other shapes for widespread commercial applications.

Progress on these challenges is occurring at many institutions in industry, academia, and the national laboratory system. Last fall, for example, an AT&T Bell Laboratory research team reported gains of 100-fold in electrical current densities after irradiating samples with neutrons. Perhaps even more significantly, researchers in another Bell Laboratory team produced bulk superconducting samples that could carry almost ten times as much current as the best bulk materials made by earlier standard methods. Both results represent breakthroughs on one of the major problems of high temperature superconductivity, although it is too early to predict the commercial outcome of this research.

Another example of recent significant R&D results is the indication that HTS materials, operated at liquid helium temperatures, may offer superior performance over conventional low-temperature superconductors for a variety of applications. A bismuth oxide superconductor was fabricated by Oak Ridge National Laboratory in collaboration with the American Superconductor Corporation and tested at liquid helium temperature. This superconductor carried higher maximum currents at high magnetic fields than can niobium-tin, the best of the conventional low temperature superconducting materials.

The lesson to be drawn from these and other recent developments is that any successful R&D plan must be sufficiently flexible to incorporate fast-breaking R&D results, both advances and setbacks. We must continue to expect the unexpected. The best strategic approach is to try to visualize what the broad commercial needs and applications might reasonably be 5, 10 and 20 years hence and conduct long-term R&D in broad areas that address those needs. For example, work on thin films is almost certain to have applications in electronics and other areas, but we cannot at present be certain what some of the specific applications will be.

Such an R&D plan is somewhat similar to constructing a new highway system. It is impossible to predict which specific new businesses and industries will be attracted by the highway system or at what rate of development, but it is certain that new businesses will result.

OVERVIEW OF THE PLAN

As you know, our OSTP Action Plan was prepared in response to the National Superconductivity and Competitiveness Act of 1988. This legislation specifies that the Plan include the following:

- o goals and priorities for superconductivity R&D;
- o a recommended programmatic and budget crosscut by individual departments and agencies; and
- o proposals for participation by industry and academia.

The legislation also calls for subsequent annual reports setting forth and evaluating the progress of the Action Plan. These reports will also include "a description of the amount of funds expended in the previous year by all Federal departments and agencies connected with superconductivity." A budget crosscut for current federal R&D in superconductivity is included with this statement and will be discussed below.

The basic strategic approach in the Plan is that of continuing at present to encourage a broad-based interagency federal R&D program incorporating a large number of alternatives and approaches. This strategic approach recognizes that we are still at an early stage in the R&D process--particularly with high temperature superconductors--and thus that it is much too early to narrow our focus. The detailed mechanisms of superconductivity in polycrystalline ceramics, for example, are only just beginning to be understood. Further progress toward answering such

fundamental questions is presently the limiting factor in determining the potential applications for high temperature superconductors.

Such an approach is, over the near-to intermediate-term, the most efficient and sure way to increase our knowledge. It is also worth noting that research programs in superconductivity have been continually revised in the last few years to take advantage of new R&D results. At a somewhat later stage, as superconductivity is better understood, it is appropriate to progressively focus and prioritize R&D with a view to future commercial applications.

I believe that the National Action Plan that you have before you is thus in accord with the "state of the art" of superconductivity. I wish to emphasize, however, that R&D planning is a continuing process. This is particularly the case in a field such as high temperature superconductivity with rapid changes to be expected.

ANNUAL REPORTS TO CONGRESS

The Congressionally directed annual reports on the progress of the Plan will provide a means of updating and refining the Plan and will reflect ongoing scientific and technical progress in the field. As our knowledge base becomes more extensive, our planning will inevitably shift from an emphasis on basic research to additional emphasis on technology development with a view to specific future commercial and national security applications.

The annual reports to Congress will include the following:

- o an updated funding crosscut for agency superconductivity programs; and
- o an ongoing and updated assessment of the strategic goals, technical programs and potential applications described in the Plan, including any R&D breakthroughs (or roadblocks) and their possible impact on achievable applications.

Some of the more visible technical goals of the Plan to be tracked in the annual reports will include such topics as the following:

- o Progress on performance characteristics of superconducting materials (e.g., increases in critical temperature and critical current density);
- o Development of new superconducting materials with desirable properties;
- o Development of high-quality HTS thin films capable of supporting adequate current densities with low surface resistance and low background noise for future use in planar sensors and electronics applications; and
- o Demonstration of a reproducible controlled process for the production of HTS bulk materials.

Progress on these and other technical goals will be reported annually. The intended outcome of this multiyear process is an evolving R&D program coordinated with industry and academia that addresses the critical technical and theoretical

hurdles required for broad-based commercialization of superconductivity 5, 10 and 20 years hence.

SUPERCONDUCTIVITY BUDGET

A budget crosscut was submitted for superconductivity as part of the President's FY 1991 budget request to Congress. Together with superconductivity, estimates for total federal funding in 1991 were provided for semiconductors, high performance computing, advanced imaging technologies and robotics. All of these technologies have great promise for the future.

The attached table provides a breakdown of funding by agency, with a further division into the categories of high and low temperature superconductivity. The totals in this table differ slightly from those in the President's FY 1991 budget request, because they reflect more recent agency estimates. These estimates are subsumed within larger appropriation requests and may change somewhat over time as agency plans are updated.

The DOE figures can be somewhat misleading, since the 1991 superconductivity request does not include magnet R&D for the Superconducting Super Collider, reflecting completion of that effort within the superconductivity program. In order to make 1991 comparable with 1990, about \$18 million would need to be added to the 1991 funding in the LTS category. With this comparability adjustment, total funding for superconductivity R&D in DOE for 1991, in constant dollars, is at a slightly higher level than it was in 1990.

Total 1991 funding for all agencies, however, shows a somewhat greater emphasis on high temperature superconductivity, which is 9 percent above that of 1990 in current dollars.

As is routinely the case, outyear funding estimates are not included in the Administration's budget request for any of the above technology crosscuts, including superconductivity. The Administration's intention, however, is to provide a stable multiyear base program for basic research in superconductivity, a requirement for continued rapid progress on the fundamental knowledge base.

While a detailed discussion of agency programs is provided in the Plan, major efforts in the agency programs include the following:

- o In the Department of Energy, work supporting agency missions in fusion, accelerators and energy storage, generation and transmission.
- o In the Department of Defense, work supporting sensors, electronics, thin films, naval propulsion and power generation. In 1991 or 1992, the Navy plans to run tests of refrigeration of passive electronic components in space using radiative cooling.
- o In the National Science Foundation, fundamental research into the theory, experimental properties, structure and the synthesis and processing of HTS materials.
- o In the National Aeronautics and Space Administration, work supporting communications, spectroscopy, power transmission and magnetic energy storage.

- o In the National Institute of Standards and Technology, work supporting measurement and determination of superconductor properties.

INDUSTRIAL AND ACADEMIC PARTICIPATION

Business and academia have important roles in the Action Plan. The Plan recommends the formation of industry-university-government laboratory consortia focusing on superconductivity, a recommendation also made by the Committee to Advise the President on Superconductivity chaired by Ralph Gomory. In addition, both the National Critical Materials Council and the new President's Council of Advisors on Science and Technology (PCAST) will provide vehicles for industrial and academic input on superconductivity. In the case of PCAST, such input will be obtained largely through working groups reporting to PCAST, with members drawn primarily from the private sector.

OSTP activities in superconductivity will be an integral part of the broader technology policy of this Administration. This policy recognizes that a strong manufacturing sector is a prerequisite for our future national well-being. The nation needs a better working relationship between government and industry and an improved climate for the formation of private sector R&D consortia. The sophistication and capital-intensive nature of modern technology require new ways of increasing cooperation between government and industry and of fostering communication on long-term technology goals.

Good examples of the increasing emphasis on government-industry cooperation are the Superconductivity Pilot Centers in the Department of Energy laboratories at Los Alamos and Argonne and the High Temperature Materials Laboratory at Oak Ridge. These R&D projects provide for cost sharing, collaborative R&D agreements, joint publications and broad industry participation. In effect, the technology is not transferred to industry but is rather developed jointly between laboratory and industry and is then carried back to companies by their participating scientists and engineers.

The first cooperative agreement under the Pilot Center Program was signed in December 1988. To date, 24 cooperative agreements have been signed. Ownership of intellectual property is negotiated for each contract. As an example of such agreements, Oak Ridge and Westinghouse signed an agreement aimed at increasing the current carrying capacity of certain high temperature superconductors. Planned funding in 1991 for the pilot centers is \$15 million, up from \$6 million in 1989 and 1990.

JAPANESE APPROACH ON SUPERCONDUCTIVITY

The Japanese also are very interested in superconductivity. I recently spoke with Professor Mildred Dresselhaus of the Massachusetts Institute of Technology, who chaired a just-completed study on high temperature superconductivity in Japan, and with Professor Shoji Tanaka of the University of Tokyo, who heads a national effort in this area. The Japanese superconductivity R&D effort provides an excellent example of how government, business and industry cooperate in Japan. It is worth

taking some time here to discuss how the Japanese are proceeding with superconductivity (and indeed with other technologies that they view as critical), although I am certainly not advocating that we attempt to copy, in any blind fashion, the Japanese approach:

- o First, the Japanese government targeted superconductivity--as well as other technology areas--for special attention. Once targeted, the Japanese government develops cooperation, from the top down, among industry, academia and the government. In superconductivity research, for example, broadly stated, long-range goals are to prepare for commercial use of superconductors in large-scale applications in transportation and the generation and use of electrical power.
- o Once targeted, a long-term commitment is made of both money and people, even if results are slow in coming or do not come at all. Japan bets on the long haul. That long time horizon is, in my opinion, crucial. Those involved are assured that if they continue an aggressive drive toward the stated long-range goals, they will continue to be supported.
- o This general policy leadership on the part of the Japanese government strongly encourages industry and academia to assign their best people and support in developing the basic technology. Once the technology is available, however, the participants separate, use this basic technology as they think best and compete with one another and with the rest of the world. It should be noted that the great majority of the investment capital involved comes from the Japanese private sector.
- o Finally, the Japanese focus on what in this country might be called "super technicians." These are people with bachelors and masters degrees who become extraordinarily expert at what they do. They are a critical link between basic research and manufacturing. The Japanese system also puts basic researchers and development engineers into close working proximity. Experts and the "super technicians" in both manufacturing and materials areas work as part of a superconductivity group so that from the very outset their concerns and expertise are part of the process.

In summary, Japan appears to be putting basic researchers, engineers, product developers and manufacturing and materials experts in groups, stirring briskly, and then assuring steady long-term support in pursuit of broadly defined national goals. We cannot and should not attempt to simply copy elements of the Japanese approach. However, we should pay close attention to what they are doing and be sufficiently flexible to incorporate some of the best features of their approach while capitalizing on our own strengths.

In particular, I believe that we, like the Japanese, need to internalize a long-term perspective in the economic life of our nation. Such a perspective would do more than anything else to assure U.S. leadership in superconductivity and in other

areas on the cutting edge of technology. Needless to say, these issues extend beyond the specific topic of superconductivity. In the area of budgeting, for example, stability and long-term commitment generally are far more effective than a cyclical approach. Patient, low-cost capital availability is also extremely important.

In conclusion, superconductivity--and particularly high temperature superconductivity--is an area with an exciting and open-ended future. More generally, the broad field of materials science and engineering, which includes superconductivity, is an area of rapidly growing importance to our modern industrial civilization. Increasingly, materials can literally be designed at the atomic level to produce desirable properties in the resulting product. The area of superconductivity is an excellent illustration of these concepts. The continuing involvement of OSTP in superconductivity will be part of an increasing involvement of this agency in the vitally important areas of materials and critical technologies.

SUPERCONDUCTIVITY BUDGETS
 BY AGENCIES FOR FY90 ESTIMATED
 AND FY91 PROPOSED
 (MILLIONS OF CURRENT DOLLARS)

<u>AGENCIES</u>	<u>FY 1990 ESTIMATE</u>	<u>FY 1991 PROPOSED</u>
DOE		
LTS	79.3	61.1 ¹
HTS	<u>34.1</u>	<u>43.3</u>
TOTAL	113.4	104.4
DOD		
LTS	13.2	13.2
HTS	<u>61.8</u>	<u>61.8</u>
TOTAL	75.0	75.0
NSF		
LTS	3.0	3.0
HTS	<u>25.8</u>	<u>27.3</u>
TOTAL	28.8	30.3
NASA		
LTS	2.0	2.0
HTS	<u>5.9</u>	<u>5.9</u>
TOTAL	7.9	7.9
NIST		
LTS	.5	.5
HTS	<u>2.8</u>	<u>4.7</u>
TOTAL	3.3	5.2
ALL AGENCIES		
LTS	98.0	79.8 ²
HTS	<u>130.4</u>	<u>143.0³</u>
TOTAL	228.4	222.8 ⁴

¹ Reflects decrease of \$17.9 million for SSC magnet R&D.

² 0% change from FY 1990 after correction for SSC.

³ 9% increase from FY 1990.

⁴ Agency total supersedes estimates for FY 1991 of \$215.4 M.

STATEMENT

BY

D. ALLAN BROMLEY,
ASSISTANT TO THE PRESIDENT FOR SCIENCE AND TECHNOLOGY, AND
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

ON

S. 324

NATIONAL ENERGY POLICY ACT OF 1990

WASHINGTON, D. C.
APRIL 5, 1990

Final
4/4/90 4:50

STATEMENT

by
D. Allan Bromley,
Assistant to the President for Science and Technology, and
Director, Office of Science and Technology Policy

before the
Committee on Energy and Natural Resources
United States Senate

on

S. 324
National Energy Policy Act of 1990

April 5, 1990

Thank you for the opportunity to present the views of the White House Office of Science and Technology Policy (OSTP) on S. 324, the National Energy Policy Act of 1990. OSTP and the entire Administration share the committee's conviction that our national energy policy must be based on sound environmental, economic, and technical considerations. However, we believe that mechanisms now in place offer a significantly better chance of developing and implementing such policy than do the measures in the Act. The Administration, therefore, opposes enactment of S.324.

SCIENTIFIC UNCERTAINTIES REGARDING GLOBAL CLIMATE CHANGE

There is no question that human beings have significantly altered the composition of the atmosphere by burning fossil fuels, cutting down forests to greatly expand agriculture, and producing industrial chemicals such as chlorofluorocarbons. Over the past two centuries, the amount of carbon dioxide in the atmosphere has risen 25 percent. The level of atmospheric methane, a potent greenhouse gas generated by agricultural and industrial practices, has more than doubled.

Although scientists have predicted since the end of the nineteenth century that increases in atmospheric carbon dioxide would increase the temperature of the planet, our understanding of the relationship between greenhouse gases and global climate change remains imprecise and inadequate. The scientific challenge is great, and our inability to separate human impact from natural variability and the uncertainties surrounding temperature records compounds the problem. Nevertheless, few scientists would argue with the contention that if we continue to load the atmosphere with greenhouse gases, we will eventually experience some degree of warming.

Our general understanding of radiative forcing mechanisms in the atmosphere leaves unanswered the critical questions regarding how much warming will occur, the timing of any warming, impacts on sea level, rainfall and soil moisture, and the regional effects created by all of these factors. Those who are following the literature know that new, and sometimes conflicting results on the predictions for future global changes appear almost on a daily basis.

It is also important to recognize that developing an improved understanding of geophysical climate processes is only the first step in developing appropriate policies. Estimates of the human and social consequences stemming from actions that might be taken to curtail greenhouse emission, as well as those stemming from predictions on future warming and ancillary changes associated with it, must then be developed and used as the basis for policy formulation. Science and economics research aimed at developing necessary estimates and insights is a top priority for the Administration.

Our scientific research is making significant progress. Nonetheless, the state of the science remains highly uncertain. In fact, several recent studies suggest a move to more moderate predictions of the extent of global climate change and its potential impacts. For example:

- o In January of this year, a National Academy of Sciences panel concluded that current climate change models predict a global warming closer to 2 degrees Celsius over the next fifty years, not the previous range of 1.5 degrees to 4.5 degrees Celsius.
- o In December 1989, the American Geophysical Union revised earlier estimates of rise in sea level of between 20 and 120

inches by the year 2100 to a new estimate of between 0 and 30 inches.

- o Recently U.K. scientists have introduced a better representation of cloud processes in their global climate change model. The new estimate of warming for a doubling of CO2 dropped to 1.9 degrees Celsius, down from the previous estimate of 5.2 degree Celsius.
- o In January of this year, NOAA reported new results from its global climate model, using more realistic ocean simulations. This model now predicts that even with a doubling of the current CO2 levels there would not be warming in the Southern Hemisphere. Indeed, projections indicate some areas of the globe will be cooler.

Given this level of uncertainty in predictions about global climate change, it is clear we need to continue the aggressive research program being supported by various Federal agencies to understand more fully the ramifications of increased greenhouse gas emissions in the atmosphere and potential impacts that could be caused by global climate change. In the meantime, we should embark, on measures to reduce greenhouse gas emission only if those measures also serve other policy objectives. That is precisely what the Administration has done.

ADMINISTRATION ACTIONS FOR ENERGY AND THE ENVIRONMENT

I would like to now summarize several initiatives undertaken by the Administration that address some of the objectives of S.324. Then I will describe our recent progress toward establishing a comprehensive research program in the areas of energy and global climate change, as well as mechanisms -- both national and international -- that we have developed for formulating informed policy decisions and for implementing these decisions. These actions, in my view, constitute an effective response to the goals that we all share.

The Administration considers it imperative that we continue to develop, in cooperation with the Congress, a well-designed program for research into the effects of greenhouse gas emissions on climate. We must also evaluate the economic and policy aspects of potential responses. Such a program will provide the foundation essential for the development of a

rational national energy policy that is economically and environmentally responsible.

I would also wish to emphasize the Administration's position that, pending the resolution of the significant scientific uncertainties surrounding climate change processes and their human and social impacts and concerns regarding economic and social dislocations stemming from efforts to limit fossil fuel use, our immediate focus should be on those actions that will reduce greenhouse gas emissions, but which can be fully justified for other reasons. For example, we have a commitment to phase out manufacturing and use of CFC's by the year 2000, ahead of the requirements of the current Montreal Protocol, provided safe substitutes exist -- these constitute 25 percent of our current greenhouse gas emissions. The Clean Air legislation currently under debate in the Congress will also provide substantial reduction in the emission of some of the greenhouse gases. A strong commitment to energy conservation is to be a major component of the Department of Energy's National Energy Strategy; and as an initial step in putting this strategy forward, the Department of Energy has already announced a series of conservation and renewable energy initiatives that are included in the President's FY 1991 budget request.

Turning from sources of these emissions to sinks, the Department of Agriculture's tree planting initiative (the planting of a billion trees on private land across America -- trees that could eventually absorb 13 million tons of carbon, annually) presented in the President's FY 1991 Budget, and our continued diplomatic discussions with countries such as Brazil aimed at protecting the remaining tropical forests, are key parts of our immediate response to this potential problem.

The Administration has already taken a number of additional steps that will enhance our understanding of, and response to, the potential effects of global climate change.

The President proposed in his FY 1991 Budget that funding for the U. S. Global Change Research Program be increased 57 percent over FY 1990, to \$1.03 billion in FY 1991. The proposed funding would significantly expand research, data gathering, and modeling activities through a carefully balanced mix of ground-based and space-based research.

An underlying theme in all of the Administration's activities relative to potential climate change is that the strategy must be scientifically-based and technically and economically sound. It must also be dynamic -- responsive to new knowledge and ideas, and to global, environmental and international changes. A report on the wide ranging public hearings that represent a step in the process of formulating the National Energy Strategy, for example, has just been released.

FEDERAL RESEARCH POLICY AND COORDINATION

The Office of Science and Technology Policy is charged with reviewing and coordinating Federal R&D that cuts across the missions of more than one Federal agency, and with providing advice to the President on issues of science and technology policy that affect national and international policy. As Assistant to the President for Science and Technology and Director of OSTP, I chair two complementary councils -- one federal, FCCSET and one private sector, PCAST -- that provide information and advice. In addition, I chair working groups of the Economic Policy Council and the Domestic Policy Council related to science and technology issues. These groups, whose functioning I shall now describe, will accomplish the objectives -- and many more besides -- of the coordinating council proposed in S.324. Thus, the organizational changes proposed in S.324, I believe, are unnecessary. The establishment of a coordinating council proposed in S.324 would be duplicative and would not add significantly to the existing mechanisms.

S.324 also sets out specific R&D criteria that the proposed coordinating council is required to use as the basis for preparing "management plans" for the conduct of R&D in certain identified technologies. We do not believe the overly prescriptive nature of such an approach will be successful. The proposed approach does not adequately include the participation of the private sector technology developers and technology users. Most observers of R&D policy have found that successful government R&D occurs most frequently when the users or ultimate manufacturers of the technology are involved in the planning, conduct and testing of the applied technologies. S.324 does not provide adequate mechanisms for this critical private sector involvement.

Federal Coordinating Council for Science and Technology

The Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) was originally established in 1976 by Public Law

94-282, the National Science and Technology Policy Organization and Priorities Act, which also established the Office of Science and Technology Policy.

FCCSET is charged with providing more effective planning, coordination and administration of federal scientific and technological programs. This includes identifying research and development needs, and developing and reviewing in close cooperation with the Office of Management and Budget federal budget plans in cross-cutting areas of science and technology.

Research on global change is supported by a number of federal agencies and constitutes an exemplary case of common effort on a science policy issue. OSTP's coordinating function in global change research has been carried out largely through the Committee on Earth Sciences (CES), which is one of the committees under FCCSET.

The CES in turn has two subcommittees that deal with global change, the Working Group on Global Change, chaired by Robert Corell of the National Science Foundation, and a new Working Group on Adaptation and Mitigation Technologies, headed by John Knauss of the National Oceanic and Atmospheric Administration.

I would like to submit for the record a copy of the document "Our Changing Planet: The FY 1991 U.S. Global Change Research Program," which was developed by the CES Working Group on Global Change and which formed the basis for the President's FY 1991 budget request in this area.

The CES has integrated the efforts of the federal agencies conducting research on global change into the U.S. Global Change Research Program (USGCRP). The goal of the program is to reduce key scientific uncertainties and to develop more reliable scientific predictions upon which sound policy strategies and responses can be based. The CES expects to update the research plan annually and to change priorities as research results are obtained and as nonfederal groups provide input into the research process.

Among the many interesting and important science questions that need to be investigated, I would mention, in particular, the reliability of general circulation models, the earth's climatic history, the role of

clouds, oceanic influences on the atmosphere and climate, the hydrologic cycle, and changes in ecosystems.

This existing interagency coordinating mechanism is far preferable to the establishment of the committee directed in S.324, composed of directors of national laboratories who, after all, are contractors to the Department of Energy. In fact, the Committee on Earth Sciences, has done an excellent job in coordinating global change R&D. Having established an interagency process that works, it would be a mistake to replace it with a new mechanism which places contractors on an equal footing with cabinet agencies.

The President's Council of Advisors on Science and Technology

The President's Council of Advisors on Science and Technology (PCAST) was established by Executive Order of the President on January 19, 1990. The Council, which I chair, reports directly to the President and consists of 12 distinguished scientists and engineers from academia, industry, and other nonfederal institutions. This council provides an important ingredient that is missing from the FCCSET process -- views from outside the federal sector.

PCAST has already met twice with the President and his senior advisors. One of the topics discussed was global climate change, and I shall request PCAST to form a panel on environmental science and global change. This panel, with its private sector perspective, will complement the advice we receive from the CES subcommittee of FCCSET. The fact that I chair both FCCSET and PCAST insures good communications between the two groups.

The Domestic Policy Council Working Group on Global Change

President Bush also has asked me to chair a Cabinet-level Working Group on Global Change under the White House Domestic Policy Council. The Working Group provides Cabinet-level coordination on global change issues and is an important source of advice for the President.

The Working Group, when established last October, called immediately for three specific studies: (1) an analysis of economic costs of global change and responses to it, (2) an analysis of private sector concerns, activities, and issues on global change, and (3) legal precedents for international agreements and conventions on the environment.

Preliminary drafts of these reports have been presented to the Working Group for use in their deliberations. In addition, the Working Group has set up a number of briefings by top experts on the scientific, economic, environmental, and industrial aspects of global change.

Economic Policy Council Working Group on Science and Technology

Late last month an Economic Policy Council Working Group on Science and Technology was established to assist in formulation, coordination and implementation of Administration policies involving science and technology. The Working Group will also develop science and technology issues related to domestic and social policy for consideration by the Domestic Policy Council.

I will chair this Working Group, and members will include White House officials and senior representatives from all federal agencies and departments with substantial involvement in scientific and technological issues. This Working Group will analyze the scientific and technological components of economic and domestic policy issues.

INTERNATIONAL RESEARCH AND POLICY-MAKING MECHANISMS

Global climate change affects all nations and thus requires international study and cooperation. Within the international scientific community are a variety of informal mechanisms for planning science programs. Often these informal mechanisms are used to plan the detailed scientific elements of a more formal program, several elements of which are outlined below.

Conference on Science and Economics Research Related to Global Change

The President has asked me, together with the Chairman of the Council of Economic Advisers and the Chairman of the Council on Environmental Quality, to organize a White House meeting of the three senior officials in science, economics, and the environment from a number of countries. This White House Conference on Science and Economics Research Related to Global Change will take place in Washington, D.C. on April 17-18, 1990.

The conference will be devoted to science and economics research issues relevant to policy on global change, including climate. The Conference is designed to address important next steps that substantially enhance and broaden international understanding of science and economics research issues, and to frame initial steps toward a strategy for implementing joint international science and economics research efforts. It seeks for the first time to join research issues central to both the science and the economics related to global change.

Intergovernmental Panel on Climate Change

The U.S. government was instrumental in establishing and continues to support the work of the Intergovernmental Panel on Climate Change (IPCC), which is sponsored by the United Nations and the World Meteorological Organization. The three working groups of the IPCC, which are studying the scientific aspects of global change, impacts, and response and mitigation strategies, respectively, met here in Washington recently to prepare their reports. The final papers of the working groups will be presented to the full IPCC in August, shortly before the Second World Climate Conference in October.

In an address to the IPCC Plenary Session here in Washington, President Bush commended their activities and reaffirmed the United States' strong commitment to the IPCC process. He said, "We consider it vital that the community of nations be drawn together in an orderly, disciplined, rational way to review the history of our global environment, to assess the potential for future climate change, and to develop effective programs."

The IPCC process is designed to provide input to an International Framework Convention on global warming. At the Malta summit last December, President Bush proposed that the United States offer a venue for the first negotiating session for this Framework Convention, and he reiterated that offer at the IPCC meeting.

CONCLUSION

A National Energy Strategy is currently being developed by the Administration that will respect the environment, meet our nation's needs for energy, and not damage our economy or international competitive position. The Administration has already taken specific actions to begin dealing with the potential problem of global change by

taking the initiative on CFCs and Clean Air legislation that will have the effect of limiting greenhouse gas emissions. A vigorous structure of coordinating and advisory councils on global change is already in place and is functioning well.

Title I of the Act would unnecessarily duplicate, and thus complicate and hinder, aspects of both the National Energy Strategy planning process and the Executive branch committee structure we have just revitalized. I would have to oppose, in particular, formation of the proposed Federal Energy-Environmental Coordinating Council. More generally, I have a concern with requirements that would set goals or targets before we have reached agreement on how to evaluate total fuel cycle costs. Certainly, we should not do so unilaterally. These requirements could constrain our technical options, weaken our economy and threaten our competitive position with little environmental gain. The White House Conference later this month will begin to provide a basis for more considered actions.

Title II addresses energy efficiency. Increased efficiency and conservation are being closely considered in the formulation of the National Energy Strategy. The removal of market barriers to increased efficiency is relatively noncontroversial. Other steps to raise efficiency must be evaluated in light of their other impacts and benefits. The contribution of increased efficiency to lowering greenhouse gas emissions is clearly relevant. Our greenhouse gas emissions goals must ultimately be set with reference to the social and economic consequences of the actions required to attain them and those that would arise in a scenario where no such goals were adopted.

If significant greenhouse emission limitation over a relatively short time frame is ultimately judged to be desirable, increased efficiency alone will not suffice. In my considered opinion, massive fuel switching in our generation of electrical energy, greatly increased reliance on nuclear energy as well as other actions will be required. Consequently, to prepare for this possible policy direction, any long-term national energy plan should include research on advanced inherently-safe reactor concepts. These critical elements are missing from the Act. These very issues, however, are being addressed in a comprehensive fashion in the development of the National Energy Strategy and in the Intergovernmental Panel on Climate Change process.

Title III, in addressing energy research initiatives, would impose in several instances, detailed micromanagement that could be harmful to our development of an effective National Energy Strategy. I will defer to the Department of Energy for specific comments on individual technologies, many of which can play vitally important niche roles, but would again note my concern — expressed above — that research continue, with high priority, on advanced reactor concepts.

In summary, the Administration shares the Committee's commitment to address global climate change issues in a comprehensive manner based on sound environmental, economic and technical considerations. We believe, however, that the mechanisms currently in place are more than adequate to achieve this objective and we oppose the bill because many of its provisions are unnecessary, duplicative and overly prescriptive.

That concludes my prepared testimony. I would be happy to answer questions from the committee.