Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01. Notes	Handwritten notes re: Russia (1 pp.)		(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Policy Development, White House Office of
Series: Kolb, Charles E.M., Files
Subseries:
WHORM Cat.:
File Location: PCAST

Date Closed:	2/2/2010	**OA/ID Number:**	06384-007
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
02. Memorandum	To: Roger Porter From: Charles Kolb Re: Center for International technical Cooperation and Research (2 pp.)	10/15/91	(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Policy Development, White House Office of
Series: Kolb, Charles E.M., Files
Subseries:
WHORM Cat.:
File Location: PCAST

Date Closed:	2/2/2010	**OA/ID Number:**	06384-007
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
03. Memorandum	To: Roger Porter From: Charles Kolb Re: Center for International technical Cooperation and Research (2 pp.)	10/15/91	(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Policy Development, White House Office of
Series: Kolb, Charles E.M., Files
Subseries:
WHORM Cat.:
File Location: PCAST

Date Closed:	2/2/2010	**OA/ID Number:**	06384-007
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

PCAST

THE WHITE HOUSE

WASHINGTON

January 3, 1991

MEMORANDUM FOR ALAN BROMLEY

FROM: CHARLES E. M. KOLB CEMK

SUBJECT: PCAST

Attached is the article from the December 19, 1990, edition of the "Princeton Alumni Weekly." I think you'll enjoy this.

Serving on a Presidential Council

Last year, I was invited to be one of the dozen members of President Bush's Council of Advisers on Science and Technology (PCAST). I was the sole economist on a committee otherwise made up of distinguished scientists and engineers and chaired by Dr. Allan Bromley, the president's science adviser. Serving on the council has been an honor and a challenge, and I'd like to share some reflections on my experience to date.

The council has a number of overlapping functions—all of them advisory to the president through Dr. Bromley. One is to help inform key federal policy-makers of recent developments in science and technology relevant to various federal issues. We also recommend policies to strengthen the nation's research and development (R&D) base. Third, we help evaluate the effects of various federal policies or policy initiatives—for example, tax law—on the science and technology base. The fourth charge is to contribute to policy discussion and analysis regarding technology transfer, that is, ways new understandings of the natural world get translated into products and processes that generate economic and social dividends such as improved economic competitiveness or health care. Finally, the council is charged to play a role, as may be requested, to advise on the coordination of federal policy in science and technology that stretches across various agencies and congressional committees.

Harold T. Shapiro

As you can see, the scope of the council's responsibilities is potentially quite broad. We began our work with a four-hour meeting with President Bush at Camp David. Our group's first challenge was to articulate an agenda for that meeting; selecting an agenda of finite size for this rare opportunity proved to be a daunting task indeed.

For one thing, it was very difficult restricting ourselves to issues of which we had special knowledge—I, at least, had many things I wished to discuss with the president! As Winston Churchill said, the only problem with democracy is that only those out of power know how to fix things. We had to keep our sights focused squarely on science and technology despite the temptation to speak to the president about other large and critical issues.

Four hours is a lot of a president's time, but not a lot of time for even a preliminary examination of the long list of issues within our charge and expertise. It was difficult to concur on what we should cover. After many hours of discussion, with each of us advocating our own perspectives, we finally agreed to submit a list of a dozen or so topics and let the president choose what he was most eager to discuss. Of these, the president selected three topics on which to concentrate our initial discussion: global change, science and mathematics education, and economic competitiveness.

As a result of that discussion, we decided to form a panel of experts in the area of global change to learn more about its nature and impact. This is, of course, a highly controversial area where much remains to be learned, but where policy actions need to be taken before all the necessary information is fully understood—a dilemma often faced by policy-makers.

As for science and math education, it is a tragedy in the classic sense: We see events unfolding before our eyes and we know what to do to improve the situation, but we seem to be paralyzed in our capacity to act. How do we mobilize a complex society to work on the problem?

With respect to economic competitiveness, we continue to focus our attention on how to translate most effectively accomplishments in science into equally extraordinary economic accomplishments. There can be a deep chasm between these two. Indeed, it is my opinion that this divide has been precisely the area of our greatest difficulty in recent years. Simply stated, whether or not we are economically competitive is intimately related to *both* the nation's R&D base and a wide series of social, political, and cultural arrangements (that is, how members of a society work together toward a common goal).

Other issues that have occupied us include tax policy; big science versus small science, and the role of the individual investigator; and the necessity of building up our country's long-term investments in physical and human capital and research and development. In addition to global change, we have also decided upon special panels in bio-science, education and human resources, and material science and high performance computers. We confer with the president and some of his advisers for about an hour at each of our monthly two-day meetings.

"We had to keep our sights focused squarely on science and technology despite the temptation to speak to the president about other large and critical issues."

Whether the suggestions of PCAST and its panels will have any impact on federal government policy I cannot predict. As my colleagues and I begin to delineate the issues for the present and the future, I am constantly reminded how vital it is to develop sound policies in these areas, and I am continually aware of the role Princeton can and should play in educating the next generation of scientists, engineers, and public officials knowledgeable about science and technology. I also know that the process has been fascinating and the discussions often profound. I consider it a high privilege to be able to serve the nation in this particular way.

PCAST

THE WHITE HOUSE

WASHINGTON

December 13, 1990

MEMORANDUM FOR D. ALLAN BROMLEY

FROM: CHARLES E.M. KOLB CEMK

SUBJECT: PCAST Briefing Material

Thank you for the opportunity to comment on the briefing memorandum to the President. I have made some minor editorial suggestions on page 2.

My more specific concern is about the section that describes White House staff comments on the PCAST paper.

I would recommend deleting the section on Comments about meeting the National Education Goals. This section will only confuse the President. First, it is unclear who the "staff" are who are commenting and why their views are needed here. I'd let the PCAST document speak for itself.

Second, the point made about assessment tends to confuse the mechanism completely. The strategy behind the National Goals is to develop an assessment issue that will provide parents and others with reliable data on how their children are performing in school. Doing so will serve as a major catalyst for reforming and restructuring our education system. This issue is altogether different from calling "for more studies on assessment" as indicated in your cover memorandum. Assessment has nothing whatsoever to do with centralized planning; in fact, it is the opposite. By providing reliable data on performance down to the individual student level, we will be offering parents greater information with which to exercise educational choice and, therefore, help reform the educational system.

I hope these comments are helpful.

cc: James W. Cicconi

Document No. _____

WHITE HOUSE STAFFING MEMORANDUM

DATE: 12/12/90 ACTION/CONCURRENCE/COMMENT DUE BY: 12/13/90 NOON

SUBJECT: PCAST BRIEFING MATERIAL

	ACTION	FYI		ACTION	FYI
VICE PRESIDENT	☐	☑	MCCLURE	☐	☐
SUNUNU	☐	☑	NEWMAN	☐	☐
SCOWCROFT	☑	☐	PORTER	☑	☐
DARMAN	☑	☐	ROGICH	☐	☐
CARD	☐	☑	UNTERMEYER	☐	☐
CICCONI	☐	☑	BOSKIN	☑	☐
DEMAREST	☐	☐	BROMLEY	☐	☑
FITZWATER	☐	☐	_____	☐	☐
GRAY	☐	☐	_____	☐	☐
HAGIN	☐	☐	_____	☐	☐
HOLIDAY	☑	☐	_____	☐	☐

REMARKS:

Please forward any comments directly to D. Allen Bromley, Rm. 358, x7116, no later than NOON, Thursday, December 13, with a copy to my office. Thank you.

RESPONSE:

James W. Cicconi
Assistant to the President
and Deputy to the Chief of Staff
Ext. 2702

THE WHITE HOUSE

WASHINGTON

December 11, 1990

MEMORANDUM FOR THE PRESIDENT

FROM: D. ALLAN BROMLEY

SUBJECT: Briefing by the President's Council of Advisors on Science and Technology

Attached are two papers prepared by your Council of Advisors on Science and Technology (PCAST), and one paper prepared through an interagency process, that will be used in discussions at their next meeting with you. The first is entitled "Education in Science and Mathematics: Meeting the National Education Goals"; the second is entitled "Technology and the American Standard of Living." The two PCAST papers are summarized below. The third paper, "U.S. Technology Policy," is a compilation of current Federal government policies that affect technology.

The two PCAST papers have been circulated to a number of offices within the Executive Office of the President for review and comment. Because PCAST is chartered as an independent advisory body it is appropriate for them to provide you with independent advice. We believe, however, that it is important for your White House staff to have an opportunity to respond to the thoughts of this group, which would also allow the PCAST to obtain a better understanding of Administration interests and policies. As a result, we have summarized here the major issues that were raised in the review process. In addition, comments received on the papers will be shared with PCAST members in preparation for their next meeting.

"MEETING THE NATIONAL EDUCATION GOALS"

The first paper applauds your leadership, and that of the nation's Governors, in moving education toward the top of the nation's agenda. It points out, however, that achieving the goals will require a fundamental restructuring of elementary and secondary education in America. The goals themselves are an important element of this restructuring, in that they focus on performance or levels of achievement rather than processes or inputs such as the amount of time a student spends in a particular class. Past reforms have most often involved changes in inputs, and the results of these reforms have been generally disappointing.

A number of other fundamental changes will also be required to meet the national goals. Promising approaches include the introduction of parental choice in education, rewarding exceptional teachers, reducing impediments to change through school-based management, and a shift in focus in education from institutions to the children those institutions serve (particularly for students at risk of dropping out).

The members of PCAST believe that an evaluation of the proposed changes will depend on the availability of reliable performance-based assessment mechanisms for both students and teachers. They indicate that considerable work needs to be done in this area to create greater confidence in assessments and more understanding of how assessments relate to actual learning.

PCAST points out that the federal government cannot mandate reform in the decentralized system of basic education in America. However, the federal government can facilitate the reform initiatives mentioned in the paper. A number of actions are presented for further consideration:

- o Provide incentives to states or regions pursuing reforms
- o Foster greatly intensified research on academic assessments
- o Facilitate and coordinate state and local programs to deal with the dropout problem
- o Encourage both private companies and government agencies to work cooperatively with local schools
- o Encourage talented females and minority students to study science and mathematics
- o Invest in teacher training programs in science and mathematics and use forgivable loans and other incentives to attract young people with degrees in science, mathematics, and engineering to teach in schools

COMMENTS ON "MEETING THE NATIONAL EDUCATION GOALS"

Some of the comments were favorable, pointing out that the papers are generally consistent with existing Administration policy and the decisions emerging from the FY 1992 budget process. However, some specific points have been raised.

Some staff objected to the emphasis on assessment, indicating that we do not need better tests to tell us how our schools are failing. To meet the goals we must take action now and not wait for more studies on assessment. Furthermore, a focus on assessment tends to emphasize central planning, whereas choice programs and other reform strategies call for greater local autonomy and flexibility.

The scientific and engineering communities were also urged to focus on specific actions that those communities might take to promote educational reform. For example, scientists and engineers could work with local communities to promote choice, magnet schools, and particularly alternate certification programs.

Finally, it was pointed out that the Federal government needs a solid rationale before embarking on major efforts to retain talented females and minorities in science and mathematics and to invest in teacher training programs. In addition, forgivable loans for teacher education is not current Administration policy; similar legislative provisions prompted veto recommendations from the Administration last year.

"TECHNOLOGY AND THE AMERICAN STANDARD OF LIVING"

The second paper states that new technologies and basic research have contributed to dramatic increases in economic growth and improvements in the quality of life. The United States has led the world in science and technology for much of this century, resulting in a standard of living to which the rest of the world aspires. But, the paper continues, we need to take other steps to continue to lead the world and provide a standard of living that will allow our children and grandchildren to live better than we do.

The paper points to three things that PCAST believes are required for America to continue to benefit from the dividends of science and technology: (1) a continuing flow of new ideas and new understanding; (2) the translation of new ideas and new technologies into significant new products and into steady improvements of existing products; and (3) a revival of quality manufacturing and production of goods.

According to the PCAST, the federal government has a role, though not the exclusive role, in each of these three areas. Regarding the flow of new ideas, the Federal government must continue to make a strong investment in basic research and must continue to support the principle of scientific diversity. To address concerns about the future support of scientific research, especially among young scientists, the federal government should develop a well-articulated position that the generation of scientific and technological talent is essential to America's future and will be given high priority. Finally, the Federal government should join with the private sector to revitalize the instrumentation and facilities that are crucial to forefront research.

The paper also discusses the importance of product development and the role of the Federal government in assisting private industry. Compared with other countries, the United States is seen as relatively weak at translating basic knowledge into significant new products and in improving those products that are already an important part of our lives. The Federal government can help to speed product development by creating an economic climate that stimulates the development of new products and processes. It can also support the development of generic, pre-competitive technologies that have widespread applications in the public and private sectors.

The federal laboratories are a major resource. PCAST believes that they could contribute more effectively to technology transfer, particularly if some of the laboratories are given new missions focusing on generic, pre-competitive technologies, on manufacturing, and on technology transfer. In addition, legislative and regulatory actions by the federal government can support and encourage appropriate technology transfer at the level of individual scientists and institutions.

Finally, even though manufacturing technology is predominantly the responsibility of industry, PCAST believes the Federal government could take several actions to make manufacturing a high priority for this country. Programs can be established to recognize the importance of manufacturing to the American standard of living, as is done through the Malcolm Baldrige National Quality Award. The Federal government could also support engineering education and fellowships targeted for research and manufacturing technology.

COMMENTS ON "TECHNOLOGY AND THE AMERICAN STANDARD OF LIVING"

The majority of comments on the PCAST's technology paper focused on their call for a renewed emphasis on manufacturing. One staff person noted that some economists disagree on this emphasis, particularly since manufacturing accounts for just 22 percent of our GNP (down from 29 percent in 1950). In addition, it was felt that this recommendation went beyond the charter of PCAST because it addresses economic rather than R&D issues.

A concern was also raised about radically redirecting the missions of the federal laboratories in support of civilian applications. If these laboratories no longer serve a useful federal purpose, they should be phased down or closed. According to this view, it would be very inefficient and unproductive to try to use the federal laboratories to support the private sector.

Attachments

EDUCATION IN SCIENCE AND MATHEMATICS: MEETING THE NATIONAL EDUCATION GOALS

The National Education Goals developed by the President and the nation's Governors have helped to move education toward the top of the nation's agenda. Following the lead of the President and the Governors, Americans in growing numbers are committing their energies to efforts designed to improve basic education.

Achieving the national goals will require significant improvement in science and mathematics education. However, revitalizing science and mathematics education will not be possible without much broader reforms in American basic education. This paper therefore examines some of the general reform strategies that will be needed to meet the national goals. It then suggests several ways in which the President and the federal government can anticipate and facilitate those reforms, with a particular emphasis on science and mathematics education.

THE NATURE OF THE GOALS

The National Education Goals have revolutionary implications for basic education. They are performance goals stated in terms of outcomes or levels of achievement. In the areas of science and mathematics, they require "demonstrated competency . . . in mathematics [and] science," sufficient to place U.S. students "first in the world in science and mathematics achievement" by the year 2000, when "every adult American will be literate and possess the knowledge and skills required in a global economy." Moreover, the call for 90 percent of our young people to graduate from high school requires that the goals extend to virtually all school-aged children, even those for whom alternate educational strategies are required.

Previous efforts to improve education have often used input or process goals, which prescribe the experiences that all students and teachers should undergo -- for example, the amount and kinds of courses required of all students. Many of the new approaches adopted in the 1980s were process reforms, and although there is some evidence that these changes have contributed to modest progress in recent years, their results have been generally disappointing.

REQUIREMENTS FOR EDUCATIONAL REFORM

Since the announcement of the National Education Goals, a consensus has emerged that achieving them will require fundamental restructuring of basic education in America. Incremental improvements may be achieved by further incremental changes, but the magnitude of improvement needed to meet the goals calls for massive change in the educational system.

The emphasis on performance implicit in the goals is one of the most important educational reforms needed to meet those goals. This focus on results rather than inputs must be accelerated and become pervasive throughout American elementary and secondary education.

However, performance can be emphasized only if achievement can be reliably measured. Today, we need greater confidence in assessment mechanisms and more understanding of how assessments relate to actual learning. Without such improvements, many in the education community feel it will be difficult to reorder the educational system on the basis of performance.

As assessment mechanisms are being improved, a complementary effort is needed in the area of curricular reform. Much good work is being done in this area, but implementation of the results in schools will not be easy. Moreover, testing standards should be coordinated with curriculum development, which is a major challenge.

A second fundamental change that will be required for the restructuring of basic education is the introduction of parental choice in the selection of schools appropriate for each child. Choice has many dimensions, ranging from permitting some children to choose "magnet" schools within the public system to distributing government vouchers for children to pay for educational expenses at any school, public or private. Whatever system is adopted, it is important to provide some measure of academic quality to act as a basis for choice. Requiring nationally standardized tests and publishing their results would provide one of the indexes that parents could use as consumers in the educational marketplace. Involving parents in education has great value, and giving parents some element of choice is often the beginning of a deeper parental involvement.

A third promising strategy in the reform of basic education is rewarding exceptional teachers. Implementation often founders on the difficulty of assessing the quality of a teacher, but improved assessments of teacher performance, along with other means of evaluation, including peer review, provide important opportunities for improving the quality of the teaching force.

Such efforts are especially important in science and technology. Unless teachers at both the elementary and secondary levels understand and appreciate science and technology, significant improvement will be difficult. Teacher training programs to improve the quality of science and mathematics teaching will be an

essential element in meeting the national goals.

A fourth requirement for effective reform is reducing bureaucracies by relying on school-based management that empowers principals and their teachers. However, bureaucracies will relinquish control to teams of teachers and principals at individual schools only if equity and accountability can be assured, which again raises the question of educational assessment.

Finally, underlying the needed reforms of basic education is the recognition that school is only one of many critical influences in a child's development. Only by shifting our focus from our institutions to our children can we truly address the challenges to our society. This strategy is particularly relevant for the retention of students at risk of dropping out, who may require strategies beginning with prenatal and child care even before formal school begins. If we are to strengthen our nation's workforce and build better citizens, we must shape society's institutions to our children and not vice versa.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government cannot mandate reform in the decentralized system of basic education in America. It can, however, facilitate, and where appropriate finance, the reform initiatives cited above, using incentives and appropriate leveraging to accelerate the reform process. In particular, we believe that the following federal actions warrant serious consideration:

o The federal government can provide incentives to states or regions pursuing any of the reforms described in the previous section, subject to constraints designed to ensure equity and equal opportunity. For example, federal funds might be used to facilitate choice for needy students, thereby providing an inducement to states or districts offering choice programs. Similarly, a national competition might be established to recognize and reward exemplary programs for restructuring education (just as the Malcolm Baldrige National Quality Award has recognized quality improvements in industry).

o The federal government can foster greatly intensified research on academic assessment and the development of measurement instruments so that performance standards can be set and the academic marketplace can function more rationally. For example, federal funds could be used to leverage voluntary participation in appropriate achievement evaluation programs.

o The federal government can make a concerted, national effort to facilitate and coordinate state and local programs, both public and private, to deal with the school dropout problem. Successful drop-out prevention programs could be recognized by the President and rewarded for their achievement.

o The federal government can encourage private corporations, universities, and

national laboratories to work cooperatively with local schools, building on the many excellent initiatives already under way.

o In the areas of mathematics and science, the federal government can encourage effective programs to engage talented girls and minority students in science and mathematics, where they are now underrepresented.

o The federal government can invest in teacher education programs in science and mathematics and use forgivable loans and other inducements to attract to teaching young people with degrees in science, mathematics, and engineering.

o The federal government can support programs using modern communications technologies, including satellite technologies, to expand access of both students and teachers to the most highly qualified teachers of science and mathematics.

THE PRESIDENT'S ROLE

Responsibility for our system of basic education in America rests fundamentally on the general population, who shape the learning environments of their children, elect their school boards and other influential politicians, and demonstrate their priorities by their behavior toward teachers and schools.

However, our nation's leaders influence the attitudes and values of the electorate. The President, in particular, has a personal role that reaches beyond his authority as our nation's chief executive officer. In choosing his own priorities as a leader, he sets a standard for all to heed.

The President, in partnership with the Governors, has placed a great challenge squarely on the national agenda. Now all of the resources of leadership must be applied to meeting that challenge. Federal budget priorities must be set, the activities of the federal agencies must be guided, and the President's personal commitment to education must continue to be demonstrated. With timely actions, and with a continuing and unremitting campaign of words, the President can secure his place in the history of American education.

TECHNOLOGY AND THE AMERICAN STANDARD OF LIVING

Today most Americans take for granted a standard of warmth, cleanliness, food, medical care, music and entertainment, and transportation that was undreamt of 150 years ago. This great surge forward in the standard of living can and will continue. Furthermore, this progress can encompass all Americans and the citizens of other countries as well.

The foundation for dramatic increases in economic growth and improvement in the standard of living has been technology. Basic research built a fundamental understanding of the physical world, including the laws of mechanics and gravity, the atomic and molecular bases of chemistry, and the basic principles of electricity and energy. Building on this knowledge, individuals brought forth one striking invention after another, from the steam engine, railroads, and the telegraph to electric lighting, the telephone, and radio. Over the years, the rate of technological progress accelerated. Advances in agriculture liberated the vast farm population for other pursuits; automobiles and airplanes provided unprecedented speed and accessibility over vast distances; and the television and computerized communications linked the world together. This remarkable surge in invention, which contributed to an equally remarkable ability to produce goods and services in volume, did much to create the modern world.

America has led the world in science and technology for much of this century -- resulting in a standard of living to which the rest of the world aspired. This paper explores what will be necessary to continue to lead the world and thereby provide a standard of living that will allow our children and grandchildren to live far better than we do today.

REQUIREMENTS FOR TECHNOLOGICAL LEADERSHIP

Since World War II, basic scientific research has provided a new foundation on which to build for the future. The molecules in a material can now be seen and studied at the atomic level. The discovery of the structure of DNA and of the immense complexity of the cell has opened up whole new areas of opportunity. New materials are being developed that are lighter, stronger, and more durable than anything known today. Advanced computers and new modes of communication, such as optical fibers, are resulting in new ways to learn, new ways to work, new kinds of

intelligent machinery with virtually unlimited new capabilities. Furthermore, a better understanding of the environment is making it possible for these advances to have far fewer negative environmental impacts than did earlier technological advances.

Three basic things will be required if the United States is to continue to benefit from the dividends of science and technology.

1. A continuing flow of new ideas and new understanding, which are the basis of new materials, better health care, new information technologies, a cleaner environment, and other technological advances.

2. The translation of new ideas and new technologies into significant new products and into the steady improvement of those that are already an important part of our lives.

3. A revival of manufacturing and the production of goods, which in the past has provided both the material wealth and the jobs that built the American standard of living.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government has a role, although not the exclusive role, in the development of technology. In particular, it has been a major catalyst for technology development through its direct investment in research and through legislative and regulatory actions that have facilitated the development and commercialization of new insights.

New Ideas and New Understanding

Our diverse science and technology base can generate new ideas anywhere -- on the production line, in industrial or government laboratories, and in the individual laboratories of universities and research institutes. Many new ideas have come from basic research, which has been supported largely by the federal government. The federal government supports this research through diverse mechanisms in government laboratories and in hundreds of universities and private research institutes throughout the United States.

Continued strong investment in basic research, the recognition that basic research is a high national priority, and the continued support of the principle of diversity without federal control of research are all essential. The federal government must also ensure that the large sums of money it is investing are invested well. Thus, oversight must be balanced with control in ensuring that this broad and diverse research base thrives.

Through its support of research and training programs, the federal government

has also played a major role in training the next generation of scientists. However, many scientists, particularly young scientists, are discouraged about their future prospects in science. Some of these problems may be based more on perceptions than realities. Nevertheless, there needs to be a well-articulated federal position across science and technology that the generation of scientific and technological talent is essential to America's future and will be given high priority.

Finally, in partnership with the private sector, the federal government has a role in revitalizing the research infrastructure. A modern infrastructure is essential if we are to create environments for talented people to generate new ideas.

Translation of New Ideas into Technologies

One of the greatest threats to continued improvements in our standard of living is our relative weakness at translating basic knowledge into significant new products and in generating steady improvement of those products that are already an important part of our lives. Other countries now succeed at this process this much more effectively than we do here in the United States.

The federal government has both a direct and an indirect role in translating new ideas and new understanding into useable technologies. First, it can help create an economic climate that stimulates the development of new products and encourages the formation of new entrepreneurial companies. The federal government can also support the development of generic, precompetitive technologies that have widespread applications in the public and private sectors (examples include high performance computing, biotechnologies, and materials science and engineering). The federal government has often taken this role in the past, as in the cases of computer technologies, aeronautical developments, and agricultural advances. It is important, however, that such support not pull the federal government into an inappropriate development role.

The federal laboratories are a major government resource that could, in some cases, be marshalled to participate more effectively in technology transfer. In particular, some federal laboratories could be given new missions focusing on generic, precompetitive technologies, on manufacturing, and on technology transfer.

In general, the federal government needs to promote legislative and regulatory actions that support and encourage appropriate technology transfer at the level of individual scientists and institutions in both the private and public sectors. Concerns about conflict of interest must be resolved so that they do not inappropriately retard the entrepreneurial spirit.

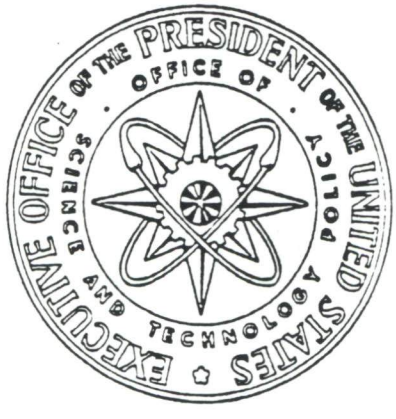
Manufacturing

If America is to benefit from its own new ideas, this country must once again become preeminent in manufacturing. This is largely the responsibility of industry, but there are certain things that the federal government can do to make manufacturing a high priority for this country. The President can recognize the importance of manufacturing to the American standard of living. The Malcolm Baldrige National Quality Award is an example that has been extremely successful. Other programs that give manufacturing this kind of recognition need to be established. The federal government can also support engineering education and fellowships targeted for research and manufacturing technology.

SETTING PRIORITIES IN SCIENCE AND TECHNOLOGY

In times of limited financial resources, choices must be made. Investments to support technology, and thereby increase the American standard of living, will not necessarily be free. The federal government's priorities in science and technology may have to shift to more explicitly recognize economic growth and a higher standard of living as national goals. In any such evaluation, we feel that the three areas discussed above -- basic research, the translation of new ideas into products, and manufacturing technologies -- must have priority if this country is to continue to increase its standard of living.

U.S. TECHNOLOGY POLICY



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C.

SEPTEMBER 26, 1990

U.S. TECHNOLOGY POLICY

A nation's technology policy is based on the broad principles that govern the allocation of its technological resources. Competitive market forces determine, for the most part, an optimal allocation of U.S. technological resources. Government can nonetheless play an important role by supplementing and complementing those forces. Technology policy is not something that, once set in place, remains immutable. Broad principles exist, but effective technology policy requires sufficient flexibility to permit response to changing national and international situations. We are in an era marked by increased international economic interdependency and increasingly stronger technological capabilities in other industrial nations. These factors pose competitive challenges for U.S. firms as well as opportunities. In formulating a national technology policy, consideration must be given to a nation's traditions, its strengths and weaknesses, and the international environment in which it exists.

In almost all respects the U.S. science and technology base remains the world's strongest. The Nation's research universities and the ability of its people to innovate remain the envy of the world. Nonetheless, industrial competitiveness depends on many factors besides technology. Our strengths in technology and innovation have not prevented an erosion in market shares of U.S. companies in many industries. As new products mature, the advantage quickly shifts from the innovator to the efficient producer. We have also seen the importance of high rates of capital investment for the industrial competitiveness of Japan, Europe, and the Pacific Rim countries.

The competitive challenges American firms face are multifaceted and complex. There will be no facile, short-term solutions. We, in this Administration, believe it is essential that we recognize and use the strengths of our economic system more effectively to help U.S. firms remain competitive. In order to do so, all elements of our society must recognize that while we possess many strengths and assets, problems do exist, and that we can mobilize our resources and solve them. At the same time, we need to refrain from actions that might distort our basic system of free enterprise -- the Nation's ultimate strength.

In order to build on its strengths, U.S. society needs to focus on ensuring:

- o a quality workforce that is educated, trained, and flexible in adapting to technological and competitive change;
- o a financial environment that is conducive to longer-term investment in technology;
- o the translation of technology into timely, cost competitive, high quality manufactured products;
- o an efficient technological infrastructure, especially in the transfer of information; and

Federal laboratories, and industry all contribute to the science and technology base. Industry makes the investments necessary to turn this knowledge base into commercial products and processes. Federal, state, and local governments support research both directly when they fund specific R&D projects, and indirectly through tax and other incentives for private sector R&D investment. The Federal Government also sets the overall macroeconomic and legal environment in which industry's decisions about product and process development and commercialization take place.

In that context, the Administration's strategy to implement U.S. technology policy includes the following major elements:

Role of the Private Sector

While the government plays a critical role in establishing an economic environment to encourage innovation, the private sector has the principal role in identifying and utilizing technologies for commercial products and processes. In particular, the private sector has the responsibility to:

- conduct research and development to advance industry-related knowledge and technology;
- identify and aggressively pursue potential commercial applications for technologies developed by its own laboratories as well as by universities, Federal laboratories, and foreign sources;
- increase quality, output, and productivity by undertaking necessary investments in physical capital;
- improve the skills and abilities of its workforce to meet its specific needs; and
- participate cooperatively in improving the quality of U.S. education.

Government policies can help establish a favorable environment for private industry to conduct these activities but cannot substitute for aggressive private sector action.

Government Incentives for the Private Sector

o Create an environment conducive to technological competitiveness by ensuring that technology policy concerns are factored into the formulation of related policies (e.g. fiscal, monetary, trade, environmental, etc.) with the overall objective of enhancing U.S. economic growth.

o Encourage private technology-related investment through Federal monetary and fiscal policies. For example, reducing the capital gains tax differential and making permanent as well as enhancing the tax credit for research and experimentation will provide incentives for added investment. Incentives can also be provided through appropriate tax policies.

- **Provide an appropriate legal environment at the Federal level that removes unnecessary obstacles to innovation. Reducing the uncertainties about antitrust enforcement related to inter-firm cooperation in research and technology development encourages the pooling of limited resources and a rapid diffusion of results while still protecting against anticompetitive practices. Reducing the antitrust uncertainties about joint production ventures will also enable firms to cooperate in the development and introduction of new products.**

- **Revise Federal procurement regulations and practices to permit greater integration of government and commercial production at the factory level, as well as encourage greater innovation and efficiency in development and production. Also encourage the use of commercial products, to the extent feasible, for defense, space, and other government applications.**

- **Improve opportunities for companies to commercialize technologies and computer software developed during the performance of government contracts by allowing the contractors to retain rights in technical data and by protecting their trade secrets.**

- **Provide a stable regulatory environment in order to decrease risk for private investment.**

- **Seek greater harmonization of regulations and standards for products and processes with our major trading partners.**

- **Encourage increased U.S. participation in multi-lateral international standardization efforts through the standards activities of the National Institute of Standards and Technology.**

- **Seek better international protection of intellectual property to allow more benefits to be recovered from R&D investments.**

Education and Training

- **Revitalize education at all levels including not only the training of scientists, engineers, and the technical workforce, but also educating our population to be sufficiently literate in science and technology to deal with the social issues arising from rapid scientific and technical change. Achieving such a goal will require a broad-based approach involving business, academia, and educational organizations, as well as Federal, state, and local governments.**

- **Develop a framework for Federal interagency coordination and collaboration in mathematics, science, engineering, and technology education. The goal is to define an effective and appropriate role for the Federal government in support of the states, localities, and universities as they improve science and technology education to build human capital in the U.S.**

- **Encourage continuing education and training, recognizing that, particularly in scientific and technological fields, education must be a lifelong activity.**

Federal R&D Responsibilities

- **Increase Federal investment in support of basic research. Private industry does not invest heavily in basic research because the payoffs are so unpredictable and diffuse that individual firms cannot be confident of fully recovering their investments. However, the long-term potential benefits of this research are so large that society cannot afford not to make the investment, especially in university research which, in addition to new knowledge, also produces trained scientists and engineers of the future.**

- **Participate with the private sector in precompetitive research on generic, enabling technologies that have the potential to contribute to a broad range of government and commercial applications. In many cases these technologies have evolved from government-funded basic research, but technical uncertainties are not sufficiently reduced to permit assessment of full commercial potential. In pre-competitive research, which occurs prior to the development of application-specific commercial prototypes, research results can be shared among potential competitors without reducing the financial incentives for individual firms to develop and market commercial products and processes based upon the results.**

- Continue the Federal government's development of products and processes for which it is the sole or major consumer, such as national defense, provided that no commercially available products can be substituted. The government, in such cases, must rely principally on the private sector to undertake the development process. Revise current Federal procurement regulations to strengthen the abilities of companies involved in developing and demonstrating these products to use the same research results and technologies for commercial purposes.

- Maintain a strong Defense technology base to provide options for future weapons systems development and to help avoid technological surprises by potential adversaries. Special emphasis needs to be placed on shortening the time required for transferring R&D results to production and on using commercial products.

- Streamline Federal decision-making structures and mechanisms to eliminate unnecessary and cumbersome regulations and practices that inhibit industrial competitiveness.

- Encourage international cooperation in science and technology, where mutually beneficial, and inform U.S. researchers of opportunities to participate in R&D initiatives outside the U.S.

Transfer of Federally Funded Technology

- Improve the transfer of Federal laboratories' R&D results to the private sector. Where appropriate, these laboratories should give greater consideration to potential commercial applications in the planning and conduct of R&D, and these efforts should be guided by input from potential users. To achieve this goal, there must be a closer working relationship among these laboratories, industry, and universities. Defense-related laboratories can make major contributions while still providing adequate safeguards for classified information.

- Promote increased industry-Federal laboratory-university collaboration, including personnel exchanges, to help convert Federally-supported R&D into new technologies that the private sector can then turn into commercial products and processes.

- Promote and encourage access by U.S. industry to Federal laboratories within the guidelines established by the Federal Technology Transfer Act of 1986 (P.L. 99-502), other existing legislation, and Executive Order 12591.

- Expedite the diffusion of the results of Federally-conducted R&D to industry, including licensing of inventions and removal of barriers to commercialization of Federally developed computer software.

- Encourage direct laboratory-industry interaction within broad, flexible Federal guidelines, since effective technology transfer occurs at the operational level.

Federal-State Activities

Recognize the importance of decentralization, and encourage states to develop programs that take into account the individual characteristics of each state. Federal programs in such areas as education, training, the national infrastructure, and regional generic technology centers, should build upon state initiatives.

Programs To Implement U.S. Technology Policy

The Administration has undertaken a broad range of programs and initiatives aimed at translating the technology policy into action. These programs and their associated budget levels requested for Fiscal Year 1991, where applicable, are summarized here.

Incentives for the Private Sector

The Administration has proposed improvements in incentives for private sector innovation by:

- **Reducing the tax rate on capital gains permanently to spur entrepreneurial activity.**

  The Administration has proposed restoring a capital gains tax differential such as existed before the Tax Reform Act of 1986. A lower tax rate on capital gains will encourage investors and entrepreneurs to make the investments necessary to be competitive.

- **Making the research and experimentation (R&E) tax credit permanent to reduce uncertainty.**

  Under current law, the R&E tax credit is scheduled to expire on December 31, 1990. The Administration proposal to make the credit permanent would permit businesses to establish and expand research facilities without fearing that the tax laws will suddenly change.

- **Protecting intellectual property through international negotiations.**

  The Administration is aggressively pursuing improved international protection of intellectual property. The current negotiations in the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) are an important forum for developing better international rules. Negotiations on intellectual property rights are also being conducted in the World Intellectual Property Organization and in trilateral talks with the European Community and Japan. In addition, the U.S. is pursuing bilateral negotiations on intellectual property rights under the provisions of the 1988 Omnibus Trade and Competitiveness Act.

- **Liberalizing export controls to enhance high technology product exports.**

  Dramatic changes in the Eastern European security environment have permitted an Administration re-evaluation of U.S. export controls, and paved the way for an expanded trade potential for U.S. high technology industries.

- **Reforming product liability laws to restore balance to the tort system.**

  The Administration supports the adoption of uniform product liability standards across the 50 states based on three principles of fairness: the right of an innocent person to fair compensation for actual damages; liability based on responsibility for harm and not ability to pay; and encouragement of alternatives to costly litigation. The proposed changes to product liability laws would

maintain incentives to produce safe products, but would restore balance to the tort system and reduce uncertainty -- particularly for new products.

o Reforming the Federal procurement process.

The Administration supports continued efforts to streamline the procurement process, reduce its complexity and paperwork burden, and provide contractors with incentives to innovate and reduce costs. The Administration has proposed changes in legislation and regulations to foster commercial style competitive procedures for the acquisition of commercial products. A revision of the Federal Acquisition Regulations is being drafted that will allow contractors to retain commercial rights in technical data developed under Federal contracts. The Administration is also developing a policy mandating increased agency use of performance based contracting that gives contractors more freedom and incentive to innovate.

o Removing barriers to research, innovation, and development.

The Administration supports continued elimination of unwarranted regulation. Deregulation can spur innovation as well as lower prices. It also requires a continuous reexamination of existing regulatory policies to avoid unnecessary stifling of new products and processes. The Administration has proposed antitrust legislation that would reduce the legal uncertainties for companies to enter joint production ventures while still protecting against anticompetitive practices. Challengers would be required to prove that such ventures would harm competition. The legislation would also eliminate punitive treble-damage awards under certain circumstances.

Education and Training

In addition to the President's broad initiatives on education, there are a number of programs directed at improving education in mathematics and science and at training of the technical workforce. These include:

o National Science Foundation: $463 million plus research assistantships proposed in Fiscal Year 1991

The National Science Foundation has a broad range of programs dealing with mathematics and science education and human resources at all levels. Major programs are:

- Research career development (graduate research fellowships and enrichment activities for talented high school students).

- Teaching materials development and informal science education (aimed primarily at the pre-college level).

- Teacher preparation and enhancement (upgrading quality of faculty, providing Presidential Awards for Excellence in Science and Mathematics Teaching, and developing model programs for women, minorities, and the handicapped).

- Undergraduate science, engineering, and mathematics education (includes instrumentation grants, curriculum development, faculty revitalization, comprehensive regional centers for minorities, and research experiences for undergraduates).

In addition, almost 16,000 graduate students are supported by research assistantships through regular research grants to universities.

o Department of Education: $333 million proposed in Fiscal Year 1991

- Eisenhower mathematics and science program (provides funds to help State and local educational agencies carry out programs to train teachers and improve instruction in mathematics and science).

- Adult education program (aimed at skills needed to cope with new technologies and providing for workplace literacy).

o National Institutes of Health: $292 million plus research assistantships proposed in Fiscal Year 1991

- Almost 12,000 graduate students receive training grants.

- Tens of thousands of graduate students are supported by research assistantships through the $4.4 billion in extramural research grants.

o National Aeronautics and Space Administration: $51 million proposed in Fiscal Year 1991

Program activities cover informal K-12 science education, mobile presentations on space to elementary and secondary schools, teacher workshops and internships at NASA research centers, grants for undergraduate and graduate students, and programs for minorities in science and engineering education.

o Department of Energy: $25 million plus research assistantships proposed in Fiscal Year 1991

- Programs include science and mathematics exposure for middle and high school students, research training of undergraduates, and graduate fellowships in science and engineering.

- An estimated 4,000-4,500 graduate students are supported by research assistantships through research grants to universities.

o **Department of Defense: $364 million projected for Fiscal Year 1991 for non-military personnel**

- **Pre-college programs (summer programs for minorities).**
- **Undergraduate programs (primarily ROTC scholarships in technical fields).**
- **Graduate fellowships and research assistantships.**
- **Post-doctoral and faculty research appointments.**

o **Department of Agriculture: $125 million proposed in Fiscal Year 1991**

- **Challenge grants to strengthen undergraduate education.**
- **Capacity building grants to strengthen teaching and research programs in the "1890 Land Grant" institutions.**
- **National needs fellowships to recruit and train scientists in the most critically deficient areas.**
- **Graduate assistantships associated with research grants projects. About 13,000 graduate students are supported for graduate studies.**
- **Ag-In-The-Classroom to support science strengthening in K-12 programs.**
- **Research apprenticeships to bring high school students into university and government laboratories to stimulate interest in science.**
- **School enrichment program to function as a catalyst between schools and community to strengthen science programs.**
- **Postdoctoral program in Agricultural Research Service and Animal and Plant Health Inspection Service laboratories.**

Federal R&D Responsibilities

The Fiscal Year 1991 budget proposes to allocate about $71 billion for research and development. This is an increase of $4.5 billion, or 7 percent, over 1990 enacted levels. Civilian R&D will increase by 12 percent, while defense-related R&D will increase by 4 percent. Within this total, $12 billion will be allocated for basic research, an increase of $1 billion or about 8 percent over 1990. The budget contains a number of new and expanded programs that will contribute to the Nation's R&D enterprise and competitive posture. These include:

- **A 13 percent increase in the National Science Foundation's budget request for research and facilities, which account for over 75 percent of the NSF budget. Support for basic science and engineering is the foundation on which U.S. technology is built. Within the overall increases there are emphases on Science and Technology Centers, networking and communications, Engineering Research Centers, and major research equipment for universities.**

- **Developing advanced technologies to meet Defense and civilian agency needs. Based on the results of a special survey of the support for selected advanced technologies that are funded by more than one Federal agency, the budget proposals are:**

  - **Robotics - The budget provides $192 million to six Federal agencies for support of robotics R&D. The focus of this R&D is on the development of systems that are more autonomous and capable of interacting with changing and uncertain environments.**

  - **High Performance Computing - The budget provides $469 million for Federal support of R&D focused on high performance computing. This activity includes the full range of advanced computing technologies as well as systems and applications software, networking, and underlying research and human resource infrastructure.**

  - **Semiconductors - The budget provides $537 million for research on semiconductor materials, development and application of semiconductor materials to meet agency mission needs, and support of R&D on semiconductor manufacturing processes. The largest single Federal program is DOD funding of $100 million per year for SEMATECH, a semiconductor industry R&D consortium.**

  - **Superconductivity - The budget provides $215 million for superconductivity R&D. Programs in five Federal agencies deal with both high temperature and low temperature superconducting phenomena and materials.**

  - **Advanced Imaging Technologies - The budget provides $118 million for advanced imaging R&D. Advanced imaging systems include interactive graphics, high definition displays, advanced signal processing, and advanced digital switching technologies.**

- **Improving productivity and the quality of life through biotechnology. The budget proposes $3.6 billion for biotechnology R&D. In pharmaceuticals, foods, agriculture, waste management, and energy, biotechnical advances offer the possibility of improvements that will make a real difference in people's lives.**

- **Developing technologies for improved transportation. The budget proposes funding for transportation R&D of $1,527 million. This R&D is aimed at maintaining a modern, efficient transportation infrastructure, an essential factor**

in being industrially competitive. Federal programs are focused on aeronautics, highways, mass transit, railroads, maritime, water, aviation, and other transportation areas.

- o Promoting alternate sources of energy. For conduct of energy R&D programs in the Department of Energy, the budget proposes total funding of $2,450 million. The R&D is aimed at maintaining abundant, reliable, and economic sources of energy. Federal programs cover a broad spectrum of energy technologies including solar, renewable, conservation, nuclear fission, nuclear fusion, and fossil energy, and supporting energy sciences.

- o Enhancing industrial productivity and development of standards. The budget proposes $198 million for the National Institute of Standards and Technology. R&D in fundamental measurements and standards provides the foundation for U.S. industry, commerce, and science to achieve levels of accuracy and compatibility required to support technological development, efficient processing, process control, and quality assurance. Special activities include R&D on advanced manufacturing technologies. In addition, the Advanced Technology Program provides grants to industry-led ventures to support research on pre-competitive generic technologies.

Transfer of Federally Funded Technology

Many important steps have been taken, pursuant to the Federal Technology Transfer Act and other legislation, to increase the degree to which Federal laboratories collaborate with private industry in commercializing the results of Federally-funded research and development. These activities include:

- o Establishment of over 200 active cooperative research and development agreements between Federal laboratories and private companies.

- o Creation of the Precision Manufacturing Technology Program by the Department of Energy to provide U.S. industry greater access to the extensive manufacturing technology, expertise, and facilities available within the Department's Defense Programs weapons complex.

- o Formation of the Biotechnology Research and Development Consortium, a joint research effort between the Department of Agriculture's Northern Regional Research Center, the University of Illinois, the State of Illinois, and six U.S. companies.

- o Formation of a joint venture in high temperature superconducting materials and applications by Du Pont, Hewlett-Packard, and Los Alamos National Laboratory.

- o Establishment of Regional Manufacturing Technology Centers. The budget provides $5 million for this program. The approach is to reduce the barriers

faced by small- and medium-sized manufacturers in adopting new technology by creating awareness and providing up-to-date, practical information and expertise on manufacturing technologies and practices.

Federal-State Activities

Federal programs have already been initiated to build upon the advantages offered by decentralized programs operating at the state and local level. These programs include:

- Department of Commerce Clearinghouse for State and Local Initiatives on Productivity, Technology and Innovation:

  The Clearinghouse gathers and analyzes information on the many technology development centers at the state and local level. It will help to develop a network of contacts among state and local officials and staff.

- Small Business Development Centers:

  Each Small Business Development Center (SBDC) serves as a one-stop assistance center for businesses and provides services ranging from pre-business start-up counseling to technical advice for existing businesses. The centers have a legislative mandate to assist in technology transfer, make use of Federal laboratories and equipment, and coordinate and conduct research they deem worthwhile.

- University Centers Program:

  This program provides funds to involve the resources of universities in economic development within the community.

- NASA Industrial Applications Centers Program:

  The centers offer clients access to a national data bank that includes over 100 million documents of accumulated technical knowledge, along with their expertise in retrieving information and applying it in support of clients' needs. The centers are backed by state-sponsored business or technical centers that provide access to the technology transfer network.

- Trade Adjustment Assistance Centers Program:

  The centers provide trade-impacted small and medium-sized manufacturers with in-depth technical assistance.

PCAST

THE WHITE HOUSE

WASHINGTON

December 10, 1990

MEMORANDUM FOR DR. BROMLEY

FROM: CHARLES KOLB C Kolb

SUBJECT: PCAST Background Papers

Thank you for the opportunity to review the two PCAST background papers on education and technology. Our detailed editorial suggestions appear on the attached copy of the documents.

More generally, I would recommend that the education paper be recast to focus more on the specific actions that might be taken by the scientific community in promoting education reform. Much of the discussion in the current draft summarizes ongoing efforts, many of which the President should be familiar with already. Consequently, I'd look for areas in which new ground might be broken. Among the possible areas are the following:

* The scientific and corporate communities can set education standards in their own laboratories and workplaces. Efforts to promote ongoing literacy activities are greatly needed.

* These communities can also work to promote education reforms such as alternative certification, choice, and magnet schools. To the extent that we need more qualified math and science teachers, these communities can join the effort to secure true alternative certification programs in each State.

* The American Society of Engineering Societies is working on a project to identify 100,000 volunteers from among their members so that each elementary and secondary school in America will have a math-science "mentor" who can work with the school to enhance math and science education activities.

* Careful review of existing Federal postsecondary education programs should be undertaken to see in what ways some of them can be targeted to deal with math-science education at the undergraduate and graduate levels, particularly with respect to minorities.

As for the background paper on technology, I would offer a couple of thoughts. George Gilder has written an excellent little book entitled Life After Television which includes some excellent examples about the need to improve our technology -- particularly the need to facilitate entry of new systems such as the telecomputer. Gilder might offer some useful insights to your discussion.

Second, I am concerned about the comment on page 2 concerning a "revival of manufacturing and the production of goods." I think this should be clarified somewhat, particularly in light of an article in today's The Wall Street Journal (attached) that indicates the percentage of our GNP attributed to manufacturing has dropped from 29% in 1950 to 21% in 1980 and 22% in 1987. The article notes that "[t]he rest of the economy is made up of the trade, transportation, financial insurance, real estate and services sectors, as well as government services. It is America's superior efficiency in the remaining 80% of its economy that has yielded the higher standard of living in the U.S." If this statement is, indeed, true, you might want to reconsider the manner in which you call for preeminence in manufacturing.

I hope you will find these suggestions helpful. You also might want to share the draft document with OMB and the Vice President's Council on Competitiveness for their thoughts as well. As always, we stand ready to assist OSTP and PCAST in whatever ways we can.

cc: Roger B. Porter

THE WHITE HOUSE

WASHINGTON

December 7, 1990

MEMORANDUM FOR CHARLES KOLB

FROM: D. ALLAN BROMLEY DAB.

SUBJECT: PCAST BACKGROUND PAPERS

Attached are two background papers -- one on meeting the National Education Goals and the other on technology and the American standard of living. They were prepared by the President's Council of Advisors on Science and Technology and will be used to brief the President next Friday, December 14.

I would very much appreciate your comments on these papers by next Monday evening, so that the members of PCAST may consider your thoughts before briefing the President.

Thank you in advance for your assistance.

cc: Ken Yale
Tom Welch

[DRAFT: DO NOT DISTRIBUTE OR QUOTE]
[December 6, 1990]

EDUCATION IN SCIENCE AND MATHEMATICS: MEETING THE NATIONAL EDUCATION GOALS

The National Education Goals developed by the President and the nation's Governors have helped to move education toward the top of the nation's agenda. Following the lead of the President and the Governors, Americans in growing numbers are committing their energies to efforts designed to improve basic education.

Achieving the national goals will require significant improvement in science and mathematics education. However, revitalizing science and mathematics education will not be possible without much broader reforms in American basic education. This paper therefore examines some of the general reform strategies that will be needed to meet the national goals. It then suggests several ways in which the President and the federal government can anticipate and facilitate those reforms, with a particular emphasis on science and mathematics education.

THE NATURE OF THE GOALS

The National Education Goals have revolutionary implications for basic education. They are performance goals stated in terms of outcomes or levels of achievement. In the areas of science and mathematics, they require "demonstrated competency . . . in mathematics [and] science," sufficient to place U.S. students "first in the world in science and mathematics achievement" by the year 2000, when "every adult American will be literate and possess the knowledge and skills required in a global economy." ~~Moreover, the call for 90 percent of our young people to graduate from high school requires that the goals extend to virtually all school-aged children, even those for whom alternate educational strategies are required.~~

Previous efforts to improve education have often used input or process goals, which prescribe the experiences that all students and teachers should undergo -- for example, the amount and kinds of courses required of all students. Many of the new approaches adopted in the 1980s were process reforms, and although there is some evidence that these changes have contributed to modest progress in recent years, their results have been generally disappointing.

REQUIREMENTS FOR EDUCATIONAL REFORM

Since the announcement of the National Education Goals, a consensus has ~~been~~ emerging that achieving them will require fundamental restructuring of basic education in America. ~~Incremental improvements may be achieved by further incremental changes, but the magnitude of improvement needed to meet the goals calls for massive change in the educational system.~~

~~The emphasis on performance implicit in the goals is one of the most important educational reforms needed to meet those goals.~~ This focus on results rather than inputs must ~~be accelerated and~~ become ~~pervasive throughout~~ the hallmark of American elementary and secondary education.

However, performance can be emphasized only if achievement can be reliably measured. Today, we need greater confidence in assessment mechanisms and more understanding of how assessments relate to actual learning. Without such improvements, many in the education community feel it will be difficult to reorder the educational system on the basis of performance.

As assessment mechanisms are being improved, a complementary effort is needed in the area of curricular reform. Much good work is being done in this area, but implementation of the results in schools will not be easy. Moreover, testing standards should be coordinated with curriculum development, which is a major challenge.

~~A second~~ One fundamental change that will be required for the restructuring of basic education is the introduction of parental choice in the selection of schools appropriate for each child. Choice has many dimensions, ranging from permitting some children to choose "magnet" schools within the public system to distributing government vouchers for children to ~~redeem for cash toward tuition~~ pay for educational expenses at any school, public or private. Whatever system is adopted, it is important to provide ~~some measure of academic quality~~ to act as a basis for choice. ~~Requiring nationally standardized tests and publishing their results would provide one of the indexes that parents could use as consumers in the educational marketplace.~~ ~~Involving parents in education has great value, and~~ giving parents ~~some element of~~ choice is ~~often~~ the beginning of a ~~deeper~~ greater parental involvement in their children's education and central to effectively reforming American education.

the customers of education, parents and students with results-oriented measures of the quality of schools

~~A third~~ second promising strategy in the reform of basic education is ~~rewarding exceptional teachers.~~ attracting talented individuals to the teaching force through alternative certification programs ~~Implementation often founders on the difficulty of assessing the quality of a teacher, but improved assessments of teacher performance, along with other means of evaluation, including peer review, provide important opportunities for improving the quality of the teaching force.~~

Such ~~efforts~~ programs are especially important in science and technology. Unless teachers at both the elementary and secondary levels understand and appreciate

Alternative certification enables qualified professionals who want to teach to enter the teaching force through routes other than traditional teacher education.

science and technology, significant improvement will be difficult. Teacher training programs to improve the quality of science and mathematics teaching will be an essential element in meeting the national goals.

A ~~fourth~~ third requirement for effective reform is reducing bureaucracies ~~by relying on~~ through school-based management that empowers principals and ~~their~~ teachers. ~~However, bureaucracies will relinquish control to teams of teachers and principals at individual schools only if equity and accountability can be assured, which again raises the question of educational assessment.~~ also impediments to change and providing greater flexibility in the use of funds for education in exchange for enhanced accountability for improved performance

~~Finally~~, underlying the needed reforms of basic education is the recognition that school is only one of many critical influences in a child's development. ~~Only by shifting our focus from our institutions to our children can we truly address the challenges to our society. This strategy is particularly relevant for the retention of students at risk of dropping out, who may require strategies beginning with prenatal and child care even before formal school begins.~~ If we are to strengthen our nation's workforce and build better citizens, we must shape society's institutions to our children and not vice versa. American homes must be places of learning where parents recognize their role as a child's first ~~teacher~~.

Community-, school-, and home-based strategies involving every sector that influences a child's learning should be encouraged.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government cannot mandate reform in the ~~distributed~~ decentralized system of basic education in America. It can, however, facilitate, ~~and where appropriate finance~~, the reform initiatives cited above, using incentives and appropriate leveraging to accelerate the reform process. In particular, we believe that the following federal actions warrant serious consideration:

o The federal government can provide incentives to states or regions pursuing any of the reforms described in the previous section, ~~subject to constraints designed to ensure equity and equal opportunity~~. For example, federal funds might be used to facilitate choice for needy students, thereby providing an inducement to states or districts offering choice programs. Similarly, a national competition might be established to recognize and reward exemplary programs for restructuring education (just as the Malcolm Baldrige National Quality Award has recognized quality improvements in industry).

o The federal government can foster greatly intensified research on academic assessment and the development of measurement instruments so that performance standards can be set and ~~the academic marketplace can function more rationally.~~ For example, federal funds could be used to ~~pay for~~ participat~~ing~~ion in appropriate achievement evaluation programs. achievement validly measured. leverage voluntary

o The federal government can ~~make a concerted, national effort to facilitate and coordinate state and local programs, both public and private, to deal with the school dropout problem. Successful drop-out prevention programs could be recognized by the President and rewarded for their achievement.~~ work to reduce regulations that limit flexibility and seek legislation that will permit states and schools ~~to use~~ to seek regulatory waivers and to consolidate ~~combination of~~ funds in order to enact strategies that work.

o The federal government can encourage private corporations, universities, and national laboratories to work cooperatively with local schools, building on the many excellent initiatives already under way.

o In the areas of mathematics and science, the federal government can ~~invest~~ encourage effective ~~in~~ programs to engage talented girls and minority students in science and mathematics, where they are now underrepresented.

o The federal government can ~~invest in teacher education programs in science and mathematics and use forgivable loans and other inducements to attract to~~ encourage states to enact alternative certification programs GET ~~teaching young people with degrees in science, mathematics~~, and engineering.

o The federal government can support programs using modern communications technologies, including satellite technologies, to expand access of both students and teachers to the most highly qualified teachers of science and mathematics. ?

o The federal government can initiate a cooperative demonstration project with the school system of the District of Columbia. why ?

THE PRESIDENT'S ROLE

Responsibility for our system of basic education in America rests fundamentally on the general population, who shape the learning environments of their children, elect their school boards and other influential politicians, and demonstrate their priorities by their behavior toward teachers and schools.

However, our nation's leaders influence the attitudes and values of the electorate. The President, in particular, has a personal role that reaches beyond his authority as our nation's chief executive officer. In choosing his own priorities as a leader, he sets a standard for all to heed.

The President, in partnership with the Governors, has placed a great challenge squarely on the national agenda. Now all of the resources of leadership must be applied to meeting that challenge. Federal budget priorities must be set, the activities of the federal agencies must be guided, and the President's personal commitment to education must continue to be demonstrated. With timely actions, and with a continuing and unremitting campaign of words, the President can secure his place in the history of American education.

Rewrite or omit

[DRAFT: DO NOT DISTRIBUTE OR QUOTE]
[December 7, 1990]

TECHNOLOGY AND THE AMERICAN STANDARD OF LIVING

? the surge in the standard.

Today most Americans take for granted a standard of warmth, cleanliness, food, medical care, music and entertainment, and transportation that was undreamt of 150 years ago. This great surge forward in the standard of living can and will continue. Furthermore, it can encompass all Americans and the citizens of other countries as well.

along w/ free-market economic policy

The foundation for dramatic increases in economic growth and improvement in the standard of living has been technology. Basic research built a fundamental understanding of the physical world, including the laws of mechanics and gravity, the atomic and molecular bases of chemistry, and the basic principles of electricity and energy. Building on this knowledge, individuals brought forth one striking invention after another, from the steam engine, railroads, and the telegraph to electric lighting, the telephone, and radio. Over the years, the rate of technological progress accelerated. Advances in agriculture liberated the vast farm population for other pursuits; automobiles and airplanes provided unprecedented speed and accessibility over vast distances; and the television and computerized communications linked the world together. This remarkable surge in invention, which contributed to an equally remarkable ability to produce goods and services in volume, did much to create the modern world.

America has led the world in science and technology for much of this century -- resulting in a standard of living to which the rest of the world aspired. This paper explores what will be necessary to continue to lead the world and thereby provide a standard of living that will allow our children and grandchildren to live far better than we do today.

REQUIREMENTS FOR TECHNOLOGICAL LEADERSHIP

Since World War II, basic scientific research has provided a new foundation on which to build for the future. The molecules in a material can now be seen and studied at the atomic level. The discovery of the structure of DNA and of the immense complexity of the cell has opened up whole new areas of opportunity. New materials are being developed that are lighter, stronger, and more durable than

anything known today. Advanced computers and new modes of communication, such as optical fibers, are resulting in new ways to learn, new ways to work, new kinds of intelligent machinery with virtually unlimited new capabilities. Furthermore, a better understanding of the environment is making it possible for these advances to have far fewer negative environmental impacts than did earlier technological advances.

Three basic things will be required if the United States is to continue to benefit from the dividends of science and technology.

1. A continuing flow of new ideas and new understanding, which are the basis of new materials, better health care, new information technologies, a cleaner environment, and other technological advances.

2. The translation of new ideas and new technologies into significant new products and into the steady improvement of those that are already an important part of our lives.

3. A revival of manufacturing and the production of goods, which in the past has provided both the material wealth and the jobs that built the American standard of living.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government has a role, although not the exclusive role, in the development of technology. In particular, it has been a major catalyst for technology development through its direct investment in research and through legislative and regulatory actions that have facilitated the development and commercialization of new insights.

New Ideas and New Understanding

Our diverse science and technology base can generate new ideas anywhere -- on the production line, in industrial or government laboratories, and in the individual laboratories of universities and research institutes. Many new ideas have come from basic research, which has been supported largely by the federal government. The federal government supports this research through diverse mechanisms in government laboratories and in hundreds of universities and private research institutes throughout the United States.

Continued strong investment in basic research, the recognition that basic research is a high national priority, and the continued support of the principle of diversity without federal control of research are all essential. The federal government must also ensure that the large sums of money it is investing are invested well. Thus, oversight must be balanced with control in ensuring that this broad and diverse research base thrives.

Through its support of research and training programs, the federal government has also played a major role in training the next generation of scientists. However, many scientists, particularly young scientists, are discouraged about their future prospects in science. Some of these problems may be based more on perceptions than realities. Nevertheless, there needs to be a well-articulated federal position across science and technology that the generation of scientific and technological talent is essential to America's future and will given high priority.

Finally, in partnership with the private sector, the federal government has a role in revitalizing the research infrastructure. A modern infrastructure is essential if we are to create environments for talented people to generate new ideas.

Translation of New Ideas into Technologies

One of the greatest threats to continued improvements in our standard of living is our relative weakness at translating basic knowledge into significant new products and in generating steady improvement of those products that are already an important part of our lives. Other countries now succeed at this process this much more effectively than we do here in the United States.

The federal government has both a direct and an indirect role in translating new ideas and new understanding into useable technologies. First, it can help create an economic climate that stimulates the development of new products and encourages the formation of new entrepreneurial companies. The federal government can also support the development of generic, precompetitive technologies that have widespread applications in the public and private sectors (examples include high performance computing, biotechnologies, and materials science and engineering). The federal government has often taken this role in the past, as in the cases of computer technologies, aeronautical developments, and agricultural advances. It is important, however, that such support not pull the federal government into an inappropriate development role.

The federal laboratories are a major government resource that could, in some cases, be marshalled to participate more effectively in technology transfer. In particular, some federal laboratories could be given new missions focusing on generic, precompetitive technologies, on manufacturing, and on technology transfer.

In general, the federal government needs to promote legislative and regulatory actions that support and encourage appropriate technology transfer at the level of individual scientists and institutions in both the private and public sectors. Concerns about conflict of interest must be handled judiciously so that they do not inappropriately retard the entrepreneurial spirit.

Manufacturing

If America is to benefit from its own new ideas, this country must once again become preeminent in manufacturing. This is largely the responsibility of industry, but there are certain things that the federal government can do to make manufacturing a high priority for this country. The President can recognize the importance of manufacturing to the American standard of living. The Malcolm Baldrige National Quality Award is an example that has been extremely successful. Other programs that give manufacturing this kind of recognition need to be established. The federal government can also support engineering education and fellowships targeted for research and manufacturing technology.

SETTING PRIORITIES IN SCIENCE AND TECHNOLOGY

In times of limited financial resources, choices must be made. Investments to support technology, and thereby increase the American standard of living, will not necessarily be free. The federal government's priorities in science and technology may have to shift to more explicitly recognize economic growth and a higher standard of living as national goals. In any such evaluation, we feel that the three areas discussed above -- basic research, the translation of new ideas into products, and manufacturing technologies -- must have priority if this country is to continue to increase its standard of living.

Europe, Japan Would Lose Trade War

By Fred Gluck

The disintegration of the GATT talks in Brussels on Friday is bad news for all countries, but worse for some than for others. The casualties of a trade war will not be evenly spread. The U.S. economy has always outperformed and continues to outperform the economies of all other nations. If world trade now slows, Japanese and the Europeans will suffer more than Americans.

At the end of World War II, the U.S. enjoyed a vast economic lead over Europe and Japan, both in terms of absolute output and in terms of output per capita. The Organization for Economic Cooperation and Development has created an index that measures how much above or below the average (for developed countries) a country's production per capita is. A perfectly average country would score 100. In 1950 the American index stood at 175, West Germany's at 72 and Japan's at slightly above 20. Twenty years later, in 1970, Europe and Japan had closed on the U.S.: The American index had fallen to 142, West Germany had climbed to 98 and Japan had zoomed to 80.

It seemed obvious to most economists in 1970 that Europe and Japan would continue to close the gap, until production per capita in all the developed countries hovered around the average of 100. In fact, however, Europe and Japan have made astonishingly little relative progress since 1970. Between 1970 and 1980, the U.S. dropped to 134 from 142, West Germany inched up from 98 to 100 and Japan rose to 89 from 80. Between 1980 and 1990, West Germany dropped back to 97, Japan rose to 98—and the U.S. remained at 134.

35% Advantage

In other words, the U.S. seems to have a continuing advantage of approximately 35% over its leading trading partners in the output of goods and services per capita. (The output per worker numbers show a similar picture.)

How do we reconcile this comparison of overall economic performance with the doom and gloom about America's economy one hears so frequently? The gloomsters and doomsters usually concern themselves exclusively with manufacturing. Manufacturing is important, but in all advanced economies it represents a relatively small fraction of the economy. In the U.S., for example, manufacturing accounted for 29% of gross national product in 1950, 21% in 1980 and 22% in 1987.

The rest of the economy is made up of the trade, transportation, financial, insurance, real estate and services sectors, as well as government services. It is America's superior efficiency in the remaining 80% of its economy that has yielded the higher standard of living in the U.S.

This view is more than just one economist's guess. Consider the efficiency differences that have resulted from deregulation of the U.S. airline industry. It costs about half as much to fly a mile in the U.S. as in other industrialized countries. On the East Coast, we complain about the cost of the New York to Washington shuttle, now around $140. A similar trip between London and Paris costs $260. Other examples can be cited in trucking, securities brokerage and long-distance telephone service.

Then there are the large increases in productivity in wholesale, retail and distribution, which may not be captured in national economic statistics. Mail order purchasing based on the enormous advances in information technology has led to the replacement of whole chains of stores, warehouses and transportation links with a telephone and computer network served by a few large warehouses and nationwide express delivery services. The headlines are about the difficulties of big department stores, not the success of L.L. Bean, where one worker can sell more than a whole street of "mom and pops" in Tokyo.

The efficiency of the U.S. economy in these sectors comes from more intense competition, more deregulation and more decontrol than in Europe or Japan. These efficiencies enable the U.S. to capture the benefits from a more open market for trade. U.S. consumers have access to the best skills in the world wherever they are. Many of the goods acquired through direct order catalogues are imported. The efficiency of the trade and distribution sectors makes it easier, of course, for imports to penetrate the U.S. market to the benefit of U.S. consumers and U.S. distributors. But that doesn't mean the U.S. is "giving away the store." Notwithstanding the American reverence for making things and the distrust of the "service" elements of business, increasingly it is "downstream" where the money is made because that's where most of the value is added.

If a trade war now breaks out, developing countries, as well as Japan and Europe, are vulnerable. The U.S. is much less so. It is starting from a higher position.

The implication of this analysis is that the current gap in per-capita gross domestic product is the potential economic gain to be achieved by Europe and Japan if they decontrol economic activity in their countries. They will not close it by making semiconductor chips more efficiently or by protecting manufacturers. Because the gap between the U.S. and the European countries and Japan is still so large, it is very important for these latter nations to open their economies for their own benefit. Friday was a big step backward.

The desirability of free trade is one of the few things that all economists basically agree on. However, free trade has been tested rather severely in the past decade and is certainly being challenged now. Economists in the U.S. have examined the major cases where nations or regions have practiced so-called managed or strategic trade, such as the European subsidy of Airbus and Japan's protection of its 16K memory chip producers.

The results of these analyses show that strategic trade measures did significantly disadvantage U.S. corporations. In the chip case, U.S. consumers also lost, because prices rose; in the Airbus case, American consumers gained from the increased competition in aircraft production. Nevertheless, the benefits to the subsidizing country's corporations from protection and subsidies were accompanied by damage to that country's consumers and taxpayers. The economic evidence is that a nation can offer advantages to its corporations through managed or strategic trade, but only at some sacrifice of the standard of living of its own citizens. It costs more to travel, it costs more in the supermarket, it costs more in taxes.

It's not economists but politicians who determine international trade policies. Most politicians do not have a broad grasp of the benefits of free trade at the macro level, nor do they have tangible evidence of how jobs, capital and technology are moved around by Adam Smith's invisible hand. Politicians react to what's concrete and what's concrete is loss of jobs.

In that regard, it is unfortunate that economists have not given us a better picture of how comparative advantage works at the micro level through the movement of labor, skills and capital. We all know it happens. The flexibility of the basic inputs in economic performance, namely labor and capital, is considerably higher in the U.S. than in Japan and Europe, not only because of regulation, but also for cultural reasons. That very flexibility allows comparative advantage to work more quickly and more thoroughly. Political integration in Europe and increased mobility in corporate Japan could help those countries to achieve that same flexibility.

Unlike any of history's other great powers, the U.S. believes that its interests are in essential harmony with those of other powers. The U.S. has clearly and consistently supported European political integration and the emergence of Japan as a political power. Now Europe and Japan must show that they believe their interests to be harmonious with those of the U.S. and of the developing countries by adopting more open economic policies. That would be good for the world trading system, and also for European and Japanese citizens.

Failure of GATT

The failure of the GATT negotiations comes at a particularly unfortunate moment. For the first time in the history of GATT, many developing countries—Mexico, for example, and Brazil—are voluntarily trying to develop the competitiveness and efficiency of market economies and are moving away from state participation and guidance. Eastern Europe is running away from managed trade. These countries must be allowed the opportunity to realize their comparative advantage in sectors such as agriculture and textiles. The best way to do this—far better than aid—is to give them access to markets.

If a trade war now breaks out, these countries, as well as Japan and Europe, are vulnerable. The U.S. is much less so. The U.S. is starting from a considerably higher position and is by far the largest, most homogenous market in the world. Trade war is in nobody's interest, and the U.S. would lose significantly from it. But the U.S. market is more important to its trading partners than any one of their markets is to the U.S. The direct implication is that Japan and Europe stand to lose more from Friday's failure than their policy makers seem to realize.

Mr. Gluck is managing director of McKinsey & Co. Bill Lewis, a principal in McKinsey's Washington office, contributed to this analysis.

PCAST

THE WHITE HOUSE

WASHINGTON

December 7, 1990

MEMORANDUM FOR CHARLES KOLB

FROM: D. ALLAN BROMLEY DAB.

SUBJECT: PCAST BACKGROUND PAPERS

Attached are two background papers -- one on meeting the National Education Goals and the other on technology and the American standard of living. They were prepared by the President's Council of Advisors on Science and Technology and will be used to brief the President next Friday, December 14.

I would very much appreciate your comments on these papers by next Monday evening, so that the members of PCAST may consider your thoughts before briefing the President.

Thank you in advance for your assistance.

cc: Ken Yale
Tom Welch

[DRAFT: DO NOT DISTRIBUTE OR QUOTE]
[December 6, 1990]

EDUCATION IN SCIENCE AND MATHEMATICS: MEETING THE NATIONAL EDUCATION GOALS

The National Education Goals developed by the President and the nation's Governors have helped to move education toward the top of the nation's agenda. Following the lead of the President and the Governors, Americans in growing numbers are committing their energies to efforts designed to improve basic education.

Achieving the national goals will require significant improvement in science and mathematics education. However, revitalizing science and mathematics education will not be possible without much broader reforms in American basic education. This paper therefore examines some of the general reform strategies that will be needed to meet the national goals. It then suggests several ways in which the President and the federal government can anticipate and facilitate those reforms, with a particular emphasis on science and mathematics education.

THE NATURE OF THE GOALS

The National Education Goals have revolutionary implications for basic education. They are performance goals stated in terms of outcomes or levels of achievement. In the areas of science and mathematics, they require "demonstrated competency . . . in mathematics [and] science," sufficient to place U.S. students "first in the world in science and mathematics achievement" by the year 2000, when "every adult American will be literate and possess the knowledge and skills required in a global economy." Moreover, the call for 90 percent of our young people to graduate from high school requires that the goals extend to virtually all school-aged children, even those for whom alternate educational strategies are required.

Previous efforts to improve education have often used input or process goals, which prescribe the experiences that all students and teachers should undergo -- for example, the amount and kinds of courses required of all students. Many of the new approaches adopted in the 1980s were process reforms, and although there is some evidence that these changes have contributed to modest progress in recent years, their results have been generally disappointing.

REQUIREMENTS FOR EDUCATIONAL REFORM

Since the announcement of the National Education Goals, a consensus has been emerging that achieving them will require fundamental restructuring of basic education in America. Incremental improvements may be achieved by further incremental changes, but the magnitude of improvement needed to meet the goals calls for massive change in the educational system.

The emphasis on performance implicit in the goals is one of the most important educational reforms needed to meet those goals. This focus on results rather than inputs must be accelerated and become pervasive throughout American elementary and secondary education.

However, performance can be emphasized only if achievement can be reliably measured. Today, we need greater confidence in assessment mechanisms and more understanding of how assessments relate to actual learning. Without such improvements, many in the education community feel it will be difficult to reorder the educational system on the basis of performance.

As assessment mechanisms are being improved, a complementary effort is needed in the area of curricular reform. Much good work is being done in this area, but implementation of the results in schools will not be easy. Moreover, testing standards should be coordinated with curriculum development, which is a major challenge.

A second fundamental change that will be required for the restructuring of basic education is the introduction of choice in the selection of schools appropriate for each child. Choice has many dimensions, ranging from permitting some children to choose "magnet" schools within the public system to distributing government vouchers for children to redeem for cash toward tuition at any school, public or private. Whatever system is adopted, it is important to provide some measure of academic quality to act as a basis for choice. Requiring nationally standardized tests and publishing their results would provide one of the indexes that parents could use as consumers in the educational marketplace. Involving parents in education has great value, and giving parents some element of choice is often the beginning of a deeper parental involvement.

A third promising strategy in the reform of basic education is rewarding exceptional teachers. Implementation often founders on the difficulty of assessing the quality of a teacher, but improved assessments of teacher performance, along with other means of evaluation, including peer review, provide important opportunities for improving the quality of the teaching force.

Such efforts are especially important in science and technology. Unless teachers at both the elementary and secondary levels understand and appreciate

science and technology, significant improvement will be difficult. Teacher training programs to improve the quality of science and mathematics teaching will be an essential element in meeting the national goals.

A fourth requirement for reform is reducing bureaucracies by relying on school-based management that empowers principals and their teachers. However, bureaucracies will relinquish control to teams of teachers and principals at individual schools only if equity and accountability can be assured, which again raises the question of educational assessment.

Finally, underlying the needed reforms of basic education is the recognition that school is only one of many critical influences in a child's development. Only by shifting our focus from our institutions to our children can we truly address the challenges to our society. This strategy is particularly relevant for the retention of students at risk of dropping out, who may require strategies beginning with prenatal and child care even before formal school begins. If we are to strengthen our nation's workforce and build better citizens, we must shape society's institutions to our children and not vice versa.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government cannot mandate reform in the distributed system of basic education in America. It can, however, facilitate, and where appropriate finance, the reform initiatives cited above, using incentives and appropriate leveraging to accelerate the reform process. In particular, we believe that the following federal actions warrant serious consideration:

o The federal government can provide incentives to states or regions pursuing any of the reforms described in the previous section, subject to constraints designed to ensure equity and equal opportunity. For example, federal funds might be used to facilitate choice for needy students, thereby providing an inducement to states or districts offering choice programs. Similarly, a national competition might be established to recognize and reward exemplary programs for restructuring education (just as the Malcolm Baldrige National Quality Award has recognized quality improvements in industry).

o The federal government can foster greatly intensified research on academic assessment and the development of measurement instruments so that performance standards can be set and the academic marketplace can function more rationally. For example, federal funds could be used to pay for participating in appropriate achievement evaluation programs.

o The federal government can make a concerted, national effort to facilitate and coordinate state and local programs, both public and private, to deal with the school dropout problem. Successful drop-out prevention programs could be recognized by the President and rewarded for their achievement.

o The federal government can encourage private corporations, universities, and national laboratories to work cooperatively with local schools, building on the many excellent initiatives already under way.

o In the areas of mathematics and science, the federal government can invest in programs to engage talented girls and minority students in science and mathematics, where they are now underrepresented.

o The federal government can invest in teacher education programs in science and mathematics and use forgivable loans and other inducements to attract to teaching young people with degrees in science, mathematics, and engineering.

o The federal government can support programs using modern communications technologies, including satellite technologies, to expand access of both students and teachers to the most highly qualified teachers of science and mathematics.

o The federal government can initiate a cooperative demonstration project with the school system of the District of Columbia.

THE PRESIDENT'S ROLE

Responsibility for our system of basic education in America rests fundamentally on the general population, who shape the learning environments of their children, elect their school boards and other influential politicians, and demonstrate their priorities by their behavior toward teachers and schools.

However, our nation's leaders influence the attitudes and values of the electorate. The President, in particular, has a personal role that reaches beyond his authority as our nation's chief executive officer. In choosing his own priorities as a leader, he sets a standard for all to heed.

The President, in partnership with the Governors, has placed a great challenge squarely on the national agenda. Now all of the resources of leadership must be applied to meeting that challenge. Federal budget priorities must be set, the activities of the federal agencies must be guided, and the President's personal commitment to education must continue to be demonstrated. With timely actions, and with a continuing and unremitting campaign of words, the President can secure his place in the history of American education.

PCAST

THE WHITE HOUSE

WASHINGTON

December 7, 1990

MEMORANDUM FOR CHARLES KOLB

FROM: D. ALLAN BROMLEY DAB.

SUBJECT: PCAST BACKGROUND PAPERS

Attached are two background papers -- one on meeting the National Education Goals and the other on technology and the American standard of living. They were prepared by the President's Council of Advisors on Science and Technology and will be used to brief the President next Friday, December 14.

I would very much appreciate your comments on these papers by next Monday evening, so that the members of PCAST may consider your thoughts before briefing the President.

Thank you in advance for your assistance.

cc: Ken Yale
Tom Welch

[DRAFT: DO NOT DISTRIBUTE OR QUOTE]
[December 6, 1990]

EDUCATION IN SCIENCE AND MATHEMATICS: MEETING THE NATIONAL EDUCATION GOALS

The National Education Goals developed by the President and the nation's Governors have helped to move education toward the top of the nation's agenda. Following the lead of the President and the Governors, Americans in growing numbers are committing their energies to efforts designed to improve basic education.

Achieving the national goals will require significant improvement in science and mathematics education. However, revitalizing science and mathematics education will not be possible without much broader reforms in American basic education. This paper therefore examines some of the general reform strategies that will be needed to meet the national goals. It then suggests several ways in which the President and the federal government can anticipate and facilitate those reforms, with a particular emphasis on science and mathematics education.

THE NATURE OF THE GOALS

The National Education Goals have revolutionary implications for basic education. They are performance goals stated in terms of outcomes or levels of achievement. In the areas of science and mathematics, they require "demonstrated competency . . . in mathematics [and] science," sufficient to place U.S. students "first in the world in science and mathematics achievement" by the year 2000, when "every adult American will be literate and possess the knowledge and skills required in a global economy." Moreover, the call for 90 percent of our young people to graduate from high school requires that the goals extend to virtually all school-aged children, even those for whom alternate educational strategies are required.

Previous efforts to improve education have often used input or process goals, which prescribe the experiences that all students and teachers should undergo -- for example, the amount and kinds of courses required of all students. Many of the new approaches adopted in the 1980s were process reforms, and although there is some evidence that these changes have contributed to modest progress in recent years, their results have been generally disappointing.

REQUIREMENTS FOR EDUCATIONAL REFORM

Since the announcement of the National Education Goals, a consensus has been emerging that achieving them will require fundamental restructuring of basic education in America. Incremental improvements may be achieved by further incremental changes, but the magnitude of improvement needed to meet the goals calls for massive change in the educational system.

The emphasis on performance implicit in the goals is one of the most important educational reforms needed to meet those goals. This focus on results rather than inputs must be accelerated and become pervasive throughout American elementary and secondary education.

However, performance can be emphasized only if achievement can be reliably measured. Today, we need greater confidence in assessment mechanisms and more understanding of how assessments relate to actual learning. Without such improvements, many in the education community feel it will be difficult to reorder the educational system on the basis of performance.

As assessment mechanisms are being improved, a complementary effort is needed in the area of curricular reform. Much good work is being done in this area, but implementation of the results in schools will not be easy. Moreover, testing standards should be coordinated with curriculum development, which is a major challenge.

A second fundamental change that will be required for the restructuring of basic education is the introduction of choice in the selection of schools appropriate for each child. Choice has many dimensions, ranging from permitting some children to choose "magnet" schools within the public system to distributing government vouchers for children to redeem for cash toward tuition at any school, public or private. Whatever system is adopted, it is important to provide some measure of academic quality to act as a basis for choice. Requiring nationally standardized tests and publishing their results would provide one of the indexes that parents could use as consumers in the educational marketplace. Involving parents in education has great value, and giving parents some element of choice is often the beginning of a deeper parental involvement.

A third promising strategy in the reform of basic education is rewarding exceptional teachers. Implementation often founders on the difficulty of assessing the quality of a teacher, but improved assessments of teacher performance, along with other means of evaluation, including peer review, provide important opportunities for improving the quality of the teaching force.

Such efforts are especially important in science and technology. Unless teachers at both the elementary and secondary levels understand and appreciate

- alternative certification

flexibility/accountability not included

science and technology, significant improvement will be difficult. Teacher training programs to improve the quality of science and mathematics teaching will be an essential element in meeting the national goals.

A fourth requirement for reform is reducing bureaucracies by relying on school-based management that empowers principals and their teachers. However, bureaucracies will relinquish control to teams of teachers and principals at individual schools only if equity and accountability can be assured, which again raises the question of educational assessment.

what?

Finally, underlying the needed reforms of basic education is the recognition that school is only one of many critical influences in a child's development. Only by shifting our focus from our institutions to our children can we truly address the challenges to our society. This strategy is particularly relevant for the retention of students at risk of dropping out, who may require strategies beginning with prenatal and child care even before formal school begins. If we are to strengthen our nation's workforce and build better citizens, we must shape society's institutions to our children and not vice versa.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government cannot mandate reform in the distributed system of basic education in America. It can, however, facilitate, and where appropriate finance, the reform initiatives cited above, using incentives and appropriate leveraging to accelerate the reform process. In particular, we believe that the following federal actions warrant serious consideration:

o The federal government can provide incentives to states or regions pursuing any of the reforms described in the previous section, subject to constraints designed to ensure equity and equal opportunity. For example, federal funds might be used to facilitate choice for needy students, thereby providing an inducement to states or districts offering choice programs. Similarly, a national competition might be established to recognize and reward exemplary programs for restructuring education (just as the Malcolm Baldrige National Quality Award has recognized quality improvements in industry).

o The federal government can foster greatly intensified research on academic assessment and the development of measurement instruments so that performance standards can be set and the academic marketplace can function more rationally. For example, federal funds could be used to pay for participating in appropriate achievement evaluation programs.

o The federal government can make a concerted, national effort to facilitate and coordinate state and local programs, both public and private, to deal with the school dropout problem. Successful drop-out prevention programs could be recognized by the President and rewarded for their achievement.

o The federal government can encourage private corporations, universities, and national laboratories to work cooperatively with local schools, building on the many excellent initiatives already under way.

o In the areas of mathematics and science, the federal government can ~~invest~~ encourage in programs to engage talented girls and minority students in science and mathematics, where they are now underrepresented.

o The federal government can invest in teacher education programs in science and mathematics and use forgivable loans and other inducements to attract to teaching young people with degrees in science, mathematics, and engineering.

o The federal government can support programs using modern communications technologies, including satellite technologies, to expand access of both students and teachers to the most highly qualified teachers of science and mathematics.

o The federal government can initiate a cooperative demonstration project with the school system of the District of Columbia.

THE PRESIDENT'S ROLE

Responsibility for our system of basic education in America rests fundamentally on the general population, who shape the learning environments of their children, elect their school boards and other influential politicians, and demonstrate their priorities by their behavior toward teachers and schools.

However, our nation's leaders influence the attitudes and values of the electorate. The President, in particular, has a personal role that reaches beyond his authority as our nation's chief executive officer. In choosing his own priorities as a leader, he sets a standard for all to heed.

The President, in partnership with the Governors, has placed a great challenge squarely on the national agenda. Now all of the resources of leadership must be applied to meeting that challenge. Federal budget priorities must be set, the activities of the federal agencies must be guided, and the President's personal commitment to education must continue to be demonstrated. With timely actions, and with a continuing and unremitting campaign of words, the President can secure his place in the history of American education.

[DRAFT: DO NOT DISTRIBUTE OR QUOTE]
[December 7, 1990]

TECHNOLOGY AND THE AMERICAN STANDARD OF LIVING

Today most Americans take for granted a standard of warmth, cleanliness, food, medical care, music and entertainment, and transportation that was undreamt of 150 years ago. This great surge forward in the standard of living can and will continue. Furthermore, it can encompass all Americans and the citizens of other countries as well.

The foundation for dramatic increases in economic growth and improvement in the standard of living has been technology. Basic research built a fundamental understanding of the physical world, including the laws of mechanics and gravity, the atomic and molecular bases of chemistry, and the basic principles of electricity and energy. Building on this knowledge, individuals brought forth one striking invention after another, from the steam engine, railroads, and the telegraph to electric lighting, the telephone, and radio. Over the years, the rate of technological progress accelerated. Advances in agriculture liberated the vast farm population for other pursuits; automobiles and airplanes provided unprecedented speed and accessibility over vast distances; and the television and computerized communications linked the world together. This remarkable surge in invention, which contributed to an equally remarkable ability to produce goods and services in volume, did much to create the modern world.

America has led the world in science and technology for much of this century -- resulting in a standard of living to which the rest of the world aspired. This paper explores what will be necessary to continue to lead the world and thereby provide a standard of living that will allow our children and grandchildren to live far better than we do today.

REQUIREMENTS FOR TECHNOLOGICAL LEADERSHIP

Since World War II, basic scientific research has provided a new foundation on which to build for the future. The molecules in a material can now be seen and studied at the atomic level. The discovery of the structure of DNA and of the immense complexity of the cell has opened up whole new areas of opportunity. New materials are being developed that are lighter, stronger, and more durable than

anything known today. Advanced computers and new modes of communication, such as optical fibers, are resulting in new ways to learn, new ways to work, new kinds of intelligent machinery with virtually unlimited new capabilities. Furthermore, a better understanding of the environment is making it possible for these advances to have far fewer negative environmental impacts than did earlier technological advances.

Three basic things will be required if the United States is to continue to benefit from the dividends of science and technology.

1. A continuing flow of new ideas and new understanding, which are the basis of new materials, better health care, new information technologies, a cleaner environment, and other technological advances.

2. The translation of new ideas and new technologies into significant new products and into the steady improvement of those that are already an important part of our lives.

3. A revival of manufacturing and the production of goods, which in the past has provided both the material wealth and the jobs that built the American standard of living.

THE ROLE OF THE FEDERAL GOVERNMENT

The federal government has a role, although not the exclusive role, in the development of technology. In particular, it has been a major catalyst for technology development through its direct investment in research and through legislative and regulatory actions that have facilitated the development and commercialization of new insights.

New Ideas and New Understanding

Our diverse science and technology base can generate new ideas anywhere -- on the production line, in industrial or government laboratories, and in the individual laboratories of universities and research institutes. Many new ideas have come from basic research, which has been supported largely by the federal government. The federal government supports this research through diverse mechanisms in government laboratories and in hundreds of universities and private research institutes throughout the United States.

Continued strong investment in basic research, the recognition that basic research is a high national priority, and the continued support of the principle of diversity without federal control of research are all essential. The federal government must also ensure that the large sums of money it is investing are invested well. Thus, oversight must be balanced with control in ensuring that this broad and diverse research base thrives.

Through its support of research and training programs, the federal government has also played a major role in training the next generation of scientists. However, many scientists, particularly young scientists, are discouraged about their future prospects in science. Some of these problems may be based more on perceptions than realities. Nevertheless, there needs to be a well-articulated federal position across science and technology that the generation of scientific and technological talent is essential to America's future and will given high priority.

Finally, in partnership with the private sector, the federal government has a role in revitalizing the research infrastructure. A modern infrastructure is essential if we are to create environments for talented people to generate new ideas.

Translation of New Ideas into Technologies

One of the greatest threats to continued improvements in our standard of living is our relative weakness at translating basic knowledge into significant new products and in generating steady improvement of those products that are already an important part of our lives. Other countries now succeed at this process this much more effectively than we do here in the United States.

The federal government has both a direct and an indirect role in translating new ideas and new understanding into useable technologies. First, it can help create an economic climate that stimulates the development of new products and encourages the formation of new entrepreneurial companies. The federal government can also support the development of generic, precompetitive technologies that have widespread applications in the public and private sectors (examples include high performance computing, biotechnologies, and materials science and engineering). The federal government has often taken this role in the past, as in the cases of computer technologies, aeronautical developments, and agricultural advances. It is important, however, that such support not pull the federal government into an inappropriate development role.

The federal laboratories are a major government resource that could, in some cases, be marshalled to participate more effectively in technology transfer. In particular, some federal laboratories could be given new missions focusing on generic, precompetitive technologies, on manufacturing, and on technology transfer.

In general, the federal government needs to promote legislative and regulatory actions that support and encourage appropriate technology transfer at the level of individual scientists and institutions in both the private and public sectors. Concerns about conflict of interest must be handled judiciously so that they do not inappropriately retard the entrepreneurial spirit.

Manufacturing

If America is to benefit from its own new ideas, this country must once again become preeminent in manufacturing. This is largely the responsibility of industry, but there are certain things that the federal government can do to make manufacturing a high priority for this country. The President can recognize the importance of manufacturing to the American standard of living. The Malcolm Baldrige National Quality Award is an example that has been extremely successful. Other programs that give manufacturing this kind of recognition need to be established. The federal government can also support engineering education and fellowships targeted for research and manufacturing technology.

SETTING PRIORITIES IN SCIENCE AND TECHNOLOGY

In times of limited financial resources, choices must be made. Investments to support technology, and thereby increase the American standard of living, will not necessarily be free. The federal government's priorities in science and technology may have to shift to more explicitly recognize economic growth and a higher standard of living as national goals. In any such evaluation, we feel that the three areas discussed above -- basic research, the translation of new ideas into products, and manufacturing technologies -- must have priority if this country is to continue to increase its standard of living.

THE WHITE HOUSE

WASHINGTON

December 7, 1990

MEMORANDUM FOR CHARLES KOLB

FROM: D. ALLAN BROMLEY DAB.

SUBJECT: PCAST BACKGROUND PAPERS

Attached are two background papers -- one on meeting the National Education Goals and the other on technology and the American standard of living. They were prepared by the President's Council of Advisors on Science and Technology and will be used to brief the President next Friday, December 14.

I would very much appreciate your comments on these papers by next Monday evening, so that the members of PCAST may consider your thoughts before briefing the President.

Thank you in advance for your assistance.

cc: Ken Yale
Tom Welch

PCAST

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

July 20, 1990

MEMORANDUM FOR CHARLES KOLB

THROUGH: J. THOMAS RATCHFORD

FROM: CHARLES DICKENS

SUBJECT: Materials about PCAST

Attached are background materials about PCAST that we discussed:

1. Executive Order 12700, dated January 19, 1990;
2. PCAST Charter;
3. PCAST membership;
4. Proposed PCAST panels for 1990-1991;
5. Minutes for February and March PCAST meetings;
6. PCAST Memoranda for the President;
7. Proposed agenda for the July PCAST meeting.

Attachments

Office of the Press Secretary
(Miami, Florida)

For Immediate Release January 19, 1990

EXECUTIVE ORDER

- - - - - - -

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY

By the authority vested in me as President by the Constitution and laws of the United States of America, and in order to establish, in accordance with the provisions of the Federal Advisory Committee Act, as amended (5 U.S.C. App. 2), an advisory committee on science and technology, it is hereby ordered as follows:

Section 1. Establishment. There is established the President's Council of Advisors on Science and Technology ("Council"). The Council shall be composed of not more than 15 members, one of whom shall be the Director of the Office of Science and Technology Policy, and 14 of whom shall be distinguished individuals from the private sector to be appointed by the President. The Director of the Office of Science and Technology Policy shall serve as Chairman of the Council. The Vice Chairman shall be appointed by the President from among the 14 private sector members. The Chairman shall report directly to the President.

Sec. 2. Functions. (a) The Council shall advise the President on matters involving all areas of science and technology.

(b) In the performance of its advisory duties the Council shall conduct a continuing review and assessment of developments in science and technology, and shall, through the Chairman, report thereon to the President whenever requested.

(c) The Chairman may, from time to time, invite experts to investigate and report to the Council on specific issues of national consequence.

Sec. 3. Administration. (a) The heads of Executive agencies shall, to the extent permitted by law, provide the Council and its panels such information with respect to scientific and technological matters as required for the purpose of carrying out its functions.

(b) Members of the Council shall serve without any compensation for their work on the Council. However, members appointed from among private citizens of the United States may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by law for persons serving intermittently in the Government service (5 U.S.C. 5701-5707).

(c) Any expenses of the Council shall be paid from the funds available for the expenses of the Office of Science and Technology Policy.

(d) The Office of Administration shall, on a reimbursable basis, provide such administrative services as may be required.

Sec. 4. General. (a) Notwithstanding any other Executive order, the functions of the President under the Federal Advisory Committee Act, as amended, except that of reporting to the Congress, which are applicable to the Council, shall be performed by the Office of Administration in accord with the guidelines and procedures established by the Administrator of General Services.

(b) The Council shall terminate on June 30, 1991, unless sooner extended.

GEORGE BUSH

THE WHITE HOUSE,

January 19, 1990.

# # #

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

CHARTER

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY

1. Committee's Official Designation:

President's Council of Advisors on Science and Technology (PCAST). The Council was established by Executive Order Number 12700, dated January 19,1990.

2. Objective and Scope of Activities and Duties:

- The purpose of the PCAST is to advise the President on all matters involving science and technology.
- In furtherance of this mission the PCAST shall conduct a continuing review and assessment of developments in science and technology and the chairman may invite panels of experts to investigate and report to the Council on specific issues of national importance.

3. Duration

The Council will have continuing responsibility for advising the President. The Council will terminate on June 30, 1991, unless sooner extended.

4. Official to Whom the Council Reports:

The PCAST will report to the President, through the Chairman of the Council.

5. Agency Responsible for Providing Necessary Support for this Council:

Office of Science and Technology Policy(OSTP).

6. Description of Duties:

The Duties of the Council are solely advisory and are stated in paragraph 2 above.

7. Costs:

The estimated annual operating cost of the Council is $375,000, including 2 man years of support staff activity.

8. Estimated Number and Frequency of Meetings:

The President's Council of Advisors on Science and Technology shall normally meet twelve times each year at regular intervals, and at such other times as may be called by the President or the Director, OSTP. In addition, 10-15 meetings each year by Panels are anticipated.

9. Panels:

Panels may be formed to conduct studies on specific issues assigned by the President or the Director, OSTP.

10. Members:

PCAST members shall be appointed by the President from the private sector. The PCAST shall consist of no more than 14 members and the Chairman. The Director, OSTP shall serve as Chairman of the Council, and the Vice Chairman shall be appointed by the President from the members of the Council.

The Council may utilize additional technical experts as needed to constitute its panels and study groups. These technical experts shall be appointed by the Chairman and shall serve at the pleasure of the Chairman.

This Charter for the Advisory Committee named above is hereby approved:

Signed: D. Allan Bromley

Assistant to the President for Science and Technology, and Director, Office of Science and Technology Policy, and Chairman, President's Council of Advisors on Science and Technology.

Date signed: January 23, 1990

Date filed: January 24, 1990

THE PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY (PCAST)

NORMAN BORLAUG, Distinguished Professor, Department of Soils and Crop Sciences, Texas A&M University

ALLAN BROMLEY, Assistant to the President for Science and Technology, Executive Office of the President (Chairman)

SOLOMON BUCHSBAUM, Senior Vice President, Technology Systems, AT&T Bell Laboratories

CHARLES DRAKE, Albert Bradley Professor of Earth Sciences and Professor of Geology, Dartmouth College

RALPH GOMORY, President, The Alfred P. Sloan Foundation

BERNADINE HEALY, Chairman of the Research Institute, The Cleveland Clinic Foundation (Vice-Chairman)

PETER LIKINS, President, Lehigh University

THOMAS LOVEJOY, Assistant Secretary for External Affairs, Smithsonian Institution

WALTER MASSEY, Vice President for Research and for Argonne National Laboratory, University of Chicago

JOHN McTAGUE, Vice-President-Technical Affairs, Ford Motor Company

DANIEL NATHANS, Professor of Molecular Biology and Genetics, Johns Hopkins University School of Medicine

DAVID PACKARD, Chairman of the Board, Hewlett-Packard Company

HAROLD SHAPIRO, President, Princeton University

Dr. Norman E. Borlaug
International Maize and Wheat
Improvement Center (CIMMYT)
Apartado, Postal 6-641
Delegacion Cuauhtemoc
06600 Mexico D.F.

011-525-954-2100
011-525-954-1069 FAX
Mrs. Eva Viesca

Dr. Solomon J. Buchsbaum
Senior Vice President
Technology Systems
AT&T Bell Laboratories
Crawfords Corner Road
Holmdel, New Jersey 07733

(201) 949-5564
(201) 949-7183 FAX
Julie Lehnert -
(201) 949-5566

Professor Charles L. Drake
Albert Bradley Professor of Earth Sciences
and Professor of Geology
Dartmouth College
228 Fairchild
Hanover, New Hampshire 03755

(603) 646-2373 (after three
rings, switches to
Dept. line)
(603) 646-3520 FAX
Grace

Dr. Ralph E. Gomory
President
The Sloan Foundation
530 Fifth Avenue
New York, New York 10111

(212) 649-1649
(212) 757-5117 FAX
Beverly (212) 649-1623

Bernadine P. Healy, M.D.
Chairman, The Research Institute
The Cleveland Clinic Foundation
9500 Euclid Avenue
Cleveland, Ohio 44106

(216) 444-3900
(216) 444-3279 FAX
Kathleen Vaughn

Dr. Peter W. Likins
President
Lehigh University
Alumni Building No. 27
Bethlehem, Pennsylvania 18015

(215) 758-3155
(215) 868-6560 FAX
(215) 691-5420 FAX, Likins's
ofc. (may have to dial "9-1 +
#)
Molly Malone, Laurie Gannett

Dr. Thomas E. Lovejoy
Assistant Secretary for External Affairs
The Smithsonian Institution
1000 Jefferson Drive, S.W. ROOM SI-230
Washington, D.C. 20560

(202) 786-2263
(202) 786-2304 FAX
Carmen Thorndike

Dr. Walter E. Massey
Vice President for Research
and for Argonne National Laboratory
The University of Chicago
5801 Ellis Avenue
Chicago, Illinois 60637

(312) 702-6021
(312) 702-0934 FAX
Janice Stroud

Dr. John P. McTague
Vice President, Research
Ford Motor Company
Scientific Research Laboratories Building
20000 Rotunda Drive
Dearborn, Michigan 48121

(313) 322-7105
(313) 845-0512 FAX
Katie

Professor Daniel Nathans
Department of Molecular Biology and Genetics
Johns Hopkins School of Medicine
725 North Wolfe Street
Baltimore, Maryland 21205

(301) 955-8445
(301) 955-4857 FAX
Lilly Mitchell (301) 955-2382
Janet Libonate

The Honorable David Packard
Chairman of the Board
Hewlett-Packard Company
1501 Page Mill Road
Palo Alto, California 94304

(415) 857-3327
(415) 857-4012 FAX
Margaret Paull

Dr. Harold T. Shapiro
President
Princeton University
One Nassau Hall
Princeton, New Jersey 08544-0015

(609) 258-6100
(609) 258-1294 FAX
Marcia Snowden
Rosemary

PCAST PANELS UNDER CONSIDERATION

Proposed Panels 1990-1991

High Performance Computing and Communications

Chairman:	Sol Buchsbaum
Vice Chairman:	Ralph Gomory

Education and Human Resources

Chairman:	Peter Likins
Vice Chairman:	Charles Drake

International Economic Competitiveness

Including Subset issue: Materials Science and Engineering

Chairman:	Ralph Gomory/John McTague
Vice Chairman:	Harold Shapiro/Peter Likins

Proposed Panels 1991-1992

Bioscience and Biotechnology

Chairman:	Dan Nathans
Vice Chairman:	Bernadine Healy

Global Environment and Natural Resources

Chairman:	Tom Lovejoy
Vice Chairman:	David Packard
	Norman Borlaug

7/19/90

MINUTES

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY (PCAST)

FEBRUARY 3, 1990

CAMP DAVID, MARYLAND

10:30 A.M. - 1:00 P.M.

CLOSED SESSION

PCAST Members Attending: Dr. Norman Borlaug; Dr. Solomon Buchsbaum; Dr. Charles Drake; Dr. Ralph Gomory; Dr. Bernadine Healy; Dr. Peter Likins; Dr. Thomas Lovejoy; Dr. Walter Massey; Dr. John McTague; Dr. Daniel Nathans; Mr. David Packard; Dr. Harold Shapiro.

Government Attendees: President George Bush; Mr. John Sununu, Chief of Staff and Assistant to the President; Mr. Richard Darman, Director of the Office of Management and Budget; Dr. Michael Boskin, Chairman of the Council of Economic Advisers; Mr. Michael Deland, Chairman of the Council on Environmental Quality; Dr. D. Allan Bromley, Assistant to the President for Science and Technology, and Chairman of PCAST.

The meeting began with an introduction by Dr. Bromley, followed by brief opening remarks by the President. The President stressed the importance of science and technology to the nation and his desire to have a strong science advising mechanism. Dr. Bromley then introduced each member of the PCAST and asked them to briefly comment on some of the issues that they saw as important to American science and technology.

The introductions were followed by a discussion of three specific topics of particular interest to the President.

1. Science and technology and economic growth: The importance of science and technology to the economic strength and growth of the country, as well as to social welfare, was discussed at length. Issues covered included innovation in manufacturing technology; examples of successful translation of scientific developments to economic good, such as the semiconductor industry and biotechnology; the impact of the variety of federal policies on the R&D base; and the role of government laboratories and research-intensive universities in the innovation process.

2. Mathematics and science education: The President expressed great concerns about education in mathematics and science. The need for a well-educated work force, well-grounded in analytical and logical capabilities developed through mathematics and scientific training was stressed by several members of PCAST. Also discussed was the importance of maintaining a talent base of scientists and engineers,

who make the discoveries in the basic research laboratories and serve as major agents of technology transfer. Concerns were expressed about a declining interest in careers in science and technology, including biology and medicine, and some of the factors that may be contributing to this declining interest. Although it was recognized that a number of specific programs are being undertaken by the federal government, particularly within the National Science Foundation and the Department of Education, it was also noted that Mr. Bush's identification of education as a presidential issue elevated its importance and visibility at a broad national level.

3. Environmental science and global change: The President expressed his concern about the environment and the issue of global change. Uncertainties regarding the extent and the timing of possible future climate changes, as well as some of the reasons for the diversity of opinion among the scientific community on the magnitude of the problem at the present time, were discussed. Comments were made about the models that are the basis of many of the predictions, the need for further research and direct data acquisition. Other aspects of global change, such as the problems of biological diversity were mentioned. The kinds of action that might be taken to address these problems, on a national and multinational basis, will require considerable and careful evaluation.

Finally, there was a general discussion on science advising to the President and the importance of a mechanism for coordination of science and technology initiatives and policies across the many government agencies involved in science. The role of Dr. Bromley and the members of PCAST in this process were commented upon.

The President adjourned the meeting at approximately 1:30 p.m.

Minutes Approved: D. Allan Bromley

Date: May 9, 1990

MINUTES

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY (PCAST)

MARCH 22-23, 1990

WASHINGTON, D.C.

PCAST Members Attending: Dr. Allan Bromley; Dr. Bernadine Healy; Dr. Solomon Buchsbaum; Dr. Charles Drake; Dr. Ralph Gomory; Dr. Peter Likins; Dr. Thomas Lovejoy; Dr. Walter Massey; Dr. John McTague; Dr. Daniel Nathans; Mr. David Packard.

Government Attendees: President George Bush; Gov. John Sununu; Mr. Richard Darman.

OSTP Staff: Dr. William Phillips; Dr. Thomas Ratchford; Dr. Eugene Wong; Dr. James Wyngaarden; Dr. Judith Bostock; Dr. Karl Erb; Dr. Nancy Maynard; Ms. Michelle Van Cleave.

Department of Defense: Honorable Don Atwood

CIA Staff: Dr. Gordon Oehler; Dr. John Weiss

Public: Approximately 10 people attended the open session.

1. The meeting agenda is at Enclosure 1.

Open Session: 9:00 A.M. - 12:00 NOON, MARCH 22, 1990

2a. Dr. Bromley called the meeting to order and made introductory remarks. He noted that selected OSTP speeches and testimony, biographical material for presenters, and other information were available to those attending.

b. Dr. Bromley briefly discussed the need of the science and technology (S&T) community to get behind the President's S&T budget submission. He also pointed to the future need of achieving the best possible balance between very large S&T projects and small S&T investigators. He sketched the status of the revitalization of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). Dr. Bromley noted that PCAST, where appropriate, may want to parallel certain FCCSET efforts.

c. Dr. Bromley discussed the upcoming White House Conference on "Science and Economics Research Related to Global Change." A brief discussion on this followed.

d. Drs. Wong and Phillips were then introduced to the PCAST and other attendees.

3. Dr. Wong presented a briefing on High Performance Computing (HPC). (His viewgraphs and papers that he circulated to PCAST members are at Enclosure 2).

a. Dr. Buchsbaum noted the importance of standards in HPC. A discussion on this followed.

b. Dr. Bromley noted the importance of involving schools in HPC in order to meet the President's education goals. He noted the President would like to hear from the PCAST on HPC. All agreed that computer education and education in areas using or related to computers need emphasis. Dr. Gomory stressed that the need involves all levels of education, including technical schools. Dr. Likins pointed out that business majors and others are important users of computers. Dr. Healy said that here is an issue that might gain good response if portrayed to students as a "grand challenge."

Dr. Massey said that first year business students might use computers more than first year physics students use them.

c. Dr. Bromley concluded this HPC session by asking the members for comments, especially those pertaining to the need for a PCAST HPC panel. A discussion followed, and agreement was reached on recommending establishment of a panel.

4. Dr. Phillips then presented a briefing on Materials Science and Engineering (his viewgraphs are attached as Enclosure 3). Dr. Gomory stated the need for industry to make its needs known before proceeding. Dr. Likins noted that high school teachers and counselors do not see materials as an area of study. Dr. Healy pointed out the importance of biomaterials. More discussion followed.

5. Dr. Bromley departed for a noontime presentation, and Dr. Healy assumed the chairman's duties. After a discussion, all agreed that PCAST and FCCSET work in materials science and engineering was needed.

Closed Session: 1:00 P.M. - 5:00 P.M., MARCH 22, 1990

6a. PCAST panel structure and personnel to serve on the panels were discussed at length.

b. Preparations were made for the PCAST session with the President (see below).

c. Drs. Oehler and Weiss, Central Intelligence Agency, then presented a briefing. A discussion followed.

Closed Session: 9:00 A.M. - 12:00 NOON, MARCH 23, 1990

7a. Deputy Secretary of Defense Don Atwood presented the DoD's future R&D plans and budget required to meet expected threats to national security. He described the probable threats over the next decade and pointed out the importance of a strong S&T program. A discussion followed including DoD's view of increased funding for universities and dual-use technologies.

b. Mr. Atwood and the members discussed the China Lake experiment and the future of the DoD laboratory system.

c. Following Mr. Atwood's departure, a discussion began on the role of Federal agencies in mathematics and science education. All agreed that M&S education should be part of all panel work and that all panel draft terms of reference should be "scrubbed" to be certain education is addressed. Dr. Bromley noted the decreasing percentage of NSF and NIH grant applicants that are supported.

d. Dr. Bromley next led a discussion of PCAST panel structure and the persons who might best serve on those panels. He commented on parallel work underway in FCCSET.

e. Dr. Bromley led a discussion on agenda issues for future meetings. He called on all to think about long-term needs that PCAST could address. Dr. Healy suggested a PCAST panel could be helpful in the problem of drug abuse. Dr. Bromley stated his intention to have cabinet secretaries and heads of agencies address future PCAST meetings.

8a. President Bush arrived and greeted the PCAST. He recounted the Camp David PCAST meeting. Dr. Bromley recalled the President's interest in education and human resources, global warming and the environment, and the impact of science and technology on economic well-being. Some of the members told the President they were pleased to read his position on supporting generic and pre-competitive technologies.

b. Dr. Bromley asked Dr. Gomory to lead a discussion in areas where the President had indicated an interest. One issue was materials science and technology, and Dr. McTague carried this topic further. Dr. Buchsbaum presented PCAST views on high performance computing and communications. The President asked about the issue of networking, and Drs. Buchsbaum and Gomory responded.

c. Dr. Gomory then asked Dr. Massey to present PCAST views on mathematics and science (M&S) education. Dr. Massey congratulated the President on his

education goals. He underlined the importance of improving M&S education across the board. Dr. Massey pointed out the contribution of science and technology to existing industries. He noted that PCAST believes there is a special need for science and technology to support manufacturing processes. Mr. Packard stressed the need to see science and technology as long-term efforts if they are to be helpful to industry.

d. The President asked Mr. Darman to comment. Mr. Darman said he would greatly value the advice of the PCAST while he was in OMB. He discussed the S&T areas of agreement with Dr. Bromley and Gov. Sununu.

9. Dr. Bromley closed the meeting at 12:00 noon.

Minutes Approved: D. Allan Bromley

Date: May 9, 1990

THE WHITE HOUSE

WASHINGTON

June 21, 1990

MEMORANDUM FOR JAMES CICCONI

FROM: D. ALLAN BROMLEY

SUBJECT: PCAST MEMORANDA

Enclosed herewith, on behalf of the President's Council of Advisers on Science and Technology, are two memoranda that the Council has requested that I send -- one to the President and a second to Dick Cheney, with a copy to the President.

These two memoranda have been substantially revised from the earlier versions sent to you on May 31 (see the enclosed copy of my memorandum and your handwritten note). Comments and changes suggested by OMB (Bob Grady, Bob Howard) and by Legislative Affairs have largely been incorporated in the revised versions.

The third PCAST memorandum on the National Institutes of Health is being worked on further -- based on the advice and suggestions of Ede Holiday and Tom Sculley. I will get back to you later on this matter.

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY
WASHINGTON

June 20, 1990

MEMORANDUM FOR THE PRESIDENT

FROM: D. Allan Bromley, On Behalf of the President's Council of Advisors on Science and Technology

SUBJECT: Your Fiscal Year 1991 S&T Budget

The President's Council of Advisors on Science and Technology (PCAST) has stated its strong support of your overall Science and Technology (S&T) budget for Fiscal Year 1991. Within the fiscal constraints you face, your budget proposal provides appropriate balance between investing in the future and meeting our current national needs. The Administration proposals provide a strong start in revitalizing our education system and maintaining our nation's strong S&T base.

PCAST believes that your Science and Technology budget proposals are critical to the future of this country. The Council members pledge to convey their support for your FY 1991 request to leaders in the academic and industrial communities, as well as to political leaders at the grass roots. We urge the Administration to continue to convey to Congress the importance of the Science and Technology budget proposals.

Should the Congress not act to maintain strong support for Science and Technology, we risk erosion of our S&T base in this country. Of particular concern are the many individual and small-group researchers; in the aggregate, these researchers produce the stream of new knowledge that is science and becomes technology. Thus, it is vital that we protect those programs which provide support for investigator-initiated research programs.

One of the PCAST concerns is that federal support for various "big science" projects, in the context of constrained budgets, could crowd out support for these individual investigators. As Director of the Office of Science and Technology Policy, I will strive to continue the Administration's attentiveness to this concern as we work with OMB in the preparation of the Fiscal Year 1992 budget.

THE WHITE HOUSE

WASHINGTON

June 21, 1990

MEMORANDUM FOR THE PRESIDENT

FROM: D. ALLAN BROMLEY

SUBJECT: DOD-ACADEMIC RELATIONS

I am enclosing herewith a copy of a memorandum that I have sent, at the request of PCAST, to Dick Cheney concerning the desirability of rebuilding, even under current budgetary stringencies, the DOD-university bridges that served the nation so well during the post World War II decades.

Enclosure

THE WHITE HOUSE

WASHINGTON

June 19, 1990

MEMORANDUM FOR THE SECRETARY OF DEFENSE

FROM: D. Allan Bromley, On Behalf of the President's Council of Advisors on Science and Technology

SUBJECT: DOD-UNIVERSITY RELATIONSHIP

The pace of political change around the globe is so fast and so profound that our defense-related research must be both broad and deep. As you are only too well aware, we must prepare for the unexpected. This means searching for new ideas whose application is not immediately obvious and investing in our most flexible resource, people. Accordingly, I would like to convey that the President's Council of Advisors on Science and Technology was pleased to learn from Mr. Atwood that the Department places high priority on maintaining the strength of its technology base -- especially the so-called 6.1 and 6.2 programs. PCAST applauds the wisdom of such long-term strategic planning.

In this regard, PCAST would like to draw your attention to an opportunity and a need: the strengthening of the DoD-University partnership. The DoD has over the years supported science and technology emphasizing both new knowledge and the education of scientists and engineers. New interdisciplinary programs were created at research universities, helping to advance new fields such as artifical intelligence, computing and materials science and engineering. The latter, for example, produced whole new classes of materials, including polymer composites, rapidly solidified metals, sensor materials and new laser materials.

An important by-product was the training of thousands of graduate students. Indeed, a large portion of the nation's technical leaders received their graduate education through DoD support. This support of research and education has been a wise investment. The new technologies that have emerged have become essential to DoD and to the nation as a whole in ways not anticipated at the time.

In this changing world, PCAST urges that DoD continue its important role in stimulating more Americans to become scientists and engineers and in creating new knowledge even under the stringent budgetary limitations that you currently face. Such an effort would be fully consistent with the President's initiatives in education and basic research. We believe that strong DoD-academe bridges that served the nation so well in the past will prove equally important in the decades ahead.

D R A F T

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY

JULY 26-27, 1990

AGENDA

THURSDAY, JULY 26, 1990

OPEN SESSION, 9:00 - 11:15 a.m.
CONFERENCE ROOM, COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, N.W.

8:30-8:50	ARRIVAL -- COFFEE AND PASTRIES	
8:50-9:00	OPENING REMARKS	DR. BROMLEY
9:00-10:00	ENVIRONMENTAL QUALITY: TWENTIETH ANNUAL REPORT OF CEQ	HON. MICHAEL DELAND
10:00-11:00	GLOBAL CHANGE - CEES UPDATE BRIEFING AND DISCUSSION	DR. ROBERT CORELL
11:00-11:10	CLOSING REMARKS	DR. BROMLEY

THURSDAY, JULY 26, 1990 continued

CLOSED SESSION, 12:00 Noon - 5:00 p.m.

ROOM 208, CORDELL HULL CONFERENCE ROOM
OLD EXECUTIVE OFFICE BUILDING

12:00-2:15	PCAST UPDATE DURING WORKING LUNCH	DR. BROMLEY OSTP ASSOC. DIRECTORS
2:15-3:00	INITIATIVES IN EASTERN EUROPE	LTG. BRENT SCOWCROFT
3:00-3:15	BREAK	
3:15-4:15	EDUCATION AND HUMAN RESOURCES PANEL -- DISCUSSION OF ISSUES AND DIRECTION	DR. LIKINS DR. RATCHFORD
4:15-4:30	CLOSING REMARKS	DR. BROMLEY
6:30	DINNER HOSTED BY THE INDUSTRIAL RESEARCH INSTITUTE at La Chaumiere 2813 M Street, N.W. (Georgetown)	

FRIDAY, JULY 27, 1990

CLOSED SESSION, 9:00 A.M. - 12:00 NOON
ROOSEVELT ROOM, THE WHITE HOUSE

9:00-10:00	THE ROLE OF SCIENCE AND TECHNOLOGY IN U.S. ECONOMIC POLICY	DR. MICHAEL BOSKIN
10:00-10:30	DISCUSSION	
10:30-11:30	RECRUITMENT FOR FEDERAL SERVICE -- INFORMATION BRIEFING AND DISCUSSION	DR. MARY GOOD CHAIRMAN, NATIONAL SCIENCE BOARD (201) 455-4729 FAX: (201) 455-2956
11:30-11:45	OTHER PCAST ISSUES	
11:45-12:00	THE NEXT MEETING AND CLOSING REMARKS	DR. BROMLEY

D R A F T