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Science and Technology [1]

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MARINA v. N. WHITMAN
Distinguished Visiting Professor of Business Administration
and Public Policy



The University of Michigan

School of Business Administration and
Institute of Public Policy Studies

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American Foreign Service Association



John J. Harter
Conference Affairs Officer

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THE WHITE HOUSE

WASHINGTON

November 23, 1992

MEMORANDUM FOR ROGER B. PORTER

FROM:

MICHAEL FROMAN *M.F.*

SUBJECT:

Federal Funding and Foreign Patent Protection

As your requested, I looked into the issue raised by Mr. Edward Vetter concerning the problem posed by the GAO's disallowance of foreign patent filing costs in government contract overhead. As you may remember, Mr. Vetter suggested that U.S. research universities file too few foreign patent applications due in large measure to their costs. Although the problem identified by Mr. Vetter is real, it appears to be of little concern to much of the scientific community.

As Mr. Vetter correctly points out, the reason U.S. research universities do not apply for foreign patent protection as often as they apply for U.S. patent protection is the costs of doing so. U.S. patent protection costs between \$5,000 and \$10,000. To secure patent protection in Western Europe, Japan, and Canada, the costs range from \$50,000 to \$100,000. As a result, U.S. research universities tend not to file for foreign patents unless they have secured the interest of a licensee willing to assume the costs of doing so.

The universities other than MIT with whom I spoke seemed satisfied with existing patent protection. Although some would prefer to have more money to apply for foreign patents in the absence of licensees, none thought that U.S. competitiveness was at risk or the incentives for innovation diminished by their budgetary limitations. MIT appears to be uniquely aggressive in its interest in applying for foreign patents in the absence of licensees. The other universities (e.g. California Institute of Technology, Stanford) seem more confident that, should they produce a commercially viable discovery that requires foreign patent protection, they would be able to find a licensee willing to assume the costs.

In sum, it does not currently appear that the problem identified by Mr. Vetter is of such proportion as to require remedial action. I will keep an eye out for additional information.

MEMORANDUM
OF CALL

Previous editions usable

TO:

MF
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Document Originally
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GAO

United States General Accounting Office

Fax Transmittal Sheet

RCED/Energy & Science

To: (Name and address)

Mike Froman

Telephone No.

Fax Telephone No.

Date 11/19/92

From: (name and address)

R. C. Cheston

111 Massachusetts Ave., NW
Suite 201
Washington, DC 20001

Telephone No.

Fax Telephone No. (202) 512-6880 or (202) 512-6954

Subject:

OMB Circular A-21 for Indirect Costs

Additional Information

Attached is #23 in Section J, "General Provisions for Selected Items of Cost."
It would appear that foreign patenting costs would be allowable only if title
is conveyed to the government.

Acknowledgement Requested

1. ☐ Yes ☐ No

2. _____ pages, including this cover sheet, are being transmitted.

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GAO Form 224 (Rev. 7/90)

should be given for all proceeds or value received for any scrap resulting from work under the sponsored agreement. Where Government-donated or furnished material is used in performing the sponsored agreement, such material will be used without charge.

22. Memberships, subscriptions and professional activity costs.

a. Costs of the institution's membership in civic, business, technical, and professional organizations are allowable.

b. Costs of the institution's subscriptions to civic, business, professional, and technical periodicals are allowable.

c. Costs of meetings and conferences, when the primary purpose is the dissemination of technical information, are allowable. This includes costs of meals, transportation, rental of facilities, and other items incidental to such meetings or conferences.

23. Patent costs. Costs of preparing disclosures, reports, and other documents required by the sponsored agreement, and of searching the art to the extent necessary to make such invention disclosures, are allowable. In accordance with the clauses of the sponsored agreement relating to patents, costs of preparing documents and any other patent costs, in connection with the filing of a patent application where title is conveyed to the Government, are allowable. (See also Section J34.)

24. Plant security costs. Necessary expenses incurred to comply with security requirements, including wages, uniforms and equipment of personnel engaged in plant protection, are allowable.

25. Preagreement costs. Costs incurred prior to the effective date of the sponsored agreement, whether or not they would have been allowable thereunder if incurred after such date, are unallowable unless approved by the sponsoring agency.

26. Professional services costs.

a. Costs of professional services rendered by the members of a particular profession who are not employees of the institution are allowable, subject to b and c below,

(No. A-21)

EDWARD O. VETTER & ASSOCIATES, INC.

THREE FOREST PLAZA SUITE 1300

12221 MERIT DRIVE

DALLAS, TEXAS 75251

(214) 385-1482

FAX (214) 701-0024

November 11, 1992

Mr. Roger B. Porter
Assistant to the President
Executive Office of the President
The White House
Washington, DC 20500

Dear Roger,

I enjoyed seeing you again in Pasadena and regret that the days are numbered for future official contacts. Watch how Clinton will view with alarm the state of our problems - even worse than he thought. This is a time honored custom even in the private sector when new managers are appointed.

I spoke to you about a simple low cost method of protecting America's intellectual property as it develops through government contracts at our world class research universities. The enclosed copy of a letter sent in 1990 to Dr. Bromley covers the point.

Briefly, because of cost and complexity U.S. research universities file too few foreign patent applications. The cost problem is exacerbated by disallowance, by the GAO, of foreign patent filing cost in government contract overhead.

This is not a big thing. But, in addition to protecting intellectual property, it would raise awareness among smaller schools which may not be as world sensitive as Stanford, MIT, etc. One of America's shortcomings is we "fail to think globally" in many sectors of our society.

The subject is complex and I'll be glad to discuss further with anyone you suggest. I believe it could be readily fixed between now and January 20.

Sincerely,

Ed Vetter / slv

Ed Vetter

EDWARD O. VETTER & ASSOCIATES, INC.

THREE FOREST PLAZA SUITE 1300

12221 MERIT DRIVE

DALLAS, TEXAS 75251

(214) 385-4373

FAX (214) 701-0024

April 2, 1990

Dr. D. Allan Bromley
Science Advisor to the President
Office of the President
The White House
Washington, DC

Dear Allan,

I enjoyed our meeting of March 15 and believe we share some common views on how American science and technology must contribute to our collective social and economic well being.

I told you that I chair the Visiting Committee for Sponsored Research as MIT. In 1989, MIT is said to have received the highest number of patents awarded among the American universities. I believe its experience is typical among our research universities. To my suggestion that the Federal government, on an appropriate basis, provide a modest amount of Federal support to our research universities for obtaining foreign patents, I offer this data.

MIT 1989 Experience

U.S. patent applications	272
Foreign patent applications	102
U.S. patent issued	102
Foreign patents issued	36
No. of licenses signed:	
U.S. companies	58
Foreign (ex. Japan)	2
Japan	2

1989 MIT budget for intellectual property protection - \$3 million

I was surprised by the number of foreign applications made until I discovered that these are primarily filings pursuant to the provisions of the Patent Cooperation Treaty ("PCT"). The PCT is a low cost way of warehousing applications while

it is determined whether or not to proceed with the expensive effort of seeking an individual country patent.

The above is, of course, a gross oversimplification of the point being made. In the first place, many issued patents have little future value from a commercial standpoint. Second, there is much yet to be done to level the proverbial playing field in the matter of world patent rules. Nevertheless, I am convinced from my MIT experience, that additional resources restricted to cost sharing for incremental foreign patent filings would definitely be a plus toward managing America's intellectual property. Further, these patents give us a measure of control on exploiting our research accomplishments.

I have some ideas on how this might be implemented, and would be pleased to discuss my views on this as well as other areas affecting global competition should you wish.

Cordially,

Ed Vetter

THE WHITE HOUSE

WASHINGTON

October 6, 1992

Dear Marina:

It was a pleasure seeing you at the AFSA conference.

I was delighted to have the opportunity to discuss research and development with you and your colleagues. As is apparent, I am convinced it is crucial to our ability to compete successfully in the international economy. As promised, a copy of my remarks is enclosed.

I hope there is an opportunity for our paths to cross again soon.

Warmest regards,

Roger B. Porter
Assistant to the President
for Economic and Domestic Policy

Professor Marina v. N. Whitman
The University of Michigan
IPPS -- 411 Lorch Hall
Ann Arbor, MI 48109-1220

THE WHITE HOUSE

WASHINGTON

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Warmest regards,

Roger B. Porter
Assistant to the President
for Economic and Domestic Policy

Mr. Michael J. Johnson
Vice President, International Affairs
FMC Corporation
1627 K Street, N.W., Suite 500
Washington, D.C. 20006

THE WHITE HOUSE

WASHINGTON

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Roger B. Porter
Assistant to the President
for Economic and Domestic Policy

Mr. W. Robert Warne
President
Korea Economic Institute of America
1101 Vermont Avenue, N.W., Suite 401
Washington, D.C. 20006

THE WHITE HOUSE

WASHINGTON

October 6, 1992

Dear Mike:

It was great to see you at the American Foreign Service Association's conference.

Thank you very much for your kind words of introduction.

I look forward to speaking with you soon. Once again, thank you.

Warmest regards,

Roger B. Porter
Assistant to the President
for Economic and Domestic Policy

The Honorable Michael K. Young
Deputy Under Secretary for Economic
and Agricultural Affairs
U.S. Department of State
Washington, D.C. 20520

THE WHITE HOUSE

WASHINGTON

October 6, 1992

Dear Bill:

It was a pleasure seeing you at the AFSA conference.

I was honored to have been invited to speak about research and development, and am grateful to you for providing that opportunity.

I wish you and the AFSA best of luck in your activities, and look forward to seeing you again soon.

Warmest regards,

Roger B. Porter
Assistant to the President
for Economic and Domestic Policy

Mr. William Kirby
President
American Foreign Service Association
2101 E Street, N.W.
Washington, D.C. 20037

THE WHITE HOUSE

WASHINGTON

October 6, 1992

Dear John:

Thank you very much for making the arrangements for my participation in the AFSA conference.

I enjoyed the opportunity to discuss research and development, and commend you on the organization of a very fine conference.

I wish you and the AFSA best of luck in your activities, and look forward to seeing you again soon.

Warmest regards,

Roger B. Porter
Assistant to the President
for Economic and Domestic Policy

Mr. John Harter
Conference Affairs Officer
American Foreign Service Association
2101 E Street, N.W.
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Targeting Research and Development for Competitive Advantage
October 6, 1992

Schedule of Symposium

8:00 - 8:30 a.m.

Registration and Coffee

8:30 - 9:15 a.m.

Introduction William Kirby
AFSA President

KEYNOTE ADDRESS

Research and Development: The Cutting Edge of Competitiveness

Speaker: Dr. D. Allan Bromley
Assistant to the President and Director,
Office of Science & Technology Policy
The White House

Introduced by: Michael K. Young
Deputy Under Secretary for Economic and
Agricultural Affairs
Department of State

9:15 - 10:45 a.m.

PLENARY PANEL

How can the federal government most effectively encourage and support private sector R & D relating to commercially significant technologies?

Moderator: Kent H. Hughes
President
Council on Competitiveness

Panelists: Robert M. White
Under Secretary, Technology Administration
Department of Commerce

Brian M. Rushton
Senior Vice President R & D
Air Products and Chemicals, Inc. (and President,
Industrial Research Institute)

Jack Simon
Manager, Government R & D Programs
General Motors Corporation

John Armstrong
Vice President, Science and Technology
IBM Corporation

Gerhard H. Parker
Sr. Vice President, Technology and Manufacturing
Intel Corporation

10:45 - 11:00 a.m.

Coffee Break

11:00 - 12:30 p.m.

CONCURRENT PANELS

What can and should the U.S. government do to
promote commercially useful R & D?

PANEL A

Government economic policies: What government
economic policies would create a climate that would optimize
private sector R & D?

Moderator: Marina v.N. Whitman
Former Member of the President's Council of
Economic Advisors

Panelists: Sidney Jones
Assistant Secretary for Economic Policy
Department of Treasury

George N. Hatsopoulos
Chairman and President
Thermo Electron

Jerry Jasinowski
President
National Association of Manufacturers

Robert J. Samuelson
Economic Columnist
Newsweek

PANEL B

The Federal Laboratories: Can they contribute to U.S. competitiveness? How could federal research be made more relevant to industry priorities?

Moderator: Eugene Wong
Associate Director, Physical Sciences & Engineering
The White House

Panelists: Deborah Wince-Smith
Assistant Secretary for Technology Policy
Department of Commerce

Sig Hecker
Director
Los Alamos National Laboratory

Irwin Pikus
Director, Science and Technology Program
Center for Strategic and International Studies

Graham Mitchell
Director of Planning
GTE

PANEL C

Military R & D: Can we increase the contribution of military R & D to commercially useful innovations in the 1990s? If so, how?

Moderator: Albert C. Westwood
Vice President, Research & Technology
Martin Marietta Corporation

Panelists: William Andahazy
Professional Staff Member, Armed Services Committee
U.S. House of Representatives

Delbert H. Jacobs
Vice President, Advanced Technology and Design
Northrup Corporation

Robert F. Goff
Director, Government R & D Contracts
3M

Erich Bloch
Senior Fellow
Council on Competitiveness

12:45 - 2:15

*Lunch
Benjamin Franklin Diplomatic Reception Room*

SUBJECT

{TO BE ANNOUNCED}

*Speaker: Dr. Roger B. Porter
Assistant to the President for Economic & Domestic
Policy, The White House*

Introduced by: Michael K. Young

2:30 - 3:30

CONCURRENT PANELS

What is the impact of global economic integration and international competition on R & D?

PANEL D

International trade and investment in high technology products: What role do trade and investment policies play in stimulating or inhibiting R & D?

Moderator: Alan Wm. Wolff
Dewey Ballantine
(Former Deputy U.S. Trade Representative)

Panelists: Donald M. Phillips
Assistant U.S. Trade Representative for Industry
U.S.T.R.

Richard W. Heimlich
Director of International Strategy
Motorola

Gerald J. Mossinghoff
President
Pharmaceutical Manufacturers Association

Julie K. Gorte
Sr. Assoc., Industry, Tech. & Employment Program
Office of Technology Assessment, U.S. Congress

PANEL E

Other governments: What can the United States learn by examining the R & D policies of its foreign competitors?

Moderator: Peter Boer
Executive Vice President
W.R. Grace and Company

Panelists: Edward M. Malloy
Minister-Counselor for Science and Technology
American Embassy, Tokyo, Japan

Kenneth P. Wolski
Vice President, Strategy and Policy
Merck Research Laboratories

John Bush
Vice President, R & D
The Gillette Company

Gilbert Fayl
Counselor, Science and Technology
Commission of the European Communities

PANEL F

Universities and private research laboratories: How can non-government and non-commercial laboratories contribute to U.S. Competitiveness? Do foreign corporations exploit American R & D more effectively than U.S. corporations do?

Moderator: Cherri J. Langenfeld
Director, Office of Technology Utilization
Department of Energy

Panelists: Fred Bernthal
Deputy Director
National Science Foundation

Kumar N. Patel
Executive Director, Research, Materials Science,
Engineering and Academic Affairs Division
Bell Laboratories, AT & T

David Hale
Chairman, President and Chief Executive Officer
Gensia Pharmaceuticals, Inc.

Martin Rachmeler
Director, Technology Transfer Office
University of California at San Diego

3:30 - 3:45

Coffee Break

3:45 - 4:45

FINAL PLENARY

Putting It All Together: What should the President of the United States recommend to Congress and the American people in January 1993 to strengthen the contribution of R & D to the competitiveness of the American economy?

Moderator: Frank Press
President
National Academy of Sciences

Panellists: Kent Hughes
Marina v.N. Whitman
Albert C. Westwood
Eugene Wong
Alan Wm. Wolff
Pete Boer
Cherri J. Langenfeld

5:00 - 6:30

Reception
Benjamin Franklin Diplomatic Reception Room

Hosts
Michael K. Young
William Kirby

Draft
October 5, 1992

Exploring the Technological Frontier

Roger B. Porter

It is an honor to address this distinguished conference. This is a timely gathering given the fresh challenges we face as a nation with the ending of the Cold War and the approach of the 21st century.

Historians will record the twentieth century as the American Century. It was in this century that the United States first became actively engaged around the world. Throughout this century, we have sought to advance two ideals that have served us well for more than two hundred years -- democracy and free enterprise.

This is also the century when the United States led a global advance on the frontiers of science and technology. Whether in the marketplace of ideas or in the crucible of the laboratory, Americans have been on the frontier.

Nearly one hundred years ago, the noted historian Frederick Jackson Turner described the American spirit as being determined by our nation's frontier. "To the frontier," he wrote, "the American intellect owes its striking characteris-

tics. That coarseness and strength combined with acuteness and inquisitiveness, that practical, inventive turn of mind, quick to find expedients." (Frederick Jackson Turner, The Significance of the Frontier in American History, 1894, p. 34.)

The closing of the Western frontier proved to be, as Jackson observed, something of a watershed. But it did not dampen or diminish the frontier spirit in America. In our history, for every frontier that has closed, another has opened. We have always been a people with our eye on the far horizon, filled with energy to meet the next challenge, rather than willing to travel down the path of comfortable complacency.

In the last one hundred years, American invention and innovation have transformed daily life. The automobile, the airplane, television, personal computers, fax machines and countless other inventions exert such a ubiquitous influence on most Americans that we often take them for granted. We have sent men to the moon and returned them safely home. It has truly been a full and exceptional century.

Current Realities

In considering the next American frontier, it is worth recalling three realities that shape the next series of challenges we face.

The first is that we live in an increasingly integrated world economy. In 1950, world trade was less than \$70 billion. Today, world trade exceeds \$3 trillion. While the global economy has grown by approximately 4 percent over the last forty years, world trade has grown at a compound annual rate of 6.2 percent, or approximately 50 percent faster than the growth in economic activity.

Likewise, the flow of foreign direct investment during the period 1983-89 increased at an annual rate of 34 percent, nearly four times as fast as the growth of merchandise trade.

In 1950 combined direct and portfolio investment in the United States amounted to \$9.7 billion. By 1990, foreign investment in this country exceeded \$2.18 trillion.

The second reality is the relentless and beneficial technological revolution of our time and the rapid diffusion of ideas, processes, and innovations that now dominates the international economy. What is striking is not simply the pace of discoveries and innovations, but the speed with which these innovations are spread worldwide.

This diffusion of ideas and processes has been accompanied by the rise of global corporations that integrate activities across national boundaries.

The third reality is the persistent tension, most acute in advanced industrial economies, between the search for greater security and the recognition of the need for dynamism, change, and adjustment.

It is in this context that I speak of Mr. Bush -- Mr. Vannevar Bush, renowned scientist and teacher. As you will no doubt remember, Vannevar Bush was appointed in 1941 by President Roosevelt to serve as the Director of the Office of Scientific Research and Development. In that capacity, he played a uniquely important role in developing this country's post-war science and technology policy.

* In describing science as "the endless frontier," Dr. Bush shared his generation's optimism about the contribution of new knowledge to the nation's well-being. Scientific achievement had turned the tide of the war. In times of peace, no less was expected. To battle disease, to explore new worlds, and to spur innovation in the marketplace of ideas, science and technology lay at the center of our dreams.

I invoke the legacy of Vannevar Bush, despite the fact that much has changed since the war, because many of questions he faced at the time figure prominently in our nation's debate today:

- What is the nature of the technological challenge?
- What effect does technological innovation have on the U.S. economy?
- What principles underlie a technology policy?
- What is the role of the Federal government in encouraging technological innovation?

II. Strengths and Limitations

Our response to these challenges must be based on a clear understanding of our strengths and limitations. It is fashionable these days to speak of doom and gloom, but the record in fact has much to commend it. The United States spends 16% more on research and development than Japan, Germany, France, and the United Kingdom combined. Measured as a share of GNP, the United States spends roughly the same share as Japan and Germany, 2.7 compared to 2.9 and 3.0 percent. And we are on an upwards trend. Between 1980 and 1989, the U.S. increased its R&D efforts from 2.2% to 2.7% of GNP.

There are those who discount this commitment because, they claim, too much goes to defense. Putting aside defense-oriented projects, however, the U.S. spends more on civilian R&D than its three closest competitors: more than Japan, Germany, and France combined. In 1989, for example, Japan

spent \$46 billion while the United States spent \$79 billion on nondefense R&D. Moreover, while there is a long-standing debate about how to quantify spinoffs, it is clear that defense R&D makes a significant contribution to America's civilian economy. From microwave ovens to airbags, commercial aircraft to computers, numerous pillars of our competitive economy have their roots in defense R&D.

III. Technology Policy in Historical Perspective

The Federal government's made its first substantial contribution to research and development at the end of the Second World War. At that time, there was a clear consensus as to the importance of R&D and the appropriate role for government support. First and foremost, the government would support basic research that was central to the development of new knowledge, but that was uneconomical for any particular firm to conduct. "Basic research leads to new knowledge," argued Vannevar Bush. "It provides scientific capital. It creates the fund from which the practical applications of knowledge must be drawn." Whether they were too expensive, too risky, or too diffuse in their benefits, those investments that filled the coffers of that fund were the proper domain of Federal support.

But how would that fund be used? Who would draw upon it, and how would they gain access? Who would ensure the full exploration of its potential, and who would make available its benefits to all? Would it be the government or the market to decide which ideas were worth developing, which were competitive winners and which were commercial losers?

The answer, of course, was that both the government and the market had important roles to play. In the area of defense, where the Federal government was the primary consumer, it would encourage research in areas of vital interest and support the development of particular products. Government agency "missions" -- national security, space, and energy -- drove Federal funding beyond basic inquiry into applied research and development, commercialization and procurement.

* Outside defense, where the market would rule, there was remarkably little comment on the role of the Federal government. "The simplest and most effective way in which the Government can strengthen industrial research," claimed Vannevar Bush, "is to support basic research and to develop scientific talent." Scientists like Bush believed as an article of faith in the linear and inevitable progression of discoveries on the laboratory bench to products in the commercial market. With leading universities conducting cutting-edge basic research, new technology, they believed,

would almost automatically emerge.

Much has changed, however, from those early days. When the United States was unchallenged in the international economy, it could afford to be patient with the commercialization of its technology. Now it is clear that superior technology is a principle source of comparative advantage in the manufacture of products and the delivery of services. America's ability to compete internationally depends upon its ability to integrate new technologies into products, services, and the production process itself.

* More than one-third of the growth of the U.S. economy since 1930 has been due to advances in the realm of knowledge. The growth of the U.S. economy, and particularly the growth of higher-wage jobs, depends upon our ability to capitalize upon our technology: to generate new ideas and to transform those ideas into commercial realities faster than ever before.

* The transformation of new knowledge to marketplace products poses the greatest challenge to America's competitiveness. It takes a Japanese firm about 25% less time and 50% less money to commercialize innovations. One reason for this difference may very well be that Japanese firms spend twice as much as American firms on integrating innovation into the production process itself.

IV. Principles Guiding the President's Policies

When some look at Japan, they think that a larger role for government is the answer to American competitiveness. Of total expenditures on Japan's R&D, however, less than 30% comes from the Japanese government. By comparison, the Federal government funds nearly 45% of all American R&D. Governments must play a role in encouraging science and technology, but in the end it is the private sector that must have the freedom -- and the resources -- to determine the direction of research and development.

If there is a single lesson to be drawn from the revolutionary events of the recent past, it is that markets, not bureaucrats, must carry us into the future. Governments are notoriously bad at picking winners and losers. Witness the Europeans' record with the Concorde or own experience with Synfuels and SST's. Nonetheless, the Federal government can play an important role:

- By creating a dynamic economic environment that encourages investment and innovation;
- By providing incentives for greater research and development;

- By supporting basic research and development on both defense and civilian projects;
- By working cooperatively with the private sector to develop generic or enabling, pre-competitive technologies; and
- By encouraging the swift and effective transfer of technology from Federally-funded laboratories to the private sector.

V. The Appropriate Role for Government

The Bush Administration's strategy has been to provide funds for research and development that has great value for society but that would not be pursued by an individual firm alone. Projects that solve problems for a broad range of industries may not be economical for any one industry to pursue. The benefits they produce for society as a whole make them appropriate targets for Federal support.

It is important to distinguish between picking winners and losers, on one hand, and supporting particular projects with broad social benefits, on the other. For the same reasons that the first Mr. Bush supported Federal funding for basic research, the second Mr. Bush supports Federal funding for generic pre-competitive technologies as well: the high costs,

the high risks, and the great difficulties individual firms have capturing the returns from this type of investment.

Such support comes not at the expense of basic research, but as a natural complement to it. The President's support for basic research is unprecedented in scope, as well as in amount. The President's FY 1993 Budget proposes \$76.6 billion for R&D, a 35% increase over 1989. This budget includes a 7% increase for civilian R&D and an 8% increase for basic research.

We continue to work towards a doubling of the budget of the National Science Foundation by 1994. We have proposed an increased budget for individual investigators by \$666 million or 9%, and we have devoted over \$1.2 billion to new programs to research the human genome and global change. Just this past week, we renewed our commitment to the Superconducting Super Collider.

In the realm of generic pre-competitive technologies, we have proposed dramatic increases:

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Sematech, the Battery Consortium, the Automotive Composites Consortium -- these are all examples in which the government is working with industry to spur innovation and to speed the movement of new products and processes from the laboratory to the marketplace. The list goes on and on, but in the end no one can accuse this Administration of being reluctant to put its money where its mouth is. This Administration has increased its requests for Federal funds to support research and development, basic and applied, civilian and defense, at a remarkable pace.

Unfortunately, the same cannot be said about the U.S. Congress. Of \$1 billion that the President proposed to spend on High Performance Computing and Communications, Biotechnology, Advanced Materials, and Global Change, for example, Congress cut out half. The President proposed an 18% increase in the NSF budget; Congress gave them no increase at

all. In addition, members of Congress has eroded the merit-based approach to the awarding of grants and contracts by earmarking an increasing percentage of the R&D budget to particular institutions, and even particular researchers, in their particular districts. This practice threatens to undermine the Administration's efforts to maximize the potential return on R&D investment by selecting only the highest qualified research for support.

VI. The Appropriate Role for the Private Sector

Congressional support for R&D would be a step in the right direction, but research and development is only the first step. The greatest challenge to U.S. competitiveness is the commercialization of R&D results. To maintain its competitive edge, the United States must transfer technology from the laboratory to the marketplace more effectively and efficiently than it ever has before. To do that, we need to forge closer links between government, universities, and industry, because ultimately the private sector bears the primary responsibility for identifying, developing, and applying technology for commercial products and processes. To cite a few illustrations of the Administration's technology transfer strategy:

- The Advanced Technology Program, administered by the

Department of Commerce's National Institute of Standards and Technology, brings together industry and universities to work on issues ranging from research on high temperature superconductivity to methods for improving the accuracy of machine tools.

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- Under the National Technology Initiative ("NTI"), we have signed more than 1,400 Cooperative Research and Development Agreements ("CRADAs") between government laboratories and private industry. In the field of computers, ceramics, and environmental technology, we are achieving an unprecedented level of success in taking the best ideas from our labs and turning them into American products. Oakridge National Lab and IBM are working together on high performance computing. General Motors and the National Institute of Standards and Technology are developing new software for automated manufacturing equipment.

It is not just the giant companies that are benefitting

from these new partnerships. At Manufacturing Technology Centers around the country, we are working to help small businesses to integrate the latest technologies. Since 1989, more than 6,000 companies have looked to these centers for assistance in introducing new equipment and improving their manufacturing processes.

VII. Technology Policy within a Broader Framework

Funding for basic R&D, support for the development of generic pre-competitive technologies, partnerships for technology transfer: each is necessary, but together they are insufficient. It is futile to provide the tools for the job if the government then obstructs those who want to get it done. Technology policy cannot maintain U.S. competitiveness outside an economic environment in which innovation can flourish. The primary role of the Federal government is to adopt policies that support, rather than obstruct, the private sector's efforts:

- By adopting sound tax policies that stimulate private sector investment and technological innovation;
- By creating a reasonable regulatory and legal regime;
- By helping to create a more educated workforce; and
- By opening foreign markets, eliminating unfair trade

practices, and protecting intellectual property rights so that U.S. business can compete on a level playing field.

President Bush has made great strides toward creating an environment conducive to innovation. He has proposed tax policies that stimulate private sector investment in research and development and that encourage technological innovation. He has urged the Congress to make permanent the research and experimentation tax credit and he has proposed capital gains tax cuts that would lower the cost of developing new technologies and the cost of purchasing high tech equipment. So far, Congress has balked at both of these proposals.

Moreover, the Bush Administration has worked to ensure that Federal regulations protect Americans' health and well-being without impeding firms from bringing safe, new products to market. President Bush has worked to streamline the regulatory process, to accelerate approval of "breakthrough" drugs, and to permit firms to work together without the risk of anti-trust liability. Part of a larger effort to provide regulatory reasonableness and to reduce needless litigation, these policies would create an environment ripe for innovation.

Ultimately, the United States' competitive edge depends on the strengths of the American people. Preparing American

students for the challenges of the 21st century should be among the nation's highest priorities. Representing a consensus among the fifty state governors, the National Education Goals stand as a standard against which our school's results can be judged. Accountability, innovation, flexibility, and competition: principles to guide education today and to ensure competitiveness tomorrow.

Together these efforts make it possible to produce, but there is little reason to do so without markets willing to buy. A central pillar of the Bush Administration's strategy for maintaining American competitiveness has been to open markets abroad to U.S. goods and services. The North American Free Trade Agreement will create the largest and richest market in the world. Bilateral agreements with Japan have opened markets for computers, satellites, and semiconductors, in which we now hold 17% of the Japanese market. From the Uruguay Round to the Enterprise for Americas Initiative, from the intellectual property agreement with China to the Strategic Impediments Initiative with Japan, no Administration has done more to create an economic environment in which America's technology can successfully compete in an ever-expanding international market.

Policies that encourage investment and innovation, that protect consumers without imposing a wasteful regulatory and

legal burden on entrepreneurs, that educate our children for the challenges ahead, and that recognize the integrated nature of the world economy -- these are the policies that will permit the private sector to conquer the technological frontier.

Conclusion

One of the most difficult questions facing any administration is when the government should intervene in the innovation process. To Vannevar Bush, intervention began and ended with support for basic research. The role of the Federal government was to set the wheels in motion, but it was then left to the market to determine their direction. To some in this election, the proper role of the government is to substitute its own judgment for the dynamics of the market. There is a fundamental choice in this election on technology policy as on many other policies that will affect the future of our nation.

The President's policy is based on generating economic growth through private business and private enterprise. He believes that economic growth comes from less, not more, government. He is convinced that the private sector must continue to lead in commercializing new technologies and selling them around the world -- that it would be a serious

mistake for the federal bureaucracy to supplant private sector leadership.

In contrast, his opponent has claimed that increased levels of federal spending -- "investments in the future" -- are the key to U.S. growth. Increased federal spending on public infrastructure, human capital, and commercial research and development are portrayed as "silver bullets" that will assure high future growth rates.

It is important, however, to keep in mind that federal spending can only be increased by diverting resources from the private sector. Any federal investment has an opportunity cost because it involves taking money away from private sector investment or consumption through taxes or borrowing. As a result, an advocate of increased federal spending has the burden of showing that a dollar invested by the federal government would produce a higher rate of return than the same dollar invested by private business. Otherwise, more federal spending reduces, not increases, innovation, growth, and jobs.

Academic studies suggest that private investors are much more likely than the government to succeed at identifying promising commercial technologies and bringing them to market. While private R&D produces high rates of return -- up to 28% in some areas -- the returns on Federally-funded R&D are

consistently lower.

Accordingly, the President has recognized that the federal government has a vital role in supporting scientific research and technological innovation. He has proposed significant increases in federal support for basic and applied research and for the transfer of technology. But the President has vigorously opposed having the U.S. government get into the business of picking and choosing commercial technologies or having the U.S. taxpayer fund development activities that are better conducted by private firms.

Frederick Jackson Turner, ever the admirer of the American spirit, found that "dominant individualism . . . with all the buoyancy and exuberance which comes with freedom -- these are the traits of the frontier." It was our freedom and our individualism, not the omniscience of a government bureaucracy, which permitted us to explore frontier after frontier. The technological challenge is the latest frontier, but it is no more the last than was the Pacific Ocean. The choice we now face is not simply for today, but for our future capacity to close frontiers to come.

Federal funding reflected this consensus. Between 1953 and 1961, Federal support for R&D increased in real terms 14% annually. Much of the basic research was conducted by universities, while federal laboratories focused on missions, and industry on development. In the mid-1960s, the post-war consensus crumbled. Impatient with basic research, the emphasis shifted to immediate payoffs. Federal dollars would be focused on specific Federal missions. Funding for basic research declined in real terms, and with it suffered universities where much of this research was done. The late 1970s and 1980s witnessed a renewed commitment to basic research, not at the expense of Federal missions, but in addition to them. In the 1970s, basic research focused on energy; in the 1980s, there was a return to defense.

I have gone into some detail to highlight the underlying trends in this history because the current debate sometimes appears to be missing historical reference. In general, in sum, the Federal government's policy has tended to support those projects that bore significant social benefits but that would not be pursued in the absence of government support.

Early Draft

The Role of the Federal Government at the Technological Frontier

Roger B. Porter
Assistant to the President
for Economic and Domestic Policy

American Foreign Service Association
October 6, 1992
Washington, D.C.

The Role of the Federal Government at the Technological Frontier

Roger B. Porter

It is an honor to participate in this distinguished conference. There is perhaps no more important challenge to the health of the American economy than the ability of American business to maintain its competitive edge.

Today I would like to speak about frontiers: the frontiers of our country, the frontiers of science and technology, and the frontiers of our imagination. Nearly 100 years ago, Frederick Jackson Turner described the American spirit as being determined by our nation's frontier. "To the frontier," he wrote, "the American intellect owes its striking characteristics. That coarseness and strength combined with acuteness and inquisitiveness, that practical, inventive turn of mind, quick to find expedients."

Although we have long settled the Western frontier, our searching spirit continues to live on. For every frontier that we close, another lays open before us. There is no such thing as "the final frontier" -- in space or on Earth. The frontier of our imagination is without limits, as is our determination to explore the unknown.

It is in this context that I speak of Mr. Bush -- Mr. Vannevar

Bush, renowned scientist and teacher. As you will no doubt remember, Vannevar Bush was appointed in 1941 by President Roosevelt to serve as the Director of the Office of Scientific Research and Development. In that capacity, he played a uniquely important role in developing this country's post-war science and technology policy.

In describing science as "the endless frontier," Dr. Bush shared his generation's optimism about the contribution of new knowledge to the nation's well-being. Scientific achievement had turned the tide of the war. In times of peace, no less was expected. To battle disease, to explore new worlds, and to spur innovation in the marketplace of ideas, science and technology lay at the center of our dreams.

I invoke the legacy of Vannevar Bush, despite the fact that much has changed since the war, because many of questions he faced at the time figure prominently in our nation's debate today:

- What is the nature of the technological challenge?
- What effect does technological innovation have on the U.S. economy?
- What principles underlie a technology policy?
- What is the role of the Federal government in encouraging technological innovation?

I. The Nature of the Technological Challenge

[Insert section by RBP]

II. Strengths and Limitations

Our response to these challenges must be based on a clear understanding of our strengths and limitations. It is fashionable these days to speak of doom and gloom, but the record in fact has much to commend it. The United States spends 16% more on research and development than Japan, Germany, France, and the United Kingdom combined. Measured as a share of GNP, the United States spends roughly the same share as Japan and Germany, 2.7 compared to 2.9 and 3.0 percent. And we are on an upwards trend. Between 1980 and 1989, the U.S. increased its R&D efforts from 2.2% to 2.7% of GNP.

There are those who discount this commitment because, they claim, too much goes to defense. Putting aside defense-oriented projects, however, the U.S. spends more on civilian R&D than its three closest competitors: more than Japan, Germany, and France combined. In 1989, for example, Japan spent \$46 billion while the United States spent \$79 billion on nondefense R&D. Moreover, while there is a long-standing debate about how to quantify spinoffs, it is clear that defense R&D makes a significant contribution to

America's civilian economy. From microwave ovens to airbags, commercial aircraft to computers, numerous pillars of our competitive economy have their roots in defense R&D.

III. Technology Policy in Historical Perspective

The Federal government's made its first substantial contribution to research and development at the end of the Second World War. At that time, there was a clear consensus as to the importance of R&D and the appropriate role for government support. First and foremost, the government would support basic research that was central to the development of new knowledge, but that was uneconomical for any particular firm to conduct. "Basic research leads to new knowledge," argued Vannevar Bush. "It provides scientific capital. It creates the fund from which the practical applications of knowledge must be drawn." Whether they were too expensive, too risky, or too diffuse in their benefits, those investments that filled the coffers of that fund were the proper domain of Federal support.

But how would that fund be used? Who would draw upon it, and how would they gain access? Who would ensure the full exploration of its potential, and who would make available its benefits to all? Would it be the government or the market to decide which ideas were worth developing, which were competitive winners and which were

commercial losers?

The answer, of course, was that both the government and the market had important roles to play. In the area of defense, where the Federal government was the primary consumer, it would encourage research in areas of vital interest and support the development of particular products. Government agency "missions" -- national security, space, and energy -- drove Federal funding beyond basic inquiry into applied research and development, commercialization and procurement.

Outside defense, where the market would rule, there was remarkably little comment on the role of the Federal government. "The simplest and most effective way in which the Government can strengthen industrial research," claimed Vannevar Bush, "is to support basic research and to develop scientific talent." Scientists like Bush believed as an article of faith in the linear and inevitable progression of discoveries on the laboratory bench to products in the commercial market. With leading universities conducting cutting-edge basic research, new technology, they believed, would almost automatically emerge.

Much has changed, however, from those early days. When the United States was unchallenged in the international economy, it could afford to be patient with the commercialization of its technology. Now it is clear that superior technology is a

principle source of comparative advantage in the manufacture of products and the delivery of services. America's ability to compete internationally depends upon its ability to integrate new technologies into products, services, and the production process itself.

More than one-third of the growth of the U.S. economy since 1930 has been due to advances in the realm of knowledge. The growth of the U.S. economy, and particularly the growth of higher-wage jobs, depends upon our ability to capitalize upon our technology: to generate new ideas and to transform those ideas into commercial realities faster than ever before.

The transformation of new knowledge to marketplace products poses the greatest challenge to America's competitiveness. It takes a Japanese firm about 25% less time and 50% less money to commercialize innovations. One reason for this difference may very well be that Japanese firms spend twice as much as American firms on integrating innovation into the production process itself.

IV. Principles Guiding the President's Policies

When some look at Japan, they think that a larger role for government is the answer to American competitiveness. Of total expenditures on Japan's R&D, however, less than 30% comes from the

Japanese government. By comparison, the Federal government funds nearly 45% of all American R&D. Governments must play a role in encouraging science and technology, but in the end it is the private sector that must have the freedom -- and the resources -- to determine the direction of research and development.

If there is a single lesson to be drawn from the revolutionary events of the recent past, it is that markets, not bureaucrats, must carry us into the future. Governments are notoriously bad at picking winners and losers. Witness the Europeans' record with the Concorde or own experience with Synfuels and SST's. Nonetheless, the Federal government can play an important role:

- By creating a dynamic economic environment that encourages investment and innovation;
- By providing incentives for greater research and development;
- By supporting basic research and development on both defense and civilian projects;
- By working cooperatively with the private sector to develop generic or enabling, pre-competitive technologies; and
- By encouraging the swift and effective transfer of technology from Federally-funded laboratories to the private sector.

V. The Appropriate Role for Government

The Bush Administration's strategy has been to provide funds for research and development that has great value for society but that would not be pursued by an individual firm alone. Projects that solve problems for a broad range of industries may not be economical for any one industry to pursue. The benefits they produce for society as a whole make them appropriate targets for Federal support.

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

U.S. SCIENCE AND TECHNOLOGY POLICY IN THE 1990's

D. ALLAN BROMLEY

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Executive Office of the President

Pacific Economic Cooperation Conference

San Francisco, California

September 24, 1992

Toward the end of the 19th century, a number of reputable scientists thought that the age of discovery was just about over. Classical physics and chemistry seem to offer a fairly complete description of the natural world. The theory of evolution accounted for the origins of human beings. Astronomy had established our place in the galaxy, if not the universe. Everything seemed to fit together.

Today we know just how wrong that outlook was. Within the first few decades of the 20th century, relativity and quantum mechanics burst on the scene, destroying the certainties of classical physics. Developments in genetics began to point the way toward discoveries that would start to unlock the secrets of life. Astronomy discovered a host of galaxies beyond our own, as numerous as the stars in the Milky Way. The world became rich again in mystery and discovery.

If I might draw a parallel between science and the broader society, I see the United States -- and to some extent the entire developed world -- as now being in a situation comparable to that of turn-of-the-century science. Not only do we profess not to know where the world is going, but we question whether real progress is possible. We seem to have lost our faith in the future.

Even a cursory glance at the frontiers of science and technology shows how mistaken that impression is. In biomedicine, we are on the verge of a watershed in human health care, thanks to new knowledge and the development of biotechnology. After centuries of fighting against disease, we have reached the point where we can begin to focus on improving the quality of life for all of our citizens. To take just one example, the Bush Administration is supporting a Children's Vaccine Initiative, which has as its objective the development of a vaccine that can protect against 20 to 30 diseases with a few injections or oral administrations at or shortly after birth. If successfully developed, such a vaccine would have tremendous benefits not only to children in this country but to children around the world, eliminating immeasurable human suffering.

In information technology, modern computers and communications have linked

the world into a global network of knowledge. If current trends continue, we can expect to have the power of today's supercomputers on our desktops within 15 years, and there is no end in sight to continued advances. As I have said on other occasions, the day that you wake up to discover that your toaster is smarter than you are will mark a turning point in human history.

In the area of the environment, though we face very serious challenges, new knowledge in chemistry, physics, and biology has made it possible to approach the area of toxic waste in an entirely new fashion. We can think not of disposing of toxic waste but rather of eliminating it entirely. For example, the extraction of useable -- and often quite valuable -- compounds from waste streams can reduce waste significantly, and the residues can now be treated until they are environmentally benign.

These examples can be multiplied endlessly. The conclusion is inescapable: we are on the verge of a golden age of discovery in science and technology, and the benefits to people throughout the world will be unparalleled in human history.

Science and Technology in the Bush Administration

I firmly believe that there could be no better Administration than the Bush Administration to lead us into this new age of science and technology. George Bush professes not to know much about science and technology, but that is just his customary modesty speaking, because if you look at the record you will find that George Bush has been more supportive and appreciative of research and development than has any President in recent history.

First of all, funding for R&D has risen dramatically. If Congress enacts the President's FY 1993 requests for R&D, civilian R&D will have gone from about \$21 billion in FY 1989 to over \$30 billion, an increase of 43 percent. Basic research will have gone from \$10.6 billion to \$14.3 billion, an increase of 35 percent. Even defense R&D will have gone up in current dollars, though the total defense budget has fallen.

What makes these increases particularly remarkable is that they occurred when

real growth in the U.S. domestic discretionary budget has been essentially frozen to the rate of inflation as a result of the budget agreement made between the President and Congress. Increases for research and development have therefore had to come at the expense of other programs in the domestic discretionary component of our federal budget with very strong and vocal constituencies. And since research and development make up one seventh of our domestic discretionary budget -- and about an equal percentage of the defense budget -- they form very large and tempting targets.

In addition to increasing its support of R&D, the Bush Administration has been taking a number of actions to enhance the effectiveness of that support. For example, under an interagency body that I chair known as the Federal Coordinating Council for Science, Engineering, and Technology, it has undertaken special government-wide initiatives in the areas of high performance computing and communications, biotechnology, materials science, global change research, and mathematics and science education.

These initiatives focus the efforts of the entire federal government on high-impact areas of science and technology and foster new and productive partnerships between the federal government, universities, and industry. In particular, with all of the FCCSET initiatives we have worked closely with private industry to integrate their needs into the program. For example, in the High Performance Computing and Communications Program, we have now instituted nearly all of the recommendations that emerged from the review of the program by the Computer Systems Policy Project.

The initiatives are widely seen, both inside the United States and outside, as models for organizing coherent interagency programs. In fact, one of our leading business schools has put together a case study of one of these initiatives.

For next year's budget, FCCSET has also approved a new interagency program in advanced manufacturing technology. recognizes that manufacturing remains an essential element of America's economy and of its future prospects. As Stephen Cohen and John Zysman put it in their book Manufacturing Matters, "Manufacturing is critical to the health of the economy; lose manufacturing and you will lose -- not develop -- high-wage service jobs. The wealth and power of the U.S. economy would decline

drastically if major segments of manufacturing were to shut down or to move offshore."

In addition to these activities under FCCSET, this Administration has taken many other steps to improve the development and deployment of technology:

- Through the National Technology Initiative, the federal government is seeking to increase greatly the flow of scientific and technological know-how from government and university laboratories to industry. I'll be traveling to Chicago later today to attend the eleventh in a series of meetings that have been held under the NTI, meetings that have been extremely effective in catalyzing private sector-private sector cooperation.

- Since George Bush became President, he has proposed each year that the Congress make the R&E tax credit permanent, but so far Congress has not passed legislation to do so.

- In 1990 this Administration published, for the first time ever, a statement of U.S. Technology Policy that laid out the dimensions of the federal government's support for technology. That document detailed the many different ways in which federal policies affect technology and the ways in which policies have been adopted to support technology.

- In that document and in a number of other places, this Administration has also made a clear commitment to support the development of generic, precompetitive technologies that are important in both the public and the private sector. In this way, the federal government can leverage the resources of the private sector, helping companies convert new technologies to new products and expanded market share.

- By establishing the President's Council of Advisors on Science and Technology, which I chair, George Bush has been receiving input from a distinguished group of academics and industrialists on such matters as the economy, education, national security, and scientific research.

- My office is also in the process of reestablishing a council to address intergovernmental science, engineering, and technology issues -- called InterSET -- which will greatly increase the exchange of information between federal, state, and local governments in science and technology.

- Finally, given the tremendous changes that have occurred both nationally and internationally during this Administration, it is now appropriate for us to undertake a completely fresh look at our entire R&D enterprise. For example, we are examining the missions and organization of our more than 700 federal laboratories to make sure that the country is receiving the best possible return on its substantial investments in them.

The democratic candidate for President would like to be seen as emphasizing science and technology in his campaign, but I would like to make a few observations about his proposals. First of all, I have been somewhat surprised to see the number of his proposals that match things we are already doing. In technology development, manufacturing R&D, and technology outreach, this Administration is already ahead of Governor Clinton's proposals.

But there are important differences between us. Governor Clinton has spoken about targeting specific technologies through a new government agency. But given my experience in government, I seriously question whether we want to entrust huge sums of money to government bureaucrats and entrust them to spend it wisely.

Furthermore, as one of the ways of paying for these new technologies, he wants to reduce overhead payments for research and development to universities by three quarters of a billion dollars per year. Such a reduction would be a tremendous blow to the single most important and productive component of our science and technology enterprise. In his quest for technology development by government, he would slight the very foundation that has made American science and technology so strong.

International Cooperation in Science and Technology

I am also troubled by our opponent's view of international relations, particularly as they would affect science and technology. In my view, science and technology are among the most positive of positive sum games. All countries in the world economy benefit when individual countries develop expertise in science and technology.

The situation is comparable to that of trade. In the short term, various kinds of trade barriers may seem to offer the prospect of protecting specific industries or gaining a competitive advantage. But in the long term, such barriers lower efficiency, reduce competitiveness, and are as likely to end up hurting as helping the industries involved.

The North American Free Trade Agreement and GATT negotiations are clear examples of the mutual benefits that can be gained by reducing trade barriers. But Governor Clinton has expressed reservations about NAFTA, as a consequence of his courting the votes of special interest groups.

I am concerned that the same myopia would be applied to science and technology. There is no question that other countries are building on our basic research. But we unquestionably gain much more by maintaining an open system than we could by trying to build barriers. Furthermore, I am convinced that what is true of basic research is equally true -- with a very few specialized exceptions for national security reasons -- in technology. Rather than restricting access to our technology, we gain by developing capabilities greater and, where possible, more quickly than our competitors.

What we do need to do, however, is to become much better negotiators in our international science and technology interactions. In this way, all of the participants in such negotiations will receive reciprocal benefits, which will ensure that technology is a positive-sum game.

A particularly important consideration in such negotiations is the question of intellectual property rights. As science and technology become the path to prosperity in country after country, those countries will also be making discoveries that they want to protect. The same provisions that we are requiring in our international science and technology agreements will be of great benefit to them.

Mathematics and Science Education

There is one last area that I want to mention today -- that of mathematics and

science education. Governor Clinton has criticized President Bush in this area, but in fact it is hard to think of an American President who has focused more of his attention on education. Since the Education Summit in September 1989, President Bush has fostered a sea change in public perceptions toward education. The American public now realizes that education is one of the most important factors in the future success of this country, and as a result this country is on the verge of thoroughly reforming its educational institutions.

Science and technology will be a central consideration in these reforms. Jobs requiring high levels of scientific and technical training are the most rapidly growing segment of the labor market. But our schools are not producing nearly enough scientifically literate and technically training individuals to meet the demand. International comparisons show the United States at or near the bottom in scientific and mathematical achievement. If we cannot educate our young people properly, scientific and technological supremacy will inevitably pass from the United States to other countries.

The National Education Goals established by the President and the nation's governors reflect the importance of science and technology. Of the six goals, three directly involve science and technology, including the most ambitious of the six, that American students be first in the world in science and technology by the year 2000.

All of us know that particular goal is a stretch goal. Yet it is already having its desired effect in driving very significant reforms at all levels of government. At the federal level, an interagency committee under FCCSET headed by Secretary of Energy James Watkins has put together an integrated, government-wide program designed to significantly advance science and mathematics education. As part of that effort, the committee produced, for the first time, an inventory of all of the activities in the federal government that directly influence science, mathematics, engineering, and technical education. And in the budget sent to Congress last month, the President proposed a 7 percent increase for this interagency program, to a total of over \$2 billion.

We are now looking seriously at the next iteration in developing a federal program in mathematics and science education. Precollege education was the top

priority to emerge from the past year's work. A strong candidate for high priority in the FY 1994 round is technician training, in the broad sense of the term. This is an area where the United States has fallen behind other countries, especially Germany and Japan, to the detriment of our high-technology industries.

These are important first steps, but of course the federal government alone cannot guarantee the achievement of the National Education Goals. It is going to take all of us working together -- with the goals as a consensual statement of where we are headed -- to make the kind of progress they envision. We must get parents reinvested in the education of their children, in part by giving them a greater degree of choice about where they send their children to school. We must establish partnerships between universities and the surrounding schools so that the expertise available in universities can be applied to this serious national problem. We must substantially upgrade the training and abilities of our teachers and treat them with the respect and understanding that their importance to the nation's future warrants. And government and industry must work together to produce the trained technicians our country needs.

Conclusion

Education is a critical part of the Bush agenda, because it is central to the philosophy of individual empowerment that is at the heart of our approach to governing. The same considerations apply in science and technology. The strength of science and technology in this country has derived largely from its bottom-up nature. Our leadership has come from our individual scientists and engineers, not from our institutions and not from the federal government.

The Bush Administration has sought to build on this strength by supporting the foundations of science and technology rather than targeting specific commercial technologies. We have placed our trust in the creativity and ingenuity of individuals to discover and explore new directions. We believe that this pluralistic approach will be much more productive than relying on centralized directives, and the history of science

and technology bears out that belief.

That is why I was particularly disappointed when a group of business leaders from high-technology companies recently announced that they were supporting Governor Clinton in this election. You've heard my reasons why; let me also give you those of David Packard in a letter to the editor he wrote last week to the San Jose Mercury News. He wrote, "The Democratic party is indentured to union labors and has expressed opposition to the North American Free Trade Agreement, which will generate millions of jobs in Canada, the United States, and Mexico in the years ahead. The Democratic party is also endentured to the teachers' union. . . . These and other similar evaluations of well-established Democratic party positions convince me that my friends, who have defected to support Clinton, are making a serious strategic mistake."

We face an important choice in this election, one between the diversity and individual initiative that has made America strong and a greater degree of central control and planning. I hope that our legitimate concern with the issues of the moment does not send us down the wrong path.

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Compare + Contrast

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List of prominent
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II. What's unique about current period

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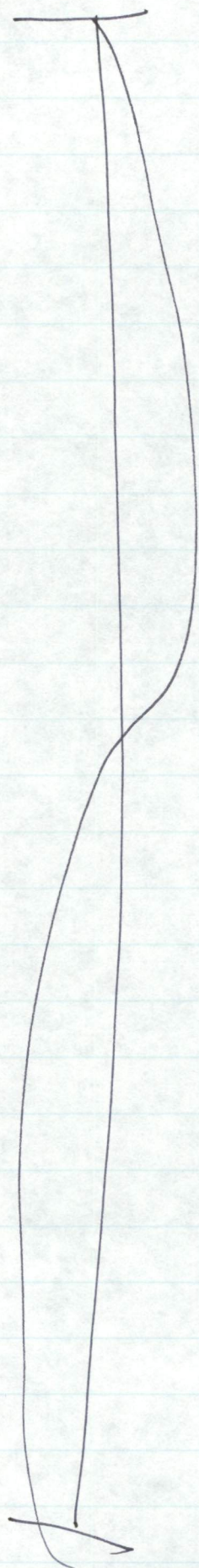
US > Japan + FRG + FR + UK
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B. priority of basic vs. applied research

III. ~~the~~ What is to be done (3-4)

As a result

IV. How does Bush define science



Materials for Speech on Technology and R&D

President Bush's speeches:

2/19/92 Oak Ridge
9/16/92 Sandia Labs
3/20/92 East Room
7/30/92 Texas Supercollider

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Fact sheet on technology/R&D (2/19/92)

National Academy of Sciences, The Government Role in Civilian Technology: Building a New Alliance (1992)

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As delivered
10/6/92

Exploring the Technological Frontier

Roger B. Porter

It is an honor to address this distinguished conference. This is a timely gathering given the fresh challenges we face as a nation with the ending of the Cold War and the approach of the 21st century.

Historians will record the twentieth century as the American Century. It was in this century that the United States first became actively engaged around the world. Throughout this century, we have sought to advance two ideals that have served us well for more than two hundred years -- democracy and free enterprise.

This is also the century when the United States led a global advance on the frontiers of science and technology. Whether in the marketplace of ideas or in the crucible of the laboratory, Americans have been on the frontier.

Nearly one hundred years ago, the noted historian Frederick Jackson Turner described the American spirit as being determined by our nation's frontier. "To the frontier," he wrote, "the American intellect owes its striking characteristics. That coarseness and strength combined with acuteness and inquisitiveness, that practical, inventive turn of mind, quick

to find expedients."¹

The closing of the Western frontier proved to be, as Jackson observed, something of a watershed. But it did not dampen or diminish the frontier spirit in America. In our history, for every frontier that has closed, another has opened. We have always been a people with our eye on the far horizon, filled with energy to meet the next challenge, rather than willing to travel down the path of comfortable complacency.

With the geographical frontier closed, the technological frontier opened. In the last one hundred years, American invention and innovation have transformed daily life. The automobile, the airplane, the transistor, television, electrophotography, personal computers, lasers, fiber optics, audiotape, videotape, videocassette recorders, pressure sensitive adhesives, thermoplastics, magnetic resonance imaging, fax machines, and not least, air conditioning exert such a ubiquitous influence on most Americans that we often take them for granted. We have sent men to the moon and returned them safely home. It has truly been a full and exceptional century.

Current Realities

In considering the technological frontier, it is worth recalling three realities that shape the next series of challenges we face.

The first is that we live in an increasingly integrated world economy. In 1950, world trade was less than \$70 billion. Today, world trade exceeds \$3 trillion. While the global economy has grown by approximately 4 percent over the last forty years, world trade has grown at a compound annual rate of 6.2 percent, or approximately 50 percent faster than the growth in economic activity.

Likewise, the flow of foreign direct investment during the period 1983-89 increased at an annual rate of 34 percent, nearly four times as fast as the growth of merchandise trade.

In 1950 combined direct and portfolio investment in the United States amounted to \$9.7 billion. By 1990, foreign investment in this country exceeded \$2.18 trillion.

The second reality is the rapid diffusion of ideas, processes, and innovations that now dominates the international economy. What is striking is not simply the pace of discoveries and innovations, but the speed with which these innovations are spread worldwide.

This diffusion of ideas and processes has been accompanied

by the rise of global corporations that integrate activities across national boundaries.

The third reality is the persistent tension, most acute in advanced industrial economies, between the search for greater security and the recognition of the need for dynamism, change, and adjustment. Measures designed to provide greater security often take forms that make dynamism, change, and adjustment more difficult.

Strengths and Limitations

In many respects, the United States is well positioned in this increasingly integrated and highly competitive international environment. In terms of total spending, public and private, devoted to research and development, we spend 16 percent more than Japan, Germany, France, and the United Kingdom combined.

Measured as a share of GNP, the United States spends roughly the same share as Japan and Germany, 2.7 compared to 2.9 and 3.0 percent. This rough comparability with Japan and Germany is the result of a renewed U.S. commitment to research and development during the during the 1980s, when R&D spending rose from 2.2 percent to 2.7 percent of GNP.²

A substantial portion of Federal R&D spending is devoted to defense and space. There is a long-standing and unresolved debate about the extent to which defense and space related research and development spending benefits the civilian sector of the economy. Precisely quantifying spinoffs from defense R&D is difficult. What is clear is that defense R&D makes a significant contribution to America's civilian economy. From microwave ovens to airbags, commercial aircraft to computers, numerous pillars of our competitive economy have their roots in defense R&D.

If one concentrates exclusively on non-defense related research and development, the U.S. spends more on civilian R&D than its three closest competitors: more than Japan, Germany, and France combined. In 1989, Japan spent \$46 billion while the United States spent \$79 billion on nondefense R&D.³

Interestingly, government spending in the United States has played a larger role than has government spending on R&D in most of our competitors. In Japan, for example, government R&D spending accounts for less than one fifth of total research and development outlays, compared with Federal outlays in the United States that amount to nearly half of total spending.⁴

A nation's technological capability rests not merely on its current expenditures for work in its laboratories, but also

on the pool of scientific and engineering talent on which it relies to generate breakthroughs and innovations. The United States leads the advanced industrial democracies in the number of nonacademic scientists and engineers per 10,000 people in the labor force. Moreover, during the 1980s our science and engineering workforce expanded at an annual rate of almost 4 percent, substantially faster than the growth of the workforce as a whole.⁵

The contribution to economic growth made by research and development rests not simply on the quality of its personnel or the size of its financial commitment. It also rests on how efficiently a nation translates discoveries into innovations, how well and how quickly it moves from basic research to full commercialization.

The capacity to move down this stream is increasingly crucial to a country's economic performance. The Office of Science and Technology Policy recently estimated that more than one-third of the growth of the U.S. economy since 1930 has been due to advances in the realm of knowledge.⁶ The growth of the U.S. economy, and particularly the growth of higher-wage jobs, depends upon our ability to capitalize upon our technology: to generate new ideas and to transform those ideas into commercial realities faster than ever before.

Professor Edwin Mansfield, one of our leading scholars of the process of research and development, has concluded that it takes a Japanese firm about 25 percent less time and 50 percent less money to commercialize innovations than its U.S. counterpart. One reason for this difference may very well be that Japanese firms spend twice as much as American firms on integrating innovation into the production process itself.⁷

Technology Policy in Historical Perspective

If one accepts the premise that research and development performance is crucial to a nation's economic strength and international competitiveness, then it is worth considering the most appropriate role for the public and private sectors in advancing technological innovation.

The Federal government made its first substantial contribution to research and development at the end of the Second World War. At that time, there was a clear consensus as to the importance of R&D and the appropriate role for government support. The government would support basic research projects that were central to the development of new knowledge, but that were uneconomical for any particular firm to conduct because they were too expensive, too risky, or too diffuse in their benefits.

The question remained what to do with the results of this research? Who would draw upon them, and how would they gain access? Who would ensure the full exploration of their potential, and who would make available their benefits to all? Would the government or the market decide which ideas to develop, which were competitive winners and which were commercial losers?

The answer, of course, was that both the government and the market had important roles to play. In the area of defense, where the Federal government was the primary consumer, it would encourage research in areas of vital interest and support the development of particular products. Government agency "missions" -- national security, space, and energy -- drove Federal funding beyond basic inquiry into applied research and development, commercialization and procurement.

Outside defense, where the market would rule, there was remarkably little comment on the role of the Federal government. Many scientists at the time believed as an article of faith in the linear and inevitable progression of discoveries on the laboratory bench to products in the commercial market. With leading universities conducting cutting-edge basic research, new technology, they believed, would almost automatically emerge.

Much has changed in the last four decades. When the United States was unchallenged in the international economy, it could afford to be patient with the commercialization of its technology. Now it is clear that superior technology is a principal source of comparative advantage in the manufacture of products and the delivery of services. America's ability to compete internationally depends upon its ability to integrate new technologies into products, services, and the production process itself.

First Principles

It is useful to think of the stream of research and development activities as akin to a spectrum. At one end is the most basic research. At the other end is full commercialization of a new product or process. At different places on the spectrum a different mix of public and private sector roles and activities is appropriate.

Most agree that government has the dominant role at the basic research end of the spectrum and that private industry has the dominant role at the commercialization end of the spectrum. The central issues involve how a nation most efficiently and rapidly moves the results of its basic research

efforts across the spectrum to commercialization, and what are the respective roles of government and the private sector.

The President's research and development strategy is based on six key elements.

- First, ensuring adequate support for basic research;
- Second, working cooperatively with the private sector to develop generic or enabling, pre-competitive technologies;
- Third, encouraging the swift and effective transfer of technology from Federally-funded laboratories to the private sector for commercial application.
- Fourth, creating a climate that encourages private sector investment in research and development;
- Fifth, preparing our children and our workforce for the technological demands of the 21st century; and
- Sixth, opening foreign markets for U.S. technology and protect the intellectual property rights of U.S. firms abroad.

Support for Basic Research

Since the Second World War, it has been a fundamental tenet of U.S. science and technology policy that the government

should take a leading role in ensuring adequate support for basic research. This is based on the difficulty for individual firms to reap the full proprietary benefits of their basic research outlays. It also reflects the large costs and considerable risks for an individual firm. Government fills this gap by providing funds for basic research projects that have great value for society but that would not be underfunded if left to the private sector alone. During the 1980s, Federal support for basic research increased in real terms by 50 percent.⁸ Support for basic research has continued to climb in the early 1990s.

The President's FY 1993 Budget proposes \$76.6 billion for R&D, a 35 percent increase over 1989. This includes a proposed 8 percent increase of more than \$1 billion for basic research. Moreover, the President's support for basic research is unprecedented in its scope:

- The President remains committed to a doubling of the National Science Foundation budget by 1994. He has proposed an 18 percent increase for the NSF's 1993 budget, 70 percent of which supports basic research primarily at colleges and universities.
- He has recommended a 9 percent increase in funds for individual investigators conducting basic research in health, energy, and a variety of other fields.

- He has proposed a 7 percent increase for the four-year old effort to unlock the secrets of the Human Genome.
- He has recommended a 24 percent increase for research devoted to understanding global climate change, a remarkable commitment that amounts to more than half of all global climate change research conducted worldwide.
- He has proposed a 6 percent increase for research into astrophysics and astronomy.
- And finally, just this past week, he renewed the nation's commitment to groundbreaking research in high energy and nuclear physics in signing legislation funding the Superconducting Super Collider.

Development of Generic Pre-Competitive Technologies

Second, the President has aggressively supported the development of generic, pre-competitive technologies. Projects that solve problems for a broad range of industries may not be economical for any one firm to pursue. These are projects that typically involve high costs and high risks. Individual firms have difficulty in capturing the returns from this type of investment. This is a realm in which government and industry

must work closely together and in which market forces must play a fundamental role.

It is important to distinguish between picking winners and losers, on one hand, and supporting the development of generic pre-competitive technologies, on the other. The President's strategy in supporting pre-competitive generic technologies does not involve identifying particular products that merit development or particular industries that deserve subsidies.

The intent is not to substitute the Federal government for private initiative, nor to fund the development of commercial products whose profits will go to private companies. Rather, our goal is to work with industry to develop those generic, or enabling, pre-competitive technologies that hold out clear commercial potential for a wide variety of products and processes in a broad range of industries.

The President has advanced an ambitious agenda of projects to help sustain our technological preeminence. His FY 1993 budget includes:

- Nearly a billion dollars for High performance computing and communications; (\$803 million, a 23 percent increase)
- Nearly two billion dollars for advanced materials and

processing; (\$1.8 billion, a 10 percent increase)

- Four billion dollars for biotechnology; (\$4 billion, a 7 percent increase)
- Nearly a billion dollars for energy technology; (\$914 million, an 18 percent increase)
- \$360 million for developing energy from fusion; (a 7 percent increase)
- One billion dollars for advanced manufacturing methods; (\$1 billion, a 27 percent increase)
- One-and-one-half billion dollars for air and transportation systems; (\$1.4 billion, a 17 percent increase)
- Nearly five billion dollars for biomedical research and research into women's health and AIDS; (\$4.8 billion, a 2 percent increase)
- \$305 million for research into technologies, such as robotics, to aid the space program. (a 12 percent increase)

Sematech, the Battery Consortium, the Automotive Composites Consortium -- are all examples in which government is working with industry to spur innovation and to speed the movement of new products and processes from the laboratory to the marketplace.

The President's commitment to this major research and

development effort reflects his conviction that we must make a series of strategic investments in our future and that these investments deserve priority, at a time when spending caps on discretionary domestic spending are in place.

Unfortunately, the same commitment to investing in our future is not reflected in the results of congressional budget deliberations. Of the \$1 billion increase that the President sought for his High Performance Computing and Communications, biotechnology, advanced materials, and global climate change initiatives, Congress cut his increase in half.

The President proposed an 18 percent increase in the NSF budget, but Congress seems reluctant to give NSF any increase at all. Equally distressing, the Congress has eroded the merit-based approach to awarding grants and contracts by earmarking an increasing percentage of the R&D budget for particular institutions, and even particular researchers. This practice has no substantive justification, reflects an unfortunate dominance of pork barrel politics, and undermines the Administration's efforts to maximize the potential return on R&D investment by selecting only the highest qualified research for support.

Encouraging Effective Technology Transfer

Third, the President has moved aggressively to encourage the swift and effective transfer of technology from Federally-funded laboratories to the private sector for commercial application. His strategy involves forging closer links between government, university, and industrial research establishments. Three examples illustrate the thrust of the Administration's technology transfer strategy:

- The Advanced Technology Program, administered by the Department of Commerce's National Institute of Standards and Technology, brings together industry and universities to work jointly on research on projects ranging from high temperature superconductivity to methods for improving the accuracy of machine tools.
- Through the NSF's Engineering Research Centers, Federal and State governments, universities, and private firms work together to address crucial technological issues. Industries match Federal funds 10 to 1 and play a leading role in defining the research agenda.
- Under the National Technology Initiative ("NTI"), Federal laboratories and the private sector counterparts have signed more than 1,400 Cooperative Research and Development Agreements ("CRADAs"). In the fields of

computers, ceramics, and environmental technology, we are achieving an unprecedented level of success in taking the best ideas from our labs and turning them into American products. Oakridge National Lab and IBM, for example, are working closely together on high performance computing. General Motors and the National Institute of Standards and Technology are developing new software for automated manufacturing equipment.

These new partnerships extend beyond major private research labs. At Manufacturing Technology Centers around the country, we are working to help small businesses to integrate the latest technologies. Since 1989, more than 6,000 companies have looked to these centers for assistance in introducing new equipment and improving their manufacturing processes.

Creating a Climate for Private Investment and Innovation

Fourth, the President has moved to strengthen private sector investment in research and development:

- By creating a stable macroeconomic environment in which private firms can plan with confidence;
- By providing specific incentives to stimulate private sector research and development; and

- By creating a balanced, responsible regulatory and legal framework that encourages innovation.

We have made some progress in nurturing an economic environment that is conducive to innovation.

- The President has repeatedly urged the Congress to make permanent the 20 percent research and experimentation tax credit and he has proposed a capital gains tax reduction that would lower the cost of developing new technologies and the cost of purchasing high tech equipment. So far, Congress has resisted both these proposals.
- The Administration has used its administrative discretion to extend for 18-months the tax rules that provide for the flexible allocation of R&D expenditures for companies with foreign operations.

At the same time, the Administration has worked to ensure that Federal regulations protect Americans' health and well-being without impeding firms from bringing safe, new products to market. Streamlining the regulatory process has enabled us to accelerate approval of "breakthrough" drugs, and to advance promising biotechnology developments. This is part of a larger effort to establish a regime of regulatory reasonableness and to reduce needless litigation.

Preparing our Workforce

The fifth element of the President's research and development strategy is preparing our workforce for the 21st century. Nothing is more central to our long-term success than the quality of our workforce. At the President's Summit Conference with the Governors on Education that led to the six national education goals, one Governor told of a conversation he had with the Chairman of the Board of Toyota. During the conversation he asked his guest: "How many of your workers are illiterate?" The Chairman of Toyota responded: "By American standards none; by Japanese standards, 15 percent."

Puzzled, the Governor asked him to explain. He replied: "All of my workers know how to read and write, but 15 percent of my workforce are not yet able to fully program a computer." That is the world we are living in. Those are the kinds of standards we are competing against.

Preparing our children will require some fundamental changes in our education system. The President's America 2000 strategy for achieving the national education goals would transform our elementary and secondary schools. The strategy is built on four principles:

- Greater accountability through national standards for what students should know and be able to do in five core subjects as measured in the 4th, 8th, and 12th grades and a voluntary national assessment system to measure students against those standards;
- Greater innovation through creating break-the-mold new American Schools and disseminating the ideas generated through the New American Schools Development Corporation;
- Greater flexibility for teachers and administrators and greater flexibility in the use of Federal funds accompanied with accountability for results; and
- Greater competition through choice for parents in selecting the schools their children attend whether those schools are public, private, or religious.

The fourth national education goal is that by the year 2000, U.S. students will be first in the world in science and mathematics achievement. The President has called for a dramatically increased Federal commitment to achieve this goal. In his most recent budget, the President called for more than \$2 billion in Federal outlays to strengthen mathematics and science education, a 69 percent increase since he took office.

Advancing and Protecting the Rights of U.S. Firms Abroad

Sixth, the President has worked to open foreign markets for U.S. technology and to protect the intellectual property rights of U.S. firms abroad. The North American Free Trade Agreement will create the largest and richest market in the world. Bilateral agreements with Japan have opened markets for supercomputers, satellites, telecommunications, and semiconductors, in which we now hold 16 percent of the Japanese market.

The ability to penetrate foreign markets must be accompanied by adequate protection for intellectual property rights. Some recent developments are encouraging. We have made genuine progress in persuading various nations to improve their intellectual property rights standards. Enhancing the protection of these rights remains a high priority for the President in the Uruguay Round GATT negotiations.

Policies that encourage investment and innovation, that protect consumers without imposing a wasteful regulatory and legal burden on entrepreneurs, that educate our children for the challenges ahead, and that recognize the integrated nature of the world economy -- these are the policies that will permit the private sector to conquer successfully the technological

frontier.

Conclusion

One of the most difficult questions facing any administration is where on the spectrum between basic research and commercialization is the proper place for government intervention. In the immediate aftermath of the Second World War, intervention began and ended with support for basic research. The role of the Federal government was to set the wheels in motion, but it was then left to the market to determine their direction.

Some today urge that the government increasingly substitute its judgment for the choices made by millions in the marketplace. It reflects a conviction that an elite possesses superior wisdom and can better manage the allocation of resources than would occur through the decisions made by the market.

The President is convinced that the private sector must continue to lead in commercializing new technologies and selling them around the world. It is worth remembering that despite all our technological advances, there is no free lunch. Federal spending can only be increased by diverting resources

from somewhere else. A driving concept in economics is that of opportunity costs. Committing resources to one activity involves less for something else, and often this means taking money away from individuals and businesses through taxes or borrowing.

The President has advanced a comprehensive, balanced strategy for meeting our nation's research and development challenge. It ensures an appropriate basic research effort, enhances Federal activity on developing pre-competitive generic technologies, establishes greater public-private partnerships in transferring technology from Federal laboratories to the private sector, creates a climate that encourages increased private R&D, prepares our children and our workforce for the 21st century, and advances and protects the rights of U.S. firms abroad.

Frederick Jackson Turner, described an America full of "all the buoyancy and exuberance which comes with freedom." These, he wrote, "are the traits of the frontier."⁹ It is these traits that will serve us well as we prepare for the next American Century.

Endnotes

1. Frederick Jackson Turner, The Significance of the Frontier in American History, 1894, p. 34.
2. National Science Board, Science & Engineering Indicators - 1991, GPO, 1991, p. 341.
3. National Science Board, Science & Engineering Indicators -- 1991, GPO, 1991, p. 342.
4. National Science Board, Science and engineering Indicators -- 1991, GPO, 1991, p. 343.
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6. Office of Science and Technology Policy, Science and Technology, GPO, 1992, pp. 104-05.
7. Edwin Mansfield, cited in Office of Science and Technology Policy, Science and Technology, GPO, 1992, pp. 106-07.
8. Budget of the United States Government -- Fiscal Year 1993, GPO, 1992, Part I, p. 117.
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THE WHITE HOUSE

WASHINGTON

October 30, 1992

MEMORANDUM FOR ROGER B. PORTER

FROM: MICHAEL FROMAN

SUBJECT: Civilian R&D with Commercial Applications

Since 1989, President Bush has aggressively pursued a strong science and technology agenda which has included proposals for an unprecedented level of support for R&D, including civilian R&D with commercial applications.

I. Administration Programs

The Administration has supported civilian R&D with commercial applications by 1) funding applied R&D, including collaborative efforts to develop generic, pre-competitive technologies, 2) encouraging the transfer of federally-funded technology to the private sector, and 3) advocating reforms of the tax, legal, and regulatory environment in which technological innovation takes place.

A. Support for Applied R&D

Most of the Administration's efforts to facilitate civilian R&D with commercial applications have focused on Federal support of applied R&D. Below are descriptions of the Administration's FY 1993 budget proposals and preliminary estimations of the Congressional response:

- \$803 million, an increase of 23 percent, for a High Performance Computing and Communications program designed to enable a thousand-fold increase in computing capability and a one hundred-fold increase in communications speed. Congress approved \$734 million.
- \$1.8 billion, an increase of 10 percent, to improve the manufacturing the performance of Advanced Materials and Processing. Congress approved \$1.7 billion.
- \$4 billion, an increase of 7 percent, for biotechnology research with applications for health, agriculture, and environmental protection. Congress approved \$3.9 billion.
- \$914 million, an increase of 18 percent, for energy

R&D, including \$42 million for the U.S. Advanced Battery Consortium. Congress approved \$901 million for all energy-related R&D.

- \$321 million for civilian advanced manufacturing R&D, an increase of 27 percent, to improve the efficiency and quality of manufacturing and to expand the capability of bringing a product from design to completion. Congress approved \$299 million.
- \$1.4 billion, an increase of 17 percent, for transportation R&D activities, including those related to intelligent vehicle/highway systems, high speed rail and Maglev trains, and the National Aerospace Plane Program. Congress approved \$1.37 billion.
- \$4.85 billion, an increase of 2 percent, for biomedical research designed to ensure that basic research discoveries are translated into marketable therapies. Congress approved \$4.8 billion.
- \$311 million, an increase of 26 percent, for civilian R&D at the National Institute of Standards and Technology (NIST). NIST conducts research into standards development and advanced measurement techniques and operates seven Manufacturing Technology Centers that facilitate the transfer of new technologies to small and medium-sized businesses.

The proposed NIST budget also included \$68 million, an increase of 36 percent, for the Advanced Technology Program, which provides matching funds to U.S. business and R&D joint ventures for the development of generic, pre-competitive technologies. In the past, the focus of such grants have included high-temperature superconductivity, improved manufacturing techniques for electronics, and methods for improving the accuracy of machine tools.

Congress approved \$384 million.

B. Support for Technology Transfer

- Under the auspices of the Administration's National Technology Initiative, there have been a series of nationwide conferences that have served as catalysts for creating new R&D partnerships among government, universities, and private companies.

- The Administration greatly expanded the number of Cooperative Research and Development Agreements (CRADAs) between government laboratories and private industry from 33 in FY 1987 to 460 in FY 1990 to an estimated 1700 in FY 1993.
- The Administration initiated the Advanced Battery Consortium with major U.S. auto companies, battery manufacturers, and electric utilities to develop storage batteries for electric cars. The Administration continued to support pre-existing R&D consortia, such as Sematech.

C. Reform of the Tax, Legal, and Regulatory Framework

The Administration has supported a number of tax, legal, and regulatory reforms to remove obstacles to technological innovation:

- The FY 1993 Budget proposed to make permanent the 20 percent research and experimentation (R&E) tax credit, which expired in June 1992. The House and the Senate approved separate versions of an 18-month extension, but there has been no action thereafter.
- The Administration has expressed its support for a capital gains tax cut to reduce the cost of developing new technologies and the cost of purchasing high tech goods.
- On June 24, 1992, the Administration published a rule that extended administratively the section 861 R&D allocation rules for 18 months.
- Under the National Cooperative Research Act of 1984 (NCRA), industries may engage in collaborative research without fear of per se antitrust violations. The Administration has supported legislation to expand the NCRA to include joint production ventures as well.
- On April 9, 1992, the Administration announced four actions to speed up the availability of new drugs and dramatically reduce unnecessary burdens in the drug development process.

II. Status of Administration Proposals

Because the Administration's initiatives were largely budgetary in nature, Congress addressed most of them in the

appropriations process. In most cases, Congress cut back the Administration's proposed increases in R&D spending, including spending on civilian R&D with commercial applications.

Congress did approve more than the Administration requested for the R&D programs of the National Institute of Standards Technology.

Making permanent the R&E tax credit, adopting a capital gains tax cut, and expanding the NCRA to include joint production ventures remain to be done.

III. Other Proposals

A. National Academy of Science's Panel on the Government Role in Civilian Technology

In a 1992 report submitted by a panel chaired by Harold Brown, the NAS made the following recommendations:

- The Defense Advanced Research Project Agency's (DARPA) role in dual-use technology development should be reaffirmed.
- A small number of federal laboratories should be designated to focus on commercial technology development and transfer.
- The scope of mission-related agency R&D programs should be enlarged to include pre-commercial projects.
- The funding of the Small Business Innovation Research program should be increased.
- The Advanced Technology Program should be evaluated with an eye toward its expansion.
- A new Industrial Extension Service should be created at the Department of Commerce to speed technology adoption by U.S. industry.
- A quasi-governmental Civilian Technology Corporation, funded through a one-time, \$5 billion appropriation, should be created to invest in pre-commercial R&D and to increase the rate at which products and processes are commercialized.

**B. Center for Strategic and International Studies'
Commission on The Strengthening of America**

In its first report, released in September 1992, the bipartisan CSIS panel chaired by Senators Nunn and Domenici recommended the following:

- The 20 percent research and experimentation tax credit should be extended.
- Federal support for manufacturing technology R&D should be increased, and each federal agency should support the development of manufacturing process technology as a component of its ongoing R&D programs.
- The role of the national laboratories should be reviewed by a senior-level panel with an eye toward removing obstacles to their participation in collaborative, commercial-oriented R&D.
- The DARPA should be transformed into the National Advanced Research Projects Agency (NARPA) to help integrate defense and commercial technology development and to focus more on the development of dual-use technology.
- Manufacturing extension programs should be developed to help small and medium-sized businesses integrate new technologies.

C. Clinton/Gore Campaign

The Democratic Presidential campaign proposed shifting \$2 billion from defense to civilian R&D for the following programs:

- The Federal government should establish 170 market-driven manufacturing extension centers to serve as "teaching factories" and to help small and medium-sized businesses integrate new manufacturing technologies. These centers should focus particularly on regions with declining defense industries and utilize scientists and engineers with expertise in this area.
- The Federal government should fund private-led centers that provide training in manufacturing skills to interested workers.
- A civilian DARPA should be created to invest in

advanced manufacturing technologies and to promote market-driven industry consortia.

D. Senate Proposals

In 1991, Senators Bingaman, Hollings, Nunn, and Gore introduced a package of technology and manufacturing bills that recommended the following:

- Federal support for pre-competitive development of critical generic technologies should be increased by expanding the efforts of the DARPA and the Advanced Technology Program.
- Federal agencies with R&D programs should increase their emphasis on the development of manufacturing technologies by earmarking 0.5 percent of the R&D budgets to support industry-led projects in this area.
- There should be a coordinated interagency planning process for Federal support for the development of critical and manufacturing technologies, with direct industry input into the planning process.
- The Federal government should greatly increase its support for new and existing State manufacturing extension programs with the creation of a National Manufacturing Extension Program.
- In cooperation private industry, the Federal government should establish Regional Critical Technology Application Centers to provide an infrastructure for the provision of technology services.

E. Council on Competitiveness

In its 1991 report, the Council on Competitiveness made the following recommendations:

- The Federal government should dramatically increase support for generic technologies R&D, work with industry to identify priorities and action plan, and direct agencies and national laboratories to advance leadership in critical technologies development.
- The Federal government should reduce the cost of capital by accelerating depreciation schedules for manufacturing equipment, making the R&E tax credit permanent and expanding it to include manufacturing

engineering and process R&D, and placing a permanent moratorium on section 861.

- The Federal government should pursue regulatory and legal reform (e.g. antitrust reform) to promote manufacturing and investment in technology.
- The Federal and State governments should invest in both physical and human technology infrastructure.

IV. Strategy for a Second Term

The recommendations from outside the Administration are summarized and evaluated as follows:

- A. **Increase funding for the development of generic, pre-competitive technologies.**
 - In the case of most R&D programs, the Congress appropriated less money than the Administration requested.
- B. **Establish a new institution or empower an existing institution to coordinate Federal support for civilian R&D and to facilitate collaboration among government agencies and Federally-funded laboratories, universities, and private business.**
 - The Administration has generally been opposed to centralizing the planning of research and development in a single government bureaucracy.
 - Given the success of DARPA, it may be worthwhile to permit that agency to increase its support for the development of dual-use technology.
- C. **Adopt tax, legal, and regulatory reforms to facilitate technological innovation.**
 - Most of the recommendations (e.g. tax credit extensions, antitrust reforms) are similar to those proposed by the Administration and should be pursued with the new Congress.

D. Encourage the development of manufacturing technology and other technology with commercial applications in the context of existing agency or Federally-funded laboratory activities.

- The Administration has been reluctant to encourage government agencies to engage in the development of such technologies outside collaborative projects with the private sector.
- The Administration should continue to encourage collaborative R&D activities among Federally-funded laboratories, universities, and private business by streamlining the process by which CRADAs are negotiated.

E. Expand existing programs or adopt new programs to facilitate the transfer of new technology to the private sector and, in particular, to small and medium-sized businesses.

- The NIST currently operates seven Manufacturing Technology Centers that have as their purpose the dissemination of technology. The Clinton/Gore Campaign proposes 170 such centers. After evaluating the success of the existing centers, an expansion of the program may or may not be called for.

V. Conclusion

In his Agenda for American Renewal, the President called for "an expansion of Civilian R&D linked to new applications." There is an increasingly strong consensus concerning the need for the Federal government to support collaboration with the private sector towards the development of generic, pre-competitive technologies. The challenge is to ensure that that support is structured in the most efficient manner -- that is, with the greatest input from the private sector and without an effort to pick particular winners and losers.

There appears to be sufficient support in Congress for at least a temporary, if not a permanent, extension of the R&E tax credit. High-tech executives, representatives of the scientific community, and the Democratic Congress, however, would like the Administration to adopt a more activist technology policy.

Should the Administration decide to expand the number of technology extension centers or to increase the DARPA's support for dual-use technology development, for example, it would probably enjoy support. The second term challenge is less likely to lie in cultivating support for particular Administration proposals than in preventing proposals that the Administration opposes from making their way to the President's desk.

Job Training/ Worker Adjustment

I. Administration Proposals

A. Job Training 2000

In January 1992, President Bush announced a comprehensive, streamlined Federal job training system to provide "one-stop shopping" at Skills Centers for job training services and vocational education in every community. The program will coordinate the delivery of more than \$11 billion in Federal vocational education and training programs.

Local Private Industry Councils will certify job training and vocational programs to prevent abusive trade schools from devouring Federal and State funds without providing any real training. The Councils will also issue up to \$2 billion in training vouchers to eligible individuals for certified programs.

The program strengthens accountability by withholding 20 percent of payment until a trainee has successfully completed the program and has held a job in the field of training for at least 90 days.

B. Worker Adjustment Initiative

In August 1992, the President announced a new \$10 billion worker adjustment initiative to provide retraining and transition assistance to dislocated workers over the next five years.

The program will assist all dislocated workers, including those who may change jobs or careers as a result of the North American Free Trade Agreement. It will serve:

- Workers who have lost their jobs;
- Workers who have been notified their jobs are being terminated; and
- Workers employed in industries experiencing work force adjustments who fear job loss in the future.

Dislocated workers would be eligible to receive three types of assistance:

- Transition assistance to help them secure new employment including skills assessment, counseling, job search assistance and job referral services.

- Training assistance, in the form of Skill Grants of up to \$3,000 per year for two years, for those workers who want and need retraining and skills development; and
- Transition income support, where necessary, for workers completing retraining.

C. Youth Skills Initiative

The President's Youth Skills Initiative is comprised of four components:

1. National Youth Apprenticeship Program: A voluntary school-to-work training program for high school juniors and seniors. Students who complete the program receive a high school diploma and a widely-recognized certificate of skill competency. Students will also have the opportunity to continue training at the post-secondary level.

The Targeted Jobs Tax Credit will be available to employers to cover eligible participating students.

The program will cost \$100 million per year beginning in FY 1994. The TJTC expansion will cost an estimated \$10 million in FY 1994 and \$160 million over 5 years.

2. Youth Training Corps (YTC): This program provides economically and socially disadvantaged youth with intensive vocational training and workplace skills. Job training will be combined with community service and conservation work in rural areas and on public lands.

- At 55 residential YTC centers nationwide, youths will receive remedial education, technical training, life-skills training, counseling and other services.
- Hiring preference for YTC staff will be given to individuals leaving military service, who have leadership and training expertise.
- The President's proposal will add 29,600 new training slots to help 43,000 additional disadvantaged youths (aged 16 to 21) each year.

3. Treat & Train: Funds 10,000 new drug treatment slots at intensive drug rehabilitation centers. This will permit an additional 28,000 youths to receive drug treatment each year. The program will cost \$150 million annually beginning in FY 1994.
4. Junior Reserve Officer Training Corps (JROTC): The President proposes to double the size of the current JROTC program, which emphasizes self-discipline, values, citizenship, personal responsibility, and staying in school. His goal is to establish 2,900 JROTC units by 1994 -- initially in inner-city high schools, but eventually to every high school across the country that requests it.

Status of Administration's Proposals:

- Legislation implementing Job Training 2000 was transmitted to Congress on April 28, 1992. It was introduced by Sen. Dole as S. 2633 on April 29, 1992 and referred to the Committee on Labor and Human Resources. No hearings were held on the Job Training 2000 Act of 1992.

On October 23, 1992, President Bush signed into law separate legislation (not proposed by the Administration) authorizing demonstration projects to consolidate Federally-funded job training programs for native Americans provided by four government agencies -- Labor, Education, Interior and HHS. (The "Indian Employment, Training and Related Services Demonstration Act of 1992")

- The Administration also transmitted legislation implementing the National Youth Apprenticeship program on May 13, 1992. This legislation was introduced by Rep. Goodling as H.R. 5220 on May 20, 1992, and referred to the Committee on Education and Labor. No hearings were held on the Youth Apprenticeship Act of 1992.

Demonstration youth apprenticeship programs were started in six States during 1992 -- _____. In his Agenda for American Renewal, the President committed to expand it to all 50 States in his second term.

In addition, Labor and Education Department officials have been holding field hearings nationwide to encourage industries voluntarily to set skill standards and certification requirements for their entry-level jobs.

- No legislation was transmitted to implement the Worker Adjustment or other Youth Skills Initiatives programs. [Is any required?]

In his Agenda for American Renewal, President Bush established a goal of having 2,900 JROTC units by 1994. He also said that he would initially expand the program in inner-city high schools, but that he wants to make JROTC available to every high school across the country that requests it.

II. Other Proposals

- A. Provide lifetime training by requiring every employer to spend 1.5% of payroll for continuing education and training for all workers, not just executives. (Bill Clinton, endorsing a 1990 recommendation of the Commission on the Skills of the American Workforce)

Variation: Four States -- Delaware, Alaska, California and Rhode Island impose a small payroll tax (0.01 percent in Delaware), collected in conjunction with unemployment insurance payments, to support a state training fund. New Jersey uses fines from violators of unemployment insurance laws to support training programs.

- B. Allow workers to deduct from their income taxes their own expenditures for job training. (Mandate for Leadership III: Heritage Foundation)
- C. Provide Federal funding to help smaller firms form an employer consortium to share training costs and reduce losses from the training investment when a trained worker moves to another company. For example, the Massachusetts Machine Action Project (MAP), a consortium of metalworking firms, trains workers to set up and run various machines, read blueprints and apply quality control principles. (Setting Domestic Priorities: What Can Government Do?: Brookings Institution)
- D. Create a nationwide extension service, along the lines of the Agriculture Department's extension service for farmers, to disseminate information and

provide technical assistance to improve workplace quality, including modernization and workforce training techniques. (Proposal by unnamed business leaders, economists and education consultants: National Journal, 8/8/92)

E. Authorize funding for various job training and employment programs, including:

- \$1.6 billion for block grant funding for certain eligible programs in enterprise zones, including a young adult employment demonstration program to provide job training, education and related services to young adults age 17 to 30 residing in enterprise zones;
- \$200 million for a community works demonstration program, to permit two States and four urban areas to provide employment and employment-related services to welfare recipients and non-custodial unemployed parents who are at least two months overdue in child support payments; and
- \$120 million for a Youthbuild program to train and put economically disadvantaged young adults (age 16 to 24) to work constructing and rehabilitating housing for the homeless or for low-income families. (H.R. 11, the urban aid/tax bill)

Recommendation: Original proposal plus individual worker tax deduction for training, small employer training consortia and Youthbuild program.

III. Strategy for the Second Term

Federal/State coordination:

- Before the end of the year, bring State administrators to Washington for 3-day seminar with Education, Labor and Commerce officials. Explore barriers to implementing job training and apprenticeship programs and need for model legislation or Federal technical assistance.
- Send model legislation to the States to provide legal structure to permit State-level implementation of Administration proposals.

Public/private sector coordination:

- Continue work with industry representatives on voluntary skill standards and certification.
[Targets?]
- Mobilize business and industry groups to push for Federal and States legislation to implement the Administration's program.

Federal legislation:

- Send to Congress by January 21 one omnibus job skills legislative package containing all seven elements of the President's original initiatives plus the three additional proposals suggested above.
- [Fill in after talk with Bob Jones.]

Outside allies:

- Business Coalition for Education Reform: Part of the National Alliance of Business; issued a press release in March 1992 endorsing the basic principles of Job Training 2000 and committing to work with the Administration and Congress to help shape an effective workforce investment system.
- National Federation of Independent Business: A leading small business organization that opposes Clinton's payroll tax for training proposal.
- National Association of Manufacturers: Members note that their inability to upgrade technologically is due in part to worker deficiencies in literacy and basic skills.
- American Society for Training and Development: An association of corporate training directors, which runs a research organization -- the Institute for Workplace Learning.

Outside opponents:

- Unions, who may well prefer Clinton's mandatory payroll tax to require training for all workers. They may also oppose non-union apprenticeship programs.