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NATIONAL RESEARCH COUNCIL REPORT ON INTERNATIONAL COMPETITION IN ADVANCED TECHNOLOGY

HEARING

BEFORE THE

COMMITTEE ON FINANCE
UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

FIRST SESSION

APRIL 14, 1983

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COMMUNICATION

NATIONAL RESEARCH COUNCIL REPORT ON INTERNATIONAL COMPETITION IN ADVANCED TECHNOLOGY

THURSDAY, APRIL 14, 1983

U.S. SENATE,
SENATE COMMITTEE ON FINANCE,
Washington, D.C.

The committee met, pursuant to notice, at 9:37 a.m. in room SD-215, Dirksen Senate Office Building, the Honorable Robert J. Dole (chairman) presiding.

Present: Senators Dole, Bentsen, Moynihan, and Mitchell.

[The press release announcing the hearing and the opening statement of Senator Grassley follow:]

[Press release No. 83-129]

FINANCE COMMITTEE REQUESTS WRITTEN COMMENT ON NATIONAL RESEARCH COUNCIL REPORT ON INTERNATIONAL COMPETITION IN ADVANCED TECHNOLOGY

Senator Bob Dole, (R., Kansas), Chairman of the Committee on Finance, announced today that the Committee will seek written comments regarding a report by the National Research Council entitled "International Competition in Advanced Technology: Decisions for America." A panel of the council presented the report to the Committee at a hearing on April 14, 1983.

The National Research Council is the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering, and is administered jointly by both Academies and the Institute of Medicine. In late 1981, the council formed a panel of 22 experts to consider the nature of technology in the context of international competition and to recommend fundamental guidelines for national policymaking in that regard.

In its report the panel considers—

(1) The nature of advanced technology and its extensive contributions to U.S. economic welfare and military security;

(2) the importance of maintaining a strong national capacity for technological innovation, including a vigorous international trade position; and

(3) the domestic and international measures required to sustain this effort.

The Committee seeks from the Administration and the public comments on the Council's analysis of these matters and their conclusions and recommendations. The Committee is particularly interested in receiving specific suggestions regarding how to implement what commentators consider to be the meritorious elements of the council's report.

The report is available for the National Academy of Sciences. Interested persons may obtain a copy by writing to—

Paul Sitton, National Academy of Sciences,
2101 Constitution Avenue, Washington, D.C.

STATEMENT OF SENATOR CHARLES GRASSLEY ON NATIONAL RESEARCH COUNCIL'S REPORT ON INTERNATIONAL COMPETITION IN ADVANCED TECHNOLOGY

Today we face many problems that are of a national concern:

High Levels Of Unemployment.
A Record Trade Deficit.
An Extremely Large Budget Deficit.
High Cost of Defense Systems.
A Decline in Productivity.
Deteriorating Industrial Base.

With the advent of High Technology coming to the forefront of this nation's thinking for the future of our industrial revitalization I believe the report which we are about to hear today is both timely and urgently needed. I strongly believe that strengthening American competitiveness in world markets must be a priority goal of this government, along with business and labor.

Quality, price, innovation, reliable deliveries, and knowledge of foreign markets are essential factors in export expansion. However, the primary responsibility for increased competiveness rest with corporate management and labor. Confronted with recessionary conditions at home, a slump in world demand, and increased foreign competition in every market, managers and employees of U.S. Companies should work within a framwork of constructive government policies to stimulate greater productivity and strengthen American competitiveness.

Our nation is losing its competitive edge and our competitive stagnation threatens both our economic health and our national security. As a nation, we must make the restoration of the U.S. competitiveness a national priority, and we must examine all avenues and options to assure recovery of our basic wealth producing and high technology industries.

We must look back on the history of this great nation of ours and learn from our mistakes, repair the foundations of our industrial bases that have begun to crumble and tap the ingenuity and inventive minds of our citizens that have kept us in the forefront of technological advancement and military strength.

In conclusion Mr. Chairman, I would like to quote from the President's State of the Union Message in which he said,

"Americans have been sustained through good times and bad by noble vision, a vision not only of what the world around us is today, but of what we, as a free people, can make it tommorrow. Back over the years, citizens like ourselves have gathered within these walls when our nation was threatened: sometimes when its very existence was at stake. Always, with courage and common sense, they met the crisis of their time and lived to see a stronger, better, and more prosperous country." End Quote.

Now is the time to call these same forces into play to meet the crisis of our time so that we and our children may live to see a stronger, better and more prosperous country and world. Mr. Chairman: The American people are aware of a fundamental crisis in our economy and I believe are ready to support extraordinary measures to reverse it if given the proper motivation and tools to compete. I think you for the time to give this brief statement and I look forward to hearing the panels report on International Competition in Advanced Technology with great enthusiasm.

The CHAIRMAN. We will now begin our hearing on the National Research Council Report on International Competitiveness in Advanced Technology.

I think in an effort to expedite matters I would call on the President of the National Academy of Sciences, Mr. Frank Press.

Frank, would you introduce the members of your group and identify them for the record and for the members?

I would say for the record, while you are taking your places, that the National Research Council is the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering and is administered jointly by both Academies and the Institute of Medicine.

In late 1981 the Council formed a panel of 22 experts to consider the nature of technology in the context of international competition and to recommend fundamental guidelines for national policymaking in that regard. The report will be released following this hearing.

So without further delay, Mr. Press, if you would introduce your colleagues; we will be happy to hear from four of the members, I understand.

I will let you proceed.

STATEMENT OF FRANK PRESS, PRESIDENT, NATIONAL ACADEMY OF SCIENCES

Mr. PRESS. Thank you, Mr. Chairman.

We welcome this opportunity to brief the committee on the new report that will be released this morning. We will present only a brief overview of the report because of the limitations of time, but we would like to submit the entire report to you for consideration, for the record.

The CHAIRMAN. Right. The report will be submitted but not included as a part of the record.

Mr. PRESS. Let me begin by introducing those members of the panel who are here this morning. The panel represented a distinguished group of Americans drawn from industry, banking, law, labor, academia, former Government officials, Americans interested in public affairs.

The chairman of the panel is Howard Johnson, to my left, who is chairman of the corporation of MIT. Also present this morning, going from far left to right, is Robert Charpie, the president of the Cabot Corp.; Shirley Hufstedler, whom you know well; to my right, Jack Steiner, vice president of Boeing Corp.; Robert Solow, professor or economics at MIT; Robert Fuller, vice president of Johnson & Johnson; and Leonard Woodcock, former Ambassador to China.

The charge to the committee was to consider the nature of advanced technology and its extensive contributions to the U.S. economic welfare and national security, to consider the importance of maintaining a strong national capacity for technological innovation including a vigorous international trade position, and the domestic and international measures required to sustain that effort.

In commending this report to you, and before turning to the panel members for brief statements, I would like to bring two key elements of the report to your attention.

The committee recommendations represent a change from the national consensus in two ways:

One, instead of a dozen agencies of government, all of whose authorities and policies affect the Nation's technological innovative capacity, often in incoherent fashion and in contradictory fashion, the committee calls for a single mechanism at the highest councils of government for assessment, policy recommendation, and for coordination.

Second, although the major factor in our future performance will be our own domestic actions—in other words, we can't blame others for our own mistakes—there are questionable trading practices of other countries which have the potential for producing irreversible harm to our domestic capacity, and these should be recognized and negotiations for change promptly undertaken.

The United States can be a powerful negotiator with a large array of domestic actions that is possible within our own traditions,

and also as the world's largest market for these important products.

The justification for this new approach is a simple one. The potential for advanced technology to contribute to all industrial, service, and agricultural sectors is enormous.

Let me now turn to several of our members for some very brief statements, because I know you do want to save time for questions and discussion.

I would like to begin with Mr. Steiner, on my right.

The CHAIRMAN. Mr. Steiner?

STATEMENT OF JOHN E. STEINER, VICE PRESIDENT, THE BOEING CO.

Mr. STEINER. Mr. Chairman, my name is John Edward Steiner. I am vice president, corporate product development, for the Boeing Co. I am proud to represent the Panel on Advanced Technology Competition and the Industrialized Allies on which I have served during the last year. I compliment the National Academy of Sciences for its leadership in the study of one of our most perplexing national problems.

The capacity for technological innovation is frequently perceived in terms of industrial products—microelectronics, computers, materials, robotics, telecommunications, aerospace, and, most recently, biotechnology. However, national innovative capacity is really something quite different. And this, I believe, reflects a very serious and deep chasm in the national understanding of technology. Furthermore, it is this singular void in national understanding that has facilitated actions which systematically diminished innovative capacity in the United States and thus eroded the Nation's security and strength.

Innovative capacity should not be thought of only in terms of products. It should be understood as a national resource, a chain of processes throughout our economy and society to perform basic research and, more importantly, to sustain and guide the results of research through the very long and costly processes of validation and risk reduction until the economic feasibility of new and competitive products is secured.

Innovation processes new knowledge through stages of research, product development, manufacturing, marketing, distribution—all of them.

Research, regardless of its setting, generates new scientific discoveries that spark the innovative chain. Communications and continuity are vital for a successful output flow. Development questions feasibility and includes a validation research phase for the understanding and removal of unacceptable risks in technology before a specific product use is known or the need defined.

Validation is usually the longest, most costly, and frequently the least understood part of the innovation chain The application phase of development integrates technology into a product designed for a specific use which is feasible from a manufacturing producibility standpoint.

Distribution addresses requirements of the user of the product. It entails marketing, delivery, training, and support services.

Each link that is described, from research and on through distribution, performs a vital interlocking step. Each must function effectively to insure success, since successful commercialization is what fosters and sustains the next round of new discoveries through the chain.

The process of innovation requires a healthy supply of capital, both venture capital for starting up new enterprises and growth capital for established firms.

Finally, innovative expansion requires economies of scale, and by definition it must secure world markets.

American innovation led the world up until the 1970 decade. Three major influences occurred which make future leadership uncertain over the decades ahead:

First, there was an accelerated growth in new technology, and with this a growth in the opportunities for innovation by all—United States and non-United States.

Second, foreign competitors pursued these opportunities by industrial targeting practices that focused and in many cases merged political, financial, and industrial resources of governments on specific product and market targets.

Finally, there was a rapid penetration of U.S. markets, foreign and domestic, by the foreign industry output.

Innovation is perceived in the United States as a private-sector task and responsibility. Very clearly, this perception is not valid with respect to the innovative process abroad.

In conclusion, we have gradually realized that our innovative capacities are flawed by discontinuities in the process chain and by a national misconception of its needs. Time is critical in correcting the deficiencies. Worldwide the opportunities and competition in exploitation of high technology are proliferating, and the next decade may well determine whether this Nation shall lead or shall observe the progress of the world.

Mr. Chairman, this completes my prepared statement.

[The prepared statement of John E. Steiner, and a statement by the Panel on Advanced Technology Competition and the Industrial Allies follows:]

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STATEMENT OF JOHN E. STEINER, VICE PRESIDENT, CORPORATE PRODUCT DEVELOPMENT, THE BOEING CO.

Mr. Chairman, my name is John Edward Steiner. I am Vice President, Corporate Product Development, for The Boeing Company. I am proud to represent the Panel on Advanced Technology Competition and the Industrialized Allies on which I have served during the last year. I compliment the National Academy of Sciences for its leadership in the study of one of our most perplexing national problems.

INTRODUCTION

The capacity for technological innovation is frequently perceived in terms of industrial products--microelectronics, computers, materials, robotics, telecommunications, aerospace and, most recently, biotechnology. However, national innovative capacity is really something quite different, and this, I believe, reflects a very serious and deep chasm in the national understanding of technology. Furthermore, it is this singular void in national understanding that has facilitated actions which systematically diminished innovative capacity in the United States, and thus eroded the nation's security and strength.

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Innovation processes new knowledge through stages of research, product development, manufacture, marketing, and distribution. Research, regardless of its setting, generates the new scientific discoveries that spark the innovation chain. Communications and continuity are vital for a successful output flow. Development questions feasibility, and includes a validation research phase for the understanding and removal of unacceptable risks in technology before a specific product use is known or the need defined. Validation is usually the longest, most costly, and frequently the least understood part of the innovation chain. The application phase of development integrates technology into a product designed for a specific use which is feasible from a manufacturing producibility standpoint. Distribution addresses requirements of the user of the product. It entails marketing, delivery, training, and support services.

Each link that is described--from research and on through distribution--performs a vital interlocking step. Each must function effectively to ensure success, since successful commercialization is what fosters and sustains the next round of new discoveries through the chain. The process of innovation requires a healthy supply of capital--both venture capital for starting up new enterprises and growth capital for established firms. Finally, innovative expansion requires economies of scale and by definition it must secure world markets.

WHAT HAS CHANGED

American innovation led the world up until the 1970 decade.

Three major influences occurred which make future leadership uncertain over the decades ahead. First, there was an accelerated growth in new technology and with this, a growth in the opportunities for innovation by all, U.S. and non-U.S. Secondly, foreign competitors pursued these opportunities by industrial targeting practices that focused and, in many cases, merged political, financial, and industrial resources of governments on specific product and market targets. Finally, there was a rapid penetration of U.S. markets (foreign and domestic) by the foreign industry output.

Innovation is perceived in the U.S. as a private sector task and responsibility. Very clearly, this perception is not valid with respect to the innovative process abroad.

CONCLUSION

We have gradually realized that our innovative capacities are flawed by discontinuities in the process chain and by a national misconception of its needs. Time is critical in restoring the deficiencies. Worldwide, the opportunities and competition in exploitation of high technology are proliferating, and the next decade may well determine whether or not this nation shall lead or observe the progress of the world.

Mr. Chairman, this completes my prepared statement.

International Competition in Advanced Technology: Decisions for America

A Consensus Statement Prepared by
the Panel on Advanced Technology Competition
and the Industrialized Allies

Office of International Affairs

National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C. 1983

Executive Summary

The health of U.S. advanced technology industries and their international competitive vigor are central issues in current economic and trade policy debates. The United States, like its major industrialized allies, views the ability to generate and use advanced technologies as essential, both to national economic well-being and to military strength. Many governments--most notably Japan and France--have designed comprehensive national policies to help promote successful technology and trade development in major sectors--telecommunications, biotechnology, computers, microelectronics, and aerospace, for example. The United States has no such defined industrial policy.

U.S. policymakers today must respond not only to a growing anxiety that U.S. leadership in advanced technology and trade is in jeopardy, but also to fears of mounting protectionism. Spurred by global economic ills, domestic unemployment, and loss of traditional markets to newly industrialized countries, governments are attracted to economic nationalism and protectionism--policies that can seriously endanger the international trading system, political alliances, and global technological progress. It is these concerns and the issues surrounding them that are addressed in this consensus statement by the Panel on Advanced Technology Competition and the Industrialized Allies.

The panel discusses the nature of advanced technology and its extensive contributions to U.S. economic welfare and military security; the importance of maintaining a strong national capacity for technological innovation, including a vigorous international trade position; and the domestic and international measures required to sustain this effort.

The panel describes U.S. government and private sector advanced technology policies and practices, as well as those of its major trading partners. Finally, the panel discusses how various national practices may be evaluated and negotiated among nations in support of a healthy mutual international trading system--and what steps the United States must take to protect its interests should international negotiations fail.

While the panel recognizes that contending policy objectives may at times take precedence over the requirements for national strength in technological innovation and trade competitiveness, it concludes that the U.S. advanced technology enterprise has been undervalued in the past in the national scheme of priorities and must be held as one of the country's most valued objectives.

HISTORICAL EVOLUTION

The United States' economic and social well-being over the last 100 years has derived substantially from the processes of discovery, invention, and entrepreneurship, which Americans have come to value so highly. The nation's capacity for technological innovation became especially apparent in the 20 years following the Second World War, when the United States was acknowledged worldwide as possessing across-the-board technological superiority. Throughout the postwar decades, however, the major industrialized allies combined their recovery from wartime destruction with a rapid rate of technological progress. The result was a progressive narrowing of American technological leadership. While the United States continued to maintain a higher overall productivity level, Europe and Japan enjoyed far higher rates of productivity growth. Today, the allies vie for positions at economic and technological frontiers that at one time seemed reserved for the United States. In many sectors, other industrialized nations are now the first to expand these frontiers.

The United States could not have expected to preserve its vast technological leadership. What it must preserve, however, is a strong capacity for technological innovation that is vital to the future growth of the entire American economy. Domestic weaknesses and damaging practices of other nations can endanger this innovative capacity, the basis for advanced technology development and international trade competitiveness. The United States must

now adopt measures designed to preserve this vital capacity.

TECHNOLOGY AND THE NATION'S ECONOMIC WELL-BEING AND MILITARY SECURITY

The national capacity to generate and use advanced technology is fundamental to the economic well-being and military security of the United States. Advanced technologies serve to increase productivity in services, manufacturing, and agriculture. The United States has the potential for a new economic surge fueled by advanced technology--a dramatic increase in the productivity of workers utilizing new information-processing technologies, new materials, and new manufacturing technologies. In addition, the U.S. positive trade balance in technology-intensive products and services contributes to domestic employment and economic health.

The nation's innovative capacity is vital to military as well as economic security. A major fraction of defense hardware is procured from technology-intensive companies. Advanced weapons employ frontier electronics gear, and verification methods fundamental to arms control agreements rely on advanced technologies. The interrelationships between the U.S. commercial and military advanced technology systems are complex, but it is clear that military systems rely on a strong civilian industrial base and that many commercial efforts benefit from defense and space research and development expenditures and procurement.

NATIONAL CAPACITY FOR INNOVATION

Our capacity for technological innovation is commonly perceived in terms of industrial sectors--microelectronics, computers, new materials, robots, telecommunications, aerospace, and, most recently, biotechnology. This list is, in fact, a transitory one--changing over time. A new list may supersede this one in a decade or two. The nation's innovative capacity should not be thought of only in terms of specific products; it should be understood as the continuous capability, widely diffused throughout the economy, to produce and put to use pioneering technological resources.

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This national innovative capacity is manifested primarily in a system of interrelated activities leading to commercial sales of products, most frequently referred to as the innovation process. This dynamic system not only involves basic research and product development, but also encompasses manufacture, marketing, and distribution. Each part of the process must function effectively to ensure success.

MAINTAINING TECHNOLOGICAL STRENGTH

The United States' capacity for technological innovation and competitiveness in world markets is an essential national resource, requiring a sophisticated and thorough understanding of the innovation process--what it is, how it works, what influences it, and what is necessary for its strength. Maintaining a world-class research structure is essential in the effort to expand technological frontiers. Research is a vital first requisite, but it is only one part of a complex, interwoven process. Product planning requires knowledge of new technologies in the research phases; development of commercially successful products requires links with marketing assessments; and successful commercialization pays for the next round of technological advance.

The innovation process, then, is an interlocking system that must be strong throughout. Its requirements include technologically sophisticated managers, quality research personnel, and a technically competent labor force. The process of innovation also requires a healthy supply of capital--both venture capital for starting up new enterprises and growth capital for established firms. Large-scale economies utilizing world markets are necessary to support succeeding rounds of technological advance.

A more elusive but major influence on the innovation process may be the government's role in establishing a climate that fosters entrepreneurial risk-taking. Stable, informed government policies can lessen uncertainty for innovative entrepreneurs.

GOVERNMENT'S ROLE

In the U.S. economy, institutional arrangements to foster advanced technology operate primarily in the private

sector--in small innovative firms, national and multinational companies, banking and financial communities, and the research universities. The United States has had no national plan nor even a loose coordinating mechanism linking the efforts of these private actors to federal government actions.

The government's primary role in fostering the nation's innovative capacity has been in education and support of basic research. There is, however, a range of government instruments to address broad national objectives that affect various stages of the innovation process, including market development. These instruments--which are compatible with our culture and style (as total government-industry coordination in the manner often attributed to Japan is not)--include tax policies fostering research, development and investment in production facilities, patent laws, regulation and deregulation, antitrust measures, export/import bank loans, and government procurement, among others. Beyond these measures, uncoordinated actions taken by various governmental agencies, designed to serve other purposes, affect the innovation process--unintentionally helping it in some instances, but hindering it in others. The nation's capacity to perform well in advanced technology and trade is, in fact, affected by decisions that are made independently, inter alia, by the Food and Drug Administration, the Environmental Protection Agency, the antitrust division of the Department of Justice, the Departments of Commerce, State, Agriculture, and Defense, the National Security Assistant, the Special Trade Representative, the President's Science Advisor, the National Aeronautics and Space Administration, the National Science Foundation, and the National Institutes of Health. Yet the heads of these executive branch entities rarely if ever have joined together to consider the totality of their separate actions on the nation's advanced technology capabilities and international competitiveness--either what it is or what it should be.

If the United States is to maintain its innovative vitality over time, it is essential that executive and congressional policymakers periodically evaluate both the U.S. comparative international trade position and the health of the nation's innovative capacity. They should do so by means of a broad analysis, conducted at cabinet level, of all the variables impinging on our capacity to innovate--both domestic and foreign. These periodic assessments would require support by a continuing source

of expertise drawn both from within the government and from outside.

Reviews should be comprehensive. They should assess:

- the impact of U.S. government policies on the nation's innovative capacity and international trade competitiveness;
- the nation's standing with regard to research and development, manufacturing, and marketing;
- the effectiveness (in comparison with other countries) of U.S. elementary and secondary educational systems, postsecondary institutions, and continuing education programs, especially in maintaining and renewing our technological and scientific manpower and knowledge;
- the trends in our comparative international trade standing; and
- the policies of major trading partners and their effects on the United States and the international trading system.

The process of periodic evaluation could result in recommendations, at the national level, to coordinate actions across agencies, to rationalize government policies, or to ensure consistency over time in government practices, as well as recommendations at the transnational level to initiate coordinated negotiations or actions with industrialized trading partners and allies. In addition, the assessment process should stimulate congressional hearings to seek the views of leaders from industry, labor, and other sectors. An opportunity for comprehensive and coherent review of U.S. innovative capacity and international trade competitiveness by representatives of all sectors contributing to it should help to elevate technological innovation goals in the scheme of national priorities.

MANAGEMENT'S RESPONSIBILITIES

A coordinated decisionmaking process is essential, but the nation's performance in advanced technology development and trade will be determined in large part by the efforts of individual firms. Successful firms are those whose managers have long-range vision of how technology affects the growth of their business. They understand the state of technology in their industry worldwide; they

respond to the international climate when planning for research, development, manufacturing, and marketing; and they are open to developing new institutional arrangements to foster technological growth--such as industry-university research relationships, cooperative research ventures among groups of firms, or consortia to seek information and ideas systematically from abroad.

ADVANCED TECHNOLOGY TRADE PRACTICES

U.S. firms face a mixed international trading system in which they are operating independently as private entities, yet are frequently competing with foreign firms, singly or in consortia, that either are government entities or have strong government backing. This mixed international trading environment often effectively places an American company in competition against a country. By "targeting" certain advanced technology sectors, a country may provide its firms with a range of support--from direct and indirect subsidies for research and manufacturing through help in penetrating foreign markets. Such practices are not within the U.S. arsenal of policies. Traditionally, U.S. philosophy has stressed private sector initiatives within a competitive framework.

U.S. firms are understandably concerned about the tactics other countries use to develop markets--both at home and abroad. American firms have difficulty penetrating European and Japanese markets when they are faced with intentional collective actions excluding them. At the same time, too, U.S. businesses must compete with European and Japanese firms for new and potentially lucrative emerging nation markets. Often foreign firms have strong support from their home governments, an advantage U.S. firms do not enjoy to a comparable extent. To lose out in this competition could be extremely damaging, not only for American advanced technology industries, but eventually, because of intersectoral linkages, for other areas of the economy as well.

There is considerable dispute among the industrialized allies regarding which trade practices are acceptable and which are not. Actions that are consistent with one nation's traditions and attitudes may be inimical to another. Friction is exacerbated worldwide by current conditions of slow growth, excess capacity, obsolete plants, and lingering inflation. These conditions make politically more difficult and financially more costly

structural adjustments that would shift financial, manpower, and other resources from less to more competitive industries. Many nations are suffering from record unemployment levels that cause significant domestic political problems.

U.S. OBJECTIVES

U.S. objectives in advanced technology trade must take into account both the needs of our own industries and those of our principal allies. Innovation proceeds most rapidly and efficiently when new products have access to the widest possible markets, thus spreading the costs and risks of innovation over more units and generating the cash flow for follow-on improvements and fresh innovation.

The United States should negotiate in international forums to secure the openness of world markets to innovative entrepreneurs wherever they may be based and to discourage large-scale distortions of free markets. Such a policy is required, both to preserve the U.S. position as a major source of innovation and to ease growing tensions among the industrialized allies, tensions that threaten not only international economic and political management, but also mutually beneficial cooperation in science and technology.

Nowhere is our national welfare more interwoven with that of our allies than in the fields of science cooperation and high-technology trade. The costs and risks of protectionist policies and market fragmentation are probably greater than in almost any other economic field except energy. Paradoxically, the international coordination of trade practices is more backward in advanced technology than in many other fields at a time when both nations and regions within nations are looking more and more to advanced technology as a primary source of economic salvation.

NEGOTIATIONS REQUIRED

Protectionist pressures are strong in today's very difficult economic times. Furthermore, international negotiations on trading practices are complicated by differing viewpoints among allies on what national practices are acceptable. Attempts to sort practices into acceptable and unacceptable categories have been

only moderately successful, but such attempts should continue. Progress may be slow and agreements difficult, but the health of the international trading system is at stake. Negotiations should consider the consequences of actions and place value on maintaining open markets, for they reward innovators by offering innovative products globally.

To foster healthy, mutual competition in advanced technology is a primary objective. Negotiations, though protracted, will serve the interests of the United States and her allies better than precipitous actions. Proposals for legislative action to protect advanced technology industries, currently before the Congress, require careful analysis and consideration in light of the findings of this report.

Cooperation among industry, government, labor, universities, financial, and other sectors is essential in dealing with these exceedingly complex problems in technology and trade. Most difficult will be those circumstances in which U.S. capacities are well nurtured and strong, yet key industries essential to the national welfare are nonetheless endangered. Vulnerability could develop because of successful aggressive policies of our allies, which individually may or may not be considered as unfair, but which together endanger U.S. major technology industries and fundamental advanced technology capacity deemed essential to economic well-being and military security. Where such broad national resources are in jeopardy, the United States must take action.

A first step is to seek to renegotiate multilaterally agreed rules in forums such as the GATT in order to establish clearer guidelines for government actions in high-technology sectors. A basic requirement of such negotiations would be that countries, including the United States, be prepared to consider altering traditional practices.

When there is a specific threat to U.S. interests from a particular country's government policies, the U.S. government should initiate bilateral consultations within the framework of GATT and other appropriate multilateral institutions. The goal of such negotiations would be to reach agreements on a time scale that would prevent or reverse damage to U.S. capacity for technological innovation. If these bilateral consultations are unsuccessful in resolving issues, the U.S. government should utilize formal multilateral dispute settlement procedures to seek a resolution. If those procedures in turn fail or if the

threat of damage is imminent, the United States would be required to take unilateral action to protect the national interest as a step of last resort.

CONCLUSIONS

- The United States must act now to preserve its basic capacity to develop and use economically advanced technology. This innovative capacity is essential for the self-renewal and well-being of the economy and the nation's military security. Trade in advanced technology products and services will contribute enormously to our economic health. Advanced technology products and processes not only permeate the economy, increasing productivity, but also form the basis of modern defense hardware.
- The nation's capacity for technological innovation is vulnerable both from domestic weaknesses and from damaging practices of other nations. Measures designed to maintain this vital aspect of the American economy within a healthy international trading system will include both domestic actions and international negotiations.
- Effective actions require a sound understanding of the nature of innovative capacity and of the innovation process through which it is primarily manifest. Innovative capacity is the capability, widely diffused throughout the economy, to produce continuously forefront technological resources, and to use those resources for the national benefit. The innovation process includes not only basic research and development but also production, marketing, and distribution in domestic and foreign markets. Each part of the process must be sound for success.
- Some of the elements that support our nation's innovative capabilities include a strong national research base, technically educated manpower and a technically literate population, capable and farsighted industrial managers, a financial base that provides capital to both new and established firms, and sizable markets. Essential, too, are a national understanding of and attention to advanced technology as a vital contributor to the national welfare.
- The U.S. government has in effect a range of

policies and practices including tax policies, patent laws, regulation and deregulation, antitrust measures, export/import bank loans, government procurement, and others that, although designed to serve other national objectives, also affect the U.S. technological enterprise and international trade position. These policies and practices and the other domestic and international elements affecting U.S. technology and trade must be well understood by senior policymakers. If viewed in ensemble, existing government instruments may become powerful means to support U.S. technology and trade interests.

- Responsibility for improving U.S. performance in advanced technology and trade rests to a large degree with the individual firm and its management. Successful managers increasingly will have to be cognizant of frontier technologies as they build businesses and compete in an international world.
- Our major industrialized allies--most notably Japan and France--have designed comprehensive national policies to help ensure successful technology and trade development in major sectors. Thus, individual U.S. firms often find themselves competing internationally, not with firms acting alone, but with countries or with consortia of firms with country backing.
- There is considerable dispute among industrialized allies regarding which practices are acceptable and which are not. Efforts to evaluate practices are protracted and difficult, but essential.

RECOMMENDATIONS

Accordingly, the panel recommends the following:

- Advanced technology development and trade must be considered as among the highest priorities of the nation. These vital interests must be well understood domestically and conveyed to our trading partners. The United States must initiate a two-part strategy: to maintain the nation's capacity for technological innovation and to foster an open healthy international trading system.
- The federal government should initiate a biennial, cabinet-level review that comprehensively assesses U.S. trade competitiveness and the health of the nation's innovative capacity in both relative and absolute terms. This review should consider the nation's overall performance: the private sector activities and the totality of government actions on technology and trade, as well as the effects of other governments' practices. These assessments would consider the strength of key technological

sectors across all stages of the innovation process--research, development, manufacture, and distribution. In addition, assessments would evaluate broad elements as they affect innovation, such as the macroeconomic environment, regulatory policy, patent policy, and antitrust policy. Careful attention would be given to maintaining the health and effectiveness of both university- and industry-based research, education, and training. The cabinet-level review should be supported by a continuing mechanism that would draw on expertise both from within the government and from outside.

- Managers of private firms must be cognizant of technological trends as they make renewed efforts to build businesses and compete in an international context. Managers should consider new institutional arrangements--the growing, mutually supportive, industry-university research relationships, cooperative research ventures among groups of firms, or consortia to seek information and ideas systematically from abroad.
- Internationally, the United States should negotiate in existing forums to encourage a healthy mutual trading system. This should include continued efforts to evaluate national trade practices and to agree on criteria for acceptability. An objective must be to encourage open markets and healthy competition.
- Countries, including the United States, throughout negotiations should be prepared to alter fundamental policies so that each country may maintain advanced technology capacities fundamental to its individual welfare.
- The United States should review the content and application of its trade laws to ensure that U.S. industries can obtain timely and meaningful trade and/or other relief in the U.S. market when imports from particular countries, based on unreasonable or excessive foreign industrial policies, threaten them.
- If key technology industries essential to national economic welfare and military security are considered endangered by the actions of another country, even with all necessary domestic efforts to strengthen these sectors, then the United States should negotiate with the other country requesting immediate relief. Negotiations should take place first in existing forums, explaining our country's vital interest in preserving advanced technology capacity. If such mechanisms prove ineffective or too slow to prevent damage to essential U.S. capabilities, then the United States should negotiate directly with the country in question. If those bilateral negotiations fail or if the threat of damage is imminent, the United States should take immediate unilateral actions as a step of last resort.

The CHAIRMAN. Thank you, Mr. Steiner.

Mr. PRESS. Mr. Chairman, I would like now to call on Robert Solow.

STATEMENT OF ROBERT M. SOLOW, INSTITUTE PROFESSOR, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Mr. SOLOW. Thank you, Mr. Chairman. The logic of this presentation is that Mr. Steiner, having described the nature of the national capacity for technological innovation and the nature of the innovative process, that I should present the panel's views on why it is essential for the United States to maintain a strong national capacity for technological innovation; that is, why it should be a special object of national concern.

On another occasion Dr. Press stated the view that advanced technology ought to be given a national priority equal to that that we already give defense, the national defense. That is so because both the economic well-being and the military security of the country are in large measure based on the national capacity to generate and use advanced technology.

Technological innovation is an important source, maybe the most important source, of increased productivity in services, manufacturing, and agriculture generally.

Many people who are more knowledgeable than I about recent technological developments think that there is now the potential for a new economic surge fueled by advanced technology—a dramatic increase in the productivity of workers utilizing new information processing technologies, new materials, and new manufacturing technologies.

Frontier technologies of this kind already pervade many sectors of the American economy, and in some sectors where they do not it is possible that they should.

Productivity in mature industries might be improved by the application of advanced technology throughout the manufacturing and distribution processes. Microelectronics, computer-aided design and computer-aided manufacturing, use of robots, advanced computer capabilities are changing business and industry throughout the country, and there may be other technological frontiers emerging from chemistry and biology.

Up until now we, the United States, continue to have a positive trade balance in technology-intensive products and services. These exports contribute not only to domestic employment but also to the more general health of the country's economy. In 1980, advanced technology products showed a positive trade balance for the United States of some $31 billion, compared to a deficit of more than $50 billion for all other manufactured goods.

Around the world the United States still has the highest market share of all industrialized countries' exports of high technology products. Our market share has declined, naturally, in the last 20 years from about 30 percent of all high technology exports in 1960 to something like 24 or 25 percent in 1980. I describe this flow as natural because our industrialized allies have grown stronger economically and technologically, and we wouldn't want it to be otherwise. In absolute terms, however, the U.S.-trade balance in high

technology products has increased over eightfold between 1962 and 1980. So in looking after the health of this sector we are playing to our national strength.

The national defense also relies on our innovative capacity and in large measure on the strength of our civilian industries. A major fraction of defense hardware is procured from technology-intensive companies. Advanced weapons employ frontier electronics gear, and in addition the verification methods fundamental to arms control agreements also rely on advanced technology.

The interrelationships between the U.S. commercial and military advanced technology systems are anything but simple but it is clear that military systems rely on a strong civilian industrial base, and that commercial efforts in the United States benefit from defense and space research and development expenditures and procurement.

The panel came to the conclusion that for the health of our economy and our military security we have to maintain strong domestic capabilities in advanced technology. If the United States were to lose its capacity to innovate in important technological areas, it might still acquire advanced technology products from abroad. Our current rivals in advanced technology did that for a very long time, and we were the source.

The innovating country has the best access to new technologies and the best opportunities to use them. The high speed change in some major technological areas requires instant knowledge of technological innovation in progress and immediate access to new technologies. Without that knowledge and access, our capacity to plan for new products would lag those of some other innovating country. The effects of that sort of lag would be felt throughout the U.S. economy, affecting not only the advanced technology industries themselves but also others that require the products of advanced technology industries for their own success. If we lose capacity in this area we will find it very hard to regain it in the modern world.

[The prepared statement of Robert M. Solow follows:]

STATEMENT OF ROBERT M. SOLOW, INSTITUTE PROFESSOR, DEPARTMENT OF ECONOMICS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Mr. Chairman, I am pleased to follow my colleague, Mr. Steiner's, excellent presentation on the nature of the national capacity for technological innovation and the nature of the innovative process. I would like to present the panel's views on why it is essential for the United States to maintain a strong national capacity for technological innovation.

Dr. Press has stated that advanced technology must be given national priority equal to that that we afford defense. This is so because both the economic well-being and military security of the United States are, in large measure, based on the national capacity to generate and use advanced technology. Technological innovation is an important source, maybe the most important source, of increased productivity in services, manufacturing, and agriculture. Many people more knowledgeable than I think that we now have the potential for a new economic surge, fuelled by advanced technology--a dramatic increase in the productivity of workers utilizing new information processing technologies, new materials, and new manufacturing technologies. Frontier technologies pervade many sectors of the American economy, and in some where they do not, it is possible that they should. Productivity in mature industries might be improved by the application of advanced technology throughout the manufacturing and distribution processes. Microelectronics, computer-aided design and computer-aided manufacturing, robotics, and advanced computer capabilities are changing business and industry throughout the country, and there may be other technological frontiers emerging from chemistry and biology.

So far as we continue to have a positive trade balance in technology-intensive products and services. These exports contribute not only to employment, but also to the general health of the nation's economy. In 1980, advanced technology products showed a positive trade balance of $31 billion, compared to a deficit of more than $50 billion for all other manufactured goods.

The United States currently holds the highest market share of the industrialized countries' exports of high technology products. Our market share naturally has declined in the last 20 years as our industrialized allies have grown stronger economically and technologically. In absolute terms, however, the U.S. trade balance of high technology products have increased over eightfold from 1962 to 1980. In caring for the health of this sector, we are playing to our strength.

Our national defense relies on our innovative capacity and, in large measure, on the strength of our civilian industries. A major fraction of our defense hardware is procured from technology-intensive companies. Advanced weapons employ frontier electronics gear, and verification methods fundamental to arms control agreements rely on advanced technology. The interrelationships between the U.S. commercial and military advanced technology systems are complex, but it is clear that military systems rely on a strong civilian industrial base, and that commercial efforts benefit from defense and space research and development expenditures and procurement.

The panel has concluded that, for the health of our economy and our military security, we must maintain strong domestic capabilities in advanced technology. Were the United States to lose its capacity to innovate in important technological areas, it might still acquire advanced technology products from abroad. The innovating country, however, has the best access to new technologies, thus the best opportunities to use them. The high speed of change in some major technological areas requires knowledge of technological innovation in progress and immediate access to new technologies. Without that knowledge and access, our capacity to plan for new products would lag those of the innovating country. The effects of such a lag could be felt throughout the U.S. economy, affecting not only advanced technology industries, but also others that require the products of these industries for their own success. If we lose capacity in this area, we will find it very hard to regain it.

Mr. Chairman, this completes my prepared statement.

Mr. Chairman, that completes my statement. Thank you.
The CHAIRMAN. Thank you, Mr. Solow.
Mr. PRESS. The next speaker is Robert Charpie.

STATEMENT OF ROBERT A. CHARPIE, PRESIDENT, CABOT CORP.

Mr. CHARPIE. Mr. Chairman, I am pleased to continue my colleagues' discussion of international competition and advanced technology by presenting the panel's evaluation of present and past U.S. policy and what may be our competitive performance in the years ahead.

In the United States the primary institutional arrangements that exist, aimed at fostering advanced technology, operate for the most part in the private sector. The United States has no national plan or even loose coordinating mechanisms linking the efforts of these private entities to Federal Government actions.

The Government's primary role in fostering the Nation's innovative capacity, as Bob Solow has emphasized, has been primarily in education and the support of basic research. We have at hand, however, a range of instruments within government that we may use to support our country's advanced technology. It is important to recognize that many of these instruments were originally designed with othe primary purposes in mind.

The panel strongly suggests that in the process of policymaking and in the allocation of resources that the country's advanced technology capacity and international competitive strength must be highly valued and prized among other national objectives.

Let me be specific now. We have in force a range of policies and practices which affect our success in the advanced technologies—tax policies, patent laws, regulation and deregulation, antitrust measures, Ex-Im Bank loans, Government procurement, and on and on and on.

The Nation's capacity to perform well in advanced technology and trade is also affected sharply by decisions that are made by the range of regulatory agencies—FDA, Environmental Protection Agency, and so on.

We believe it is essential when the time comes for the executive and congressional policymakers to review matters that they do so more critically, that they do so on schedule, periodically, and that they look at each of the elements which affects the Nation's innovative capacity.

Our governmental policies are uncoordinated and incoherent with regard to supporting advanced technology. If our country is going to continue the innovative successes we have had throughout our history, we must establish a climate more conducive to the fostering of entrepreneurial risk-taking. Such a climate can be importantly affected by government policies which lessen uncertainty and help create an environment in which the innovative processes can fourish, particularly in the advanced technology areas on which we focus.

We recognize that our competitive performance among nations in the years ahead will be primarily determined by our domestic actions, particularly the actions of each individual firm engaged in the competition.

Successful companies will be those whose managers have long-range views of how technology affects the growth of their business, and have it right. They will learn to respond to the international climate when planning for research, development, manufacturing, and marketing, and they will create the new institutional arrangements required to foster their technological growth.

The panel believes that our country's competitive performance is now and will continue to be importantly affected by the trading practices of other countries.

U.S. companies as individual firms compete within a mixed international trading system in which they find themselves competing often with a nationally-supported entire industry. It can be, in fact, a competition between company and industry, or in some cases between company and country.

There is surely a dispute among the industrialized nations regarding what trade practices are acceptable and what practices are unacceptable. Actions that are consistent with one nation's traditions and attitudes may be inimicable to the others, particularly to ours.

Problems are exacerbated worldwide by the conditions we have experienced of slow economic growth or recession in the last few years, which has resulted in excess capacity and lingering inflation.

We believe it is extremely important that the United States continue to negotiate in international forums to secure the openness of world markets. Nowhere is our national welfare more interwoven with that of our allies than in the fields of science cooperation and high technology trade, for there is the heart of national security and economic growth.

The costs and risks of protectionist policies and market fragmentation are real, probably greater than in almost any other economic field except energy.

Paradoxically, international coordination of trade practices is more backward in advanced technology than in any other fields at a time when every nation and region within nations is looking more and more to success in advanced technology as a primary source of economic salvation.

The panel is well aware that attempts to come to an agreement on which practices are acceptable and which are not have been only moderately successful. But we urge that such attempts continue.

Negotiations should consider the consequences of actions and place value on maintaining open markets; for, as we have stressed, open markets will reward innovators and thus increase the pace of innovation and the flow of advanced technology benefits nationally and globally.

We do believe, however, the United States must inform, and inform convincingly, our competitors who are our friends that we will not be denied success in advanced technology. This area is too important to our national security, to our economic success, to our self-interest. We cannot afford to take second place.

The CHAIRMAN. Thank you.

[Mr. Charpie's prepared statement follows:]

STATEMENT BY ROBERT A. CHARPIE, PRESIDENT CABOT CORP.

Mr. Chairman, I am pleased to continue my colleagues' discussion of international competition and advanced technology. I will present the panel's evaluation of present and past U.S. policy, and what may be our competitive performance in the years ahead.

In the United States, primary institutional arrangements to foster advanced technology operate, for the most part, in the private sector--in small innovative firms, national and multinational companies, the banking and financial communities, and the great research universities. The United States has had no national plan or even loose coordinating mechanisms linking the efforts of these private entities to federal government actions.

The government's primary role in fostering the nation's innovative capacity has been in education and support of basic research. We have at hand, however, a range of instruments in the government that we may use to support our country's advanced technology. These are instruments that are compatible with our culture and style and that may be used to strengthen our capacity for technological innovation as well as our international trade competitiveness.

It is important to acknowledge that many of these instruments have been designed to support other national objectives. The panel strongly suggests, however, that, in the process of policy making and in the allocation of the sources that the country's technological capacity and international competitive strength must be highly valued among other national objectives.

Let me be more specific. The United States has in force a range of policies and practices--tax policies, patent laws, regulation and deregulation, antitrust measures, export-import bank loans, government procurement, and many others. Beyond these are a range of actions taken by various governmental agencies for a variety of purposes which affect the innovation process--in some instances helping it, and in other instances hindering it.

The nation's capacity to perform well in advanced technology and trade is, in fact, affected by decisions that are made independently by the Food and Drug Administration, and Environmental Protection Agency, the antitrust division of the Department of Justice, the Departments of Commerce, State, Agriculture, and Defense, the national security system, the special trade representatives, the President's Science Advisor, the National Aeronautics and Space Administration, the National Science Foundation, and the National Institutes of Health. Yet, as we pointed out in our report, the heads of these Executive Branch entities rarely, if ever, join together to consider the totality of their separate actions on the nation's advanced technology capabilities and international competitiveness--either what it is or what it should be.

We believe that if the United States is to maintain its innovative vitality over time, it is essential that Executive and Congressional policy makers review periodically all the elements which affect the

nation's innovative capacity. Our governmental policies are uncoordinated and incoherent with regard to supporting advanced technology. If the country is going to continue the innovative successes we have had throughout our history, the government must establish a climate that fosters entrepreneurial risk-taking. Such a climate is determined, in large measure, by stable, informed government policies which lessen uncertainty and thus create an environment in which innovative firms may flourish.

Performance in the years ahead will be primarily determined by our domestic action. Not only the kind of government coordination and focus which I have described, but also the actions of each individual firm. Successful companies will be those whose managers have long-range views of how technology affects the growth of their business. They will respond to the international climate when planning for research, development, manufacturing, and marketing, and they will create new institutional arrangements to foster technological growth.

The panel believes that our country's competitive performance will be affected to a lesser, but not insigificant extent, by the trading practices of other countries. U.S. firms face a mixed international trading system in which they are operating independently as private bodies, yet frequently compete for U.S. domestic markets or abroad with foreign firms that have the backing of their governments. Thus, this mixed international trading system often effectively places an

American company in competition against a country. There is considerable dispute among the industrialized nations regarding what trade practices are acceptable and what practices are unacceptable. Actions that are consistent with one nation's traditions and attitudes may be inimicable to another. Problems are exaserbated worldwide by the conditions we have experienced in the last several years of slow growth, excess capacity, and lingering inflation.

It is extremely important that the United States continue to negotiate in international forums to secure the openness of world markets. Nowhere is our national welfare more interwoven with that of our allies than in the fields of science cooperation and high technology trade. The costs and risks of protectionist policies and market fragmentation are probably greater than in almost any other economic field except energy. Paradoxically, the international coordination of trade practices is more backward in advanced technology than in many other fields at a time when both nations and regions within nations are looking more and more to advanced technology as a primary source of economic salvation.

We are well aware that attempts to come to an agreement on which practices are acceptable and which are not have been only moderately successful, but such attempts should continue. Negotiations should consider the consequences of actions and place value on maintaining open markets for, as I have stressed, they will reward innovators and thus increase the pace of innovation and the flow of technology benefits globally.

Mr. Chairman, this completes my prepared statement.

Mr. PRESS. For the final presentation I would like to call on our chairman, Howard Johnson, to give the panel's recommendations.

STATEMENT OF HOWARD W. JOHNSON, CHAIRMAN, CORPORATION OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, AND CHAIRMAN OF THE PANEL ON ADVANCED TECHNOLOGY COMPETITION AND THE INDUSTRIALIZED ALLIES OF THE NATIONAL RESEARCH COUNCIL

Mr. JOHNSON. Thank you, Mr. Press.

Mr. Chairman, members of the committee, you have heard from 3 of the 22 members of our panel—a panel that supported unanimously the report which you have been kind enough to receive today.

I would like now to summarize our recommendations, as my colleagues have described some high spots.

We believe that the United States must elevate in the scheme of national priorities efforts to strengthen the nation's capacity for technological innovations, including a vigorous international trading position.

Our country's advanced technology enterprise has been, we believe, incompletely understood in the past and thus undervalued, and now must be placed as one of the nation's most valued objectives. Our performance will be determined by our own actions, governmental and private. We also must negotiate internationally for an open international trading system.

Accordingly, the panel recommends:

Advanced technology development and trade must be considered as among the highest priorities of the Nation. These vital interests must be well understood domestically and conveyed to our trading partners. The United States must initiate a two-part strategy: to maintain the Nation's capacity for technological innovation, and to foster an open, healthy international trading system.

The Federal Government should initiate a biennial cabinet-level review that comprehensively assesses U.S. trade competitiveness and the health of the nation's innovative capacity in both relative and absolute terms. This review should consider the nation's overall performance: the private sector activities and the totality of government actions on technology and trade as well as the effects of other governments' practices. These assessments would consider the strength of key technological sectors across all stages of the innovation process—research, development, manufacture, and distribution.

In addition, assessments would evaluate broad elements as they affect innovation, such as the macroeconomic environment, regulatory policy, patent policy, and antitrust policy. Careful attention would be given to maintaining the health and effectiveness of both university and industry-based research, education, and training.

The cabinet-level review should be supported by a continuing mechanism that would draw on expertise both from within the government and from outside. The primary purpose of the assessment is not so much to issue a report as to serve as a basis for congressional hearings and coordinated policy proposals from the executive branch.

Next, members of private firms must be cognizant of technological trends as they make renewed efforts to build businesses and compete in an international context.

Managers should consider new institutional arrangements—the growing mutually supportive industry-university research relationships, cooperative research ventures among groups of firms, or consortia to seek information and ideas systematically from abroad.

Internationally the United States should negotiate in existing forums to encourage a healthy mutual trading system. This should include continued efforts to evaluate national trade practices and to agree on criteria for acceptability. An objective must be to encourage open markets and healthy competition.

Countries including the United States throughout negotiations should be prepared to alter fundamental policies so that each country may maintain advanced technology capacities fundamental to its own individual welfare.

The United States should review the content and application of its trade laws to insure that U.S. industries can obtain timely and meaningful trade and/or other relief in the U.S. market when imports from particular countries based on unreasonable or excessive foreign industrial policies threaten them.

If key technology industries essential to the national economic welfare and military security are considered endangered by the actions of another country, even with all necessary domestic efforts to strengthen these sectors, then the United States should negotiate with other countries requesting immediate relief.

Negotiations should first take place in existing forums, explaining our country's vital interest in preserving advanced technology capacity. But if such mechanisms prove ineffective or too slow to prevent damage to essential U.S. capabilities, then the United States should negotiate directly with that country in question. And if those bilateral negotiations fail or if the threat of damage is imminent, the United States should take immediate unilateral actions as a step of last resort.

The primary thrust of this recommendation is not to protect technologically inferior, poor quality, or overly costly U.S. products as much as to seek redress for patently unfair and damaging practices of other countries.

We conclude, Mr. Chairman, that the advanced technology enterprise in this country has the potential to contribute significantly to economic and social welfare, both in the United States and throughout the world. It is essential that the industrialized allies work individually and cooperatively toward advanced technology development and a healthy free trade system for their mutual benefit.

[The prepared statement of Howard W. Johnson follows:]

STATEMENT OF HOWARD W. JOHNSON

Mr. Chairman, I would like now to summarize our recommendations. As my colleagues have described, the United States must elevate, in the scheme of national priorities, efforts to strengthen the nation's capacity for technological innovation, including a vigorous international trading position. Our country's advanced technology enterprise has been undervalued in the past and now must be placed as one of the nation's most valued objectives. Our performance will be determined primarily by our own actions--governmental and private. We also must negotiate internationally for an open international trading system.

Accordingly the panel recommends:

- Advanced technology development and trade must be considered as among the highest priorities of the nation. These vital interests must be well understood domestically and conveyed to our trading partners. The United States must initiate a two-part strategy: to maintain the nation's capacity for technological innovation and to foster an open healthy international trading system.

- The federal government should initiate a biennial, cabinet-level review that comprehensively assesses U.S. trade competitiveness and the health of the nation's innovative capacity in both relative and absolute terms. This review should consider the nation's overall performance: the private sector activities and the totality of government actions on technology and trade, as well as the effects of other governments' practices. These assessments would consider the strength of key technological sectors across all stages of the innovation process--research, development, manufacture, and distribution. In addition, assessments would evaluate broad elements as they affect innovation, such as the macroeconomic environment, regulatory policy, patent policy, and antitrust policy. Careful attention would be given to maintaining the health and effectiveness of both university and industry based research, education, and training. The cabinet-level

review should be supported by a continuing mechanism that would draw on expertise both from within the government and from outside. The primary purpose of the assessment is not so much to issue a report, as to serve as a basis for Congressional hearings and coordinated policy proposals from the Executive Branch.

- Managers of private firms must be cognizant of technological trends as they make renewed efforts to build businesses and compete in an international context. Managers should consider new institutional arrangements--the growing, mutually supportive, industry-university research relationships, cooperative research ventures among groups of firms, or consortia to seek information and ideas systematically from abroad.

- Internationally, the United States should negotiate in existing forums to encourage a healthy mutual trading system. This should include continued efforts to evaluate national trade practices and to agree on criteria for acceptability. An objective must be to encourage open markets and healthy competition.

- Countries, including the United States, throughout negotiations should be prepared to alter fundamental policies so that each country may maintain advanced technology capacities fundamental to its individual welfare.

- The United States should review the content and application of its trade laws to ensure that U.S. industries can obtain timely and meaningful trade and/or other relief in the U.S. market when imports from particular countries, based on unreasonable or excessive foreign industrial policies, threaten them.

• If key technology industries essential to national economic welfare and military security are considered endangered by the actions of another country, even with all necessary domestic efforts to strengthen these sectors, then the United States should negotiate with the other country requesting immediate relief. Negotiations should take place first in existing forums, explaining our country's vital interest in preserving advanced technology capacity. If such mechanisms prove ineffective or too slow to prevent damage to essential U.S. capabilities, then the United States should negotiate directly with the country in question. If those bilateral negotiations fail or if the threat of damage is imminent, the United States should take immediate unilateral actions as a step of last resort. The primary thrust of this recommendation is not to protect technologically inferior, poor quality, or overly costly U.S. products as much as to seek redress for patently unfair, and damaging practices of other countries.

We conclude that the advanced technology enterprise has the potential to contribute significantly to economic and social welfare, both in the United States and throughout the world. It is essential that the industrialized allies work individually and cooperatively toward advanced technology development and a healthy free trade system for their mutual benefit.

Mr. Chairman, this completes my prepared statement.

The CHAIRMAN. Senator Bentsen, do you have questions of the panel?

Senator BENTSEN. Yes, I do. Thank you very much, Mr. Chairman.

First I want to thank you for all the effort and contribution you have made on this most important subject. I am pleased to see a number of old friends on the panel.

You know, as I grasped the consensus of the report I couldn't help but think of a comment that I had made at Harvard 3 years ago at a seminar there, and I just happen to have that quote with me. It says, "This country must either strengthen the ability to meet the terms of trade worldwide or accept the consequences of failure to compete: chronic, massive balance-of-trade deficits, the diminished ability to pay for imports, and eventually the status of a second-class economic power."

I was reading about it, and I was listening to you, Dr. Johnson, talking about starting out multilateral or GATT, then bilateral, and if necessary unilateral. I couldn't agree more.

Most of us are captives of an ideology or some of our past rhetoric when we talk about free trade. We don't have free trade today, as I see it.

I've seen time and time again our going to these negotiations, and we end up with GATT just being a forum for confusion. And we see this country still operating under the Marquis of Queensbury Rules when we are up against trading partners who are black belt karate experts, and they have been able to work us over.

I do believe ultimately in free trade, but I don't think we get to free trade unless we take some unilateral actions.

We see a cosmetic reply when we go to these conferences for negotiation. We are not really taken seriously. They believe that the negotiators who they have to put up with from the United States will be another set at the next meeting, and all they have to do is wait them out. They continue to take such actions that will protect their own markets and make inroads into our markets.

So I do think it's time that we take some of that unilateral action.

I saw last spring when we were negotiating trade agreements, or trying to, that the GATT enforcement mechanism just fell flat on its face. The GATT members refused to go along with just a very modest proposal on the part of the U.S. Government that we eliminate the one-country veto. They wouldn't even do that.

And then when we took our wheat flour case to the GATT, which we thought was a very meritorious one, a GATT panel ended up by saying, "Well, we don't know what GATT means in that regard."

I wrote up a proposal that we do an unbinding of duties and do that in the area of high technology. That wouldn't cost us much at this point. The cost of the unbinding would be low, and all of that is provided for under the rules of the GATT. It would give us some protection, enable us to build up a competitive lead that's worth some consideration.

Well, I learned only yesterday that Japan may be contemplating raising duties on certain components of lasers so that they may develop the high technology that will compete with this very important sector of our economy.

This is a high-stakes game that we are playing, and I think the future prosperity and world leadership of this country is at stake, and that we have to take some of those kinds of actions.

Now, I have introduced legislation that will encourage the retention and the recruitment of teachers in math and the sciences. I am about to introduce a bill comparable to what I introduced 2 years ago that will encourage the contribution of equipment to universities and colleges, vocational schools, and in turn would encourage business to do more research in the universities.

Your point that the major role played by universities in basic research is risky but necessary to the maintenance of the internationally competitive industrial base. The universities account for one-half of all basic research, and in light of that do you think it would be appropriate that we add to the incentives in the tax system to encourage more basic research with universities? Would any of you care to comment?

Dr. JOHNSON. I would be glad to comment, Senator. Your statement about the vital importance of basic research for our country is a sound and solid statement, and we mention in this report—we state strongly in this report that a further consistent effective support of basic research in this country is not only important but is vital to maintain our advanced technology effort.

I think I would like to add to that, if I may, in one sentence. One aspect of this report which I hope will receive attention is a review of the anatomy, however, of advanced technology.

Vital as basic research is, it's part of a several-part structure in producing effective advanced technology that reaches right into industry in terms of process development, in terms of manufacturing, and in terms of marketing, and in terms of the creative finance that makes it possible.

Just as you said in your earlier comment, we couldn't agree more, I believe, as a panel, that each of those parts must be strengthened, and certainly basic research is the fundamental one.

Senator BENTSEN. Well, I mentioned Japan, and it comes to mind quite often in these discussions. But I recall the committee did some work in improving research among various companies, and allowed that and encouraged that. I understand that some of the larger companies are beginning to move away from that in Japan and do it on their own.

Do you think we should give some consideration in this country on our antitrust rules for a possible pooling of research? Would that be helpful, or do our concerns on antitrust override it?

Dr. JOHNSON. We have encouraged precisely that in the report, that the antitrust laws be reviewed in the perspective of competition which is now international. Many of our procedures in the antitrust area develop in relationship wholly to a domestic market. Now our markets are international, and we have to look at them in that light.

We also discovered in repeated testimony from corporate people that there is not a clear perception of exactly what the antitrust regulations can be expected to do. And they tend to dampen.

Senator BENTSEN. Well, I am looking at some of the deals that are being made now between our companies in this country and, say, Japanese companies—I see it in robotics, for example.

Dr. Solow, you were talking about the economies of scale, and to achieve that, if you are going to build robots you have to build a lot of them, as I understand it, to finally get your learning curve and begin to get a real return.

So we are seeing companies here reach across and make a deal over there with a company there to try to develop their economics of scale and the transfer of technology, because they just can't make the deal here with another company, because of their concern about antitrust—at least it seems to me that that's their concern—and that we have to be able to make those kinds of consortium agreements or agreements with other companies in this country so we can develop the economies of scale to take on what is a State-owned company, often, in the European Common Market.

Dr. JOHNSON. We would agree with that.

Senator BENTSEN. And then there is the whole thing that Dr. Solow talked about, our being the innovator, the originator of innovative technology, and the necessity for that remaining, and the fact that other countries have been able to get such technology from us for so many years and now they are the originators.

I think even there it is more important that we remain the originator because the information gets dispersed and diffused and becomes highly liquid in this country, and we don't have the means of limiting the distribution of that knowledge as some of these other countries do. So that merely emphasizes the fact that we must remain an originator of such technology, does it not?

Mr. SOLOW. I think that's certainly right. We have been a source for the whole world of technological innovation. And for various reasons—some having to do with public policies elsewhere, some having to do with the attitudes of American corporations—we have not absorbed technology from abroad. In many cases they would rather we wouldn't. But you are quite right, Senator Bentsen, that reinforces the importance of our staying at the frontier ourselves. We are never going to be a nation of imitators.

Senator BENTSEN. Thank you very much, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Bentsen.

I would say to the members of the committee, the only time constraint is that at 11 we need to vacate this room. I understand that you wanted some time for a press conference following your presentation.

I would like to have my statement introducing the panel be made a part of the record before comments from panel members.

[Senator Dole's statement follows:]

STATEMENT OF SENATOR DOLE

I welcome our very distinguished witnesses who today will publicly release their report entitled "International Competition in Advanced Technology: Decisions for America." I called this hearing, despite our busy schedule, because of the importance of this subject and the fact that the report raises a number of questions with respect to several areas of this committee's jurisdiction. Although we will hear only from representatives of the panel today, I intend to solicit for the record the comments of any interested person and the administration. I hope the subcommittee chairmen and members will continue to pursue their interests in the subject of competitiveness.

This committee has intensively followed competitiveness issues in recent years. For example, Senators Long, Ribicoff, and others three years ago led the committee in cosponsoring a conference on U.S. competitiveness. Senator Chafee held a hear-

ing along these lines in January. Senator Bentsen, I understand, has introduced a bill to foster science education, and took the lead in including high technology trade matters in the reciprocity bill. Certainly part of Senator Danforth's purpose in sponsoring the latter is to restore U.S. trade competitiveness.

Of course, a particularly important initiative by the committee was the economic recovery Tax Act of 1981. As a whole, the purpose of that act was to upgrade the nation's industrial base, stimulate productivity and innovation, and provide a higher savings pool from which investment could draw. Among the most important provisions supporting these goals were ones creating the accelerated cost recovery system, tax credits to increase research spending; charitable contributions of scientific property: and improvements in the foreign earned income exclusion. I am pleased to see that the panel today supports the approach we took in that law.

The panelists today will, I hope, suggest what further work lies before us. The preservation of a sound base in advanced technology research, development and sales is essential to the national economic and military security. Further, that base cannot be limited to certain Hi-Tech products. Advanced technology issues really are not ones of promoting certain manufactured products, but on promoting a climate in which innovation will thrive. The innovative process is as essential to agriculture as it is to steelmaking and fiber optics manufacture. Our well-being rests on the ability to foster innovation in all fields.

Besides the fiscal incentives the committee has already considered, our trade policy must be intensively reviewed from the perspective of fostering our advanced technology base. For example, I am interested in how our Government makes decisions regarding the impact on the national security of high levels of imports involving critical technologies. I understand that section 232 of the 1962 Trade Expansion Act, which authorizes controls of imports threatening the national security, has been invoked only once, with regard to oil imports. Perhaps we should review the standards by which such decisions are made.

In sum, the council's report is a timely, provocative challenge to the way we might approach U.S. policymaking a world increasingly integrated economically. I congratulate the panel members on their efforts, and look forward to hearing their views.

The CHAIRMAN. I have just a couple of questions, then I will be happy to yield to Senator Moynihan and Senator Mitchell.

Mr. Steiner, are we successfully utilizing some of existing tools, such as the Eximbank to foster markets for advanced technology products?

Mr. STEINER. Senator Dole, our consensus statement is on page 43 of the report. It says, firstly, we must seek a world where that sort of action is not necessary. And I agree with that.

Second, it says that in a world where such action is necessary, then we must use our existing tools such as the Eximbank, and we must use them as Mr. Charpie said, in a manner that is perceived by the market in the foreign world to be a reliable supplier—in other words, consistency in application—if we use those tools.

The CHAIRMAN. Thank you, sir.

But I understand that the Japanese have captured nearly two-thirds of the U.S. market for semiconductors and are ahead of us in the next-generation chip. Is this one of the areas that we should take some immediate action? Should we consider temporary restrictions to allow our semiconductor makers to adjust to this competition? I read your recommendations, but they are not really specific.

Dr. JOHNSON. I would ask Bob Charpie to comment.

Mr. CHARPIE. Senator, we think that's a terribly important area, and one that is in such a state of confusion and change and allegation that it is one that deserves immediate review.

What we would suggest is that the panel has not delved deeply enough in that specific area to say, "We know this is what ought to

be done." But we have heard enough testimony and have had enough discussions on the area to know that it's an area that must get top priority review with consideration for action early rather than late.

The CHAIRMAN. Now, I wonder—I think you mentioned unilateral action. Do you have anything in mind?

Mr. CHARPIE. Well, we might just take an example drawn from the immediately previous discussion of the fact that from time to time American companies will meet competition from overseas in which they are selling products that are either equivalent or perhaps on occasion not as good as ours, but through funds made available in the form of loan subsidies or preferred-interest loans from governments, our companies find that they are unable to compete successfully. And there is nothing they can do about that, because they are dealing with a coalition which is company plus government, or a company partially or wholly owned by a government.

In that case, while we would prefer not to get involved in those kinds of actions, we would suggest that it is appropriate to meet head-on, in terms of trade, the circumstances of competition we find. If somebody has a 5-percent lower price because of preferred financing and it is deemed important in the interest of the advanced technology posture of the United States to win that contract or that deal in order to stay alert and alive in that business, then we had better meet them head-on at 5 or 5¼ percent, and make them understand that we aren't going to be pushed aside.

In my world, the business world, we would call that meeting competition. That doesn't mean we like to do it; we don't like to cut the price. But, by George, you don't want to lose the sale, either.

The CHAIRMAN. Thank you very much.

Senator Moynihan?

Senator MOYNIHAN. I want to welcome some old friends and colleagues and peers. I had the great honor to serve under Howard Johnson when I was the director of the Joint Center for Urban Studies, and a looser rein never was wielded along the banks of the Charles.

I have just two general comments which I would like to hear response to, if you have any.

First of all—and I hope Dr. Press would be one of the persons who could comment on this—some of this as a science is really part of the culture of a society, is it not? I mean, it is not something you can summon up. You can't say, "Get me $10,000 worth of science," it comes and it goes, like culture, and about the only thing a government can do to encourage it is to forbid it, as in the arts. I mean, you can't be sure when science is going to come your way, can you?

It appears from time to time around the world. One place does very well, and then they miss out on something. The Chinese missed out on wave theory, and nothing else happened for 3,000 years—three millenia.

And you don't know when it is waning or waxing, but when you decide to do something about it you can be pretty sure it's waning. I mean, the first time that a country is in irreversible economic de-

cline, then the Government establishes a committee on productivity. At least that's my observation.

But you made this one point: Here you say, "A country may lead in basic science but lag in the process of making innovative ideas commercially possible. On the other hand, a country may lag in research but draw on research conducted abroad as a basis for creating commercially successful advanced technologies."

That description of a country leading in basic research but lagging in the process of making innovative ideas commercially profitable would almost describe Britain in the last century, wouldn't it?

Dr. JOHNSON. Yes, sir.

Senator MOYNIHAN. And you can see it. I think the National Science Foundation once every couple of years puts out a report on who is producing science around the world. It's a wonderful thing, just library research. They take about 400 journals, just count up who did what and where they live, and then they count the footnotes, and they see not only who is doing the research but the base they are building on. And Britain is No. 1 in about two or three things in the articles, and in cited references about fifteenth. You can just see them falling back and the Japanese coming in.

I suppose it is within the capacity of government to think of ways to help you out of your situation that while you can pick the first-rate things, you can't do anything with them.

The British invented the jet aircraft. It was one of the last big innovations of that kind, but they don't produce any anymore. They can't sell them. Boeing sells them, right?

At the same time, there are several organizations associated with being effective at putting science into commercially applicable forms that also can be unique and not necessarily transferable—another point in the culture.

And they argue that we are all becoming like the Japanese. That suggests that the people who say that don't know much about Japan, isn't that right?

Dr. JOHNSON. They don't know much about outsiders, sir.

Senator MOYNIHAN. But the fact that you have been able to produce this document is something of an achievement that you can agree on this much. And Harvey Brooks back there wouldn't even be in that spot, I think. [Laughter.]

Senator MOYNIHAN. That is our cultural pattern, whereas agreement and not disagreeing consitute a very different pattern over there, is it not?

Dr. JOHNSON. Yes.

Senator MOYNIHAN. I am trying to make a point, that is perhaps too long, but this is central, and it's a function somehow of some laws you passed or didn't pass, and that it is really quickly responsive to something we might do here.

We are in for a much longer and more difficult process than we were talking about, aren't we?

Dr. JOHNSON. Absolutely, Senator Moynihan, and we've sought to say that in this report. We have described the complexity of the process, that advanced technology is not a series of industries; it's a process that is very complex. We must begin to understand it better, we must track it, and we must encourage it. And we have said that in a half a dozen I hope useful ways.

I agree with your statement about having an off-on relationship with scientific research. It is not only impossible, it's even foolish to contemplate. It doesn't relate to the real process of the development of ideas.

Senator MOYNIHAN. What you can hope for a government to do is to provide a certain amount of money, because a certain amount of money is the minimum necessity now if you are going to have some of the equipment bought, and then hope for the best. You can't do more than hope for the best.

Dr. JOHNSON. You can provide an environment in which——

Senator MOYNIHAN. You can be sure what doesn't happen.

Dr. JOHNSON. Yes.

Senator MOYNIHAN. And that's about all.

Thank you very much.

Mr. HUFSTEDLER. Mr. Chairman, in response to the remarks of Senator Moynihan, I simply wanted to assure that it is quite true that we do not know how to be sure everybody is creative, but we do know very well how to stifle any innovation and creativity.

Part of the reasons for the examination of the process, not simply as an event but as a process, is to understand what to make that do, and to remember—I must bring up my major concern in this, on the long range—that we cannot treat whatever ripple there is as an event.

We know, for example, all of us do, that every innovator—with the slightest exceptions—that is going to exist in this country for the first half of the twenty-first century is here right now. To be sure, they are in cribs, they are in elementary school, they are in secondary school, but if we do not provide those youngsters with the kind of opportunities for the nourishment of the mind and the spirit, whatever we do with the Japanese or whoever isn't going to make any difference.

In short, that is a process, too, and it's a process that must be encouraged and nurtured and supported.

Senator MOYNIHAN. Thank you very much, Mr. Chairman.

And thank you all, again. We thank you for this.

The CHAIRMAN. Senator Mitchell?

Senator MITCHELL. Thank you, Mr. Chairman.

I read the conclusions and recommendations of your report, and I note with interest several of the conclusions which I would like to ask questions about.

One of them suggests that the United States review the content and application of its trade laws to assure that U.S. industries can obtain timely and meaningful trade and other relief when imports threaten.

I have introduced legislation to simplify and rationalize and make more readily available to small business such relief, and I wonder if Mr. Johnson or any of you would care to be more specific about what you have in mind regarding this recommendation, which I agree with but which is rather general.

Mr. JOHNSON. Well, I will make a very brief comment, Senator.

The lack of coordination, the lack of a strategy, if you will, in international trade policy is apparent to anybody who begins to get into this.

Our interests in international trade are scattered, the ways in which we develop a national policy are muted, and by this recommendation we have urged a greater coordination, a greater understanding, and a greater awareness of the fact that sometimes the right hand doesn't know what the left hand is doing. And certainly the businessman, operating as he does with great pressures on him, now in the midst of a major recession, has difficult understanding the way in which he enters the trading system, and frequently the process just doesn't work.

We specifically did not review specific items of legislation, but our views here are pretty clear, and our approach was to describe a process that ought to go on.

Senator MITCHELL. Would anybody else care to comment on that?

Mr. STEINER. I might mention that the system, whether it is laws, policies, or execution, must place the American manufacturer in a position where he is recognized as a reliable supplier by the world's markets. That is not true at the present time.

Senator MITCHELL. Well, one of the problems seems to be that we frequently adopt national policies in response to a specific problem. And with respect to the laws affecting trade or trade relief, particularly, they seem to have been designed for industries which are large, basic, and involve a few large companies—the auto industry, the steel industry, aircraft industry, industries of that type—and they do not, rather plainly, have any relevance whatsoever to industries that are identified by a very large number of small producers, none of which individually have the resources or the expertise to obtain the relief that is intended by the law.

So for the overwhelming majority of American companies, trade relief laws might just as well not exist. That's because, of course, not that they were deliberately excluded, but when the laws were written they were designed to meet a specific problem. The problem then spread to others who are not within the original group, and one of the purposes of my legislation is to attempt to take those remedies and make them more readily available to small industries.

For example, the trade laws—and I say this as a lawyer and former judge—really represent more a lawyers' WPA. They are incredible in the amount of litigation that they spawn, and of course lawyers are very good at keeping that going, without contributing anything, it seems to me, to the result or to sound public policy.

I am not suggesting that judicial review ought to be eliminated, but it's far too excessive in the trade laws and there is too much litigation in the whole process.

I hoped that you had addressed it more specifically, but I can understand your reasoning for keeping your recommendations general.

If I might, Mr. Chairman, let me in the moment remaining address one other area.

The immediate preceding recommendations deal with negotiations in existing forms to encourage a healthy mutual trading system, and you apparently suggest a process starting with multilateral, then proceeding to bilateral, then if none of those work then acting unilaterally.

Of course the recent GATT Ministerial Meeting—at that meeting the United States attempted to do just what you have suggested. They did not meet with any success, and my question is: Do you have any specific proposals regarding what unilateral action we might take as it affects the area, the industrial sector, that you addressed in this report, until such time as we can achieve some multilateral agreement on this, and specifically to promote our own domestic industries and protect them from what we at least regard as unfair foreign practices?

Mr. JOHNSON. Senator, let me say a word about that.

We have each said in various ways, and the panel in its report has said clearly, that we believe the open trade system serves this country very well, that the emphasis should be on building the effectiveness of our industry to compete, to keep the open system that has so well served our country since World War II.

It is the second part of the strategy that we recognize that trade practices of other nations have on occasion and will in the future and are now inhibiting or discouraging or penalizing vital parts of our advanced technology.

And there we have talked not about a broad sweep of legislation or about large measures; we are not protectionists in that sense. What we are saying is that those cases deserve close examination and must be dealt with in a timely way. We have deliberately not described a set of steps that should be taken. We have looked at many cases. We believe in each case it would be possible, as Mr. Charpie has indicated, to match or deal with a competitive situation that evened—evened—the competition pressure.

We believe that is the way to do it. We believe that legislation along those lines would help; but we believe that broad efforts at protection would be a mistake.

Senator MITCHELL. Well, you see, Mr. Johnson, I don't think anybody could disagree with what you just said, precisely because it is so general.

I think there is not an industrial or labor leader in this country who would disagree with the idea of free trade as an ideal or an objective. But until we get there, we have to take steps to deal with those circumstances that unfairly prejudice our domestic industries.

And you could take the oldest of our industries and make that statement applicable to them, and industries that are the very opposite of the high tech industries—the shoe industry, which is very large in Maine. You could make that statement. I have made that same statement many times.

But the difficulty comes in this area, particularly, as in many areas, in moving from the general to the specific from devising a legislative policy——

What you have just said makes sense as a policy, but devising specific legislation to implement that policy is extremely difficult. That's when you get into disagreements.

I repeat, I don't mean any criticism of the report, but there is not much in here. And perhaps that's the nature of committees which are broadly based and diverse and require consensus, that in order to achieve consensus you have to move further and further

away from the specific and more and more to the general. And it's pretty hard to disagree with some of these things.

But I thank you all. I see my time is up, twice now.

The CHAIRMAN. I want to save some time. I know there are press here who would like to talk to members of the panel, and at 11, or shortly thereafter we have another event scheduled here.

I again want to thank members of the panel. As Senator Moynihan indicated, I know you are all very busy people in very responsible positions.

Senator MOYNIHAN. Mr. Chairman, could we hope that they won't entirely disband, and that they might keep in touch with one another and with us? Because this is not a 1-year problem; this is a generation problem.

The CHAIRMAN. That is certainly correct. And I would certainly underscore that point.

Thank you very much.

[Whereupon, at 10:37 a.m., the hearing was concluded.]

[By direction of the chairman the following communication was made a part of the hearing record:]

news from the NATIONAL RESEARCH COUNCIL

The National Research Council was organized by the National Academy of Sciences in 1916 in order to provide for a broader participation by American scientists and engineers in the work of the Academy. The Academy was chartered by the U.S. Congress in 1863 as a private organization with a responsibility for examining questions of science and technology at the request of the Federal Government. The National Academy of Engineering was organized in 1964 under the original NAS charter. The National Research Council now serves as the agent of both Academies in the conduct of studies and investigations in the public interest.

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Date: April 13, 1983
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Cabinet-level Policy Development for Advanced Technology Vital;
Domestic & Foreign Policy Actions Needed

TWO-PART STRATEGY NEEDED TO PRESERVE
NATION'S ABILITY TO INNOVATE HIGH-TECH PRODUCTS

FOR RELEASE: 10:30 a.m. EST, Thursday, April 14, 1983

WASHINGTON - Preserving our national capacity to create and use frontier technologies must be "among the nation's highest priorities," a blue-ribbon panel told the Senate Finance Committee today. Stressing that domestic actions hold the key to the nation's performance in advanced technology development and trade in the years ahead, the panel urged the United States to give "immediate attention" to a two-part strategy aimed at strengthening domestic innovative capacity and reducing international trade frictions.

The panel, which included national leaders in technology, industry, labor, education, economics, and foreign affairs, was assembled by the National Research Council in late 1981 to examine international competition in advanced technology. It focused on relations among the major industrialized nations--Canada, the Federal Republic of Germany, France, Japan, the United Kingdom, and the United States.

Because U.S. technology traditionally has been the world benchmark, our advanced technology enterprise has been taken for granted and "has been undervalued in the past national scheme of priorities," the panel explained. Since World War II, however, there has been "a progressive narrowing of American technological leadership" as other countries' technological efforts have gained strength.

(MORE)

Reporters may obtain copies of the panel's report, International Competition in Advanced Technology: Decisions for America, from the Office of Information at the letterhead address. Others may purchase copies for $9.50 each (prepaid) from the National Academy Press, also at the letterhead address.

Now, the panel declared, our nation's capacity for technological innovation must be recognized as a vital national resource in government policymaking. This capacity to introduce new technologies across all industrial and service sectors is the key to improving productivity and introducing new and improved products and services that will be competitive in world markets. Technological innovation is a dynamic process essential not only to the country's economic well-being but also to its military security, the panel noted. Its priority in government decision-making and in corporate planning should reflect this growing significance in national affairs.

Stressing that our national welfare is nowhere as interwoven with that of our allies as in fields of scientific cooperation and high-technology trade, the panel warned that costs of protectionist policies and market fragmentation are probably greater than in almost any other economic field except energy. Paradoxically, said the panel, international trade practices are "more backward in advanced technology than in many other fields at a time when both nations and regions are looking more and more to advanced technology as a primary source of economic salvation."

Cabinet-level Coordination Needed

As a first step, the panel called for a special cabinet-level, policymaking process, including a review of U.S. domestic and foreign policies and trade practices that affect the nation's ability to maintain a competitive edge in world markets by introducing frontier technologies and concepts to manufacturing and distribution of products. In the meantime, current legislative proposals to protect advanced technology industries should be reexamined in light of its findings, the panel said.

The United States does not now attempt to assess the overall impact of its disparate policies that affect international competition, the panel pointed out. In fact, it concluded that the United States has no adequate policymaking process now. As a result, "governmental policies evolve without any broad assessment of how they will affect the strength of U.S. advanced technology capacity and trade."

A host of federal executive agencies, the panel noted, make independent decisions almost daily that affect the nation's ability to innovate and to compete internationally. Yet, the heads of these agencies "rarely if ever have joined together to consider the totality of their separate actions on the nation's advanced technology capabilities and international competitiveness--either what it is or what is should be." The situation is further complicated, the panel noted, because the government needs more policymakers experienced in the technological innovation process.

"If the United States is to maintain its innovative vitality over time," the panel continued, "it is essential that executive and congressional policymakers periodically evaluate both the U.S.'s comparative international trade position and the health of the nation's innovative capacity." The panel recommended a comprehensive evaluation be conducted every two years by a cabinet-level group. The group, which would draw upon expertise from both inside and outside the government, would recommend domestic and trade policies based on its biennial reviews.

A New Role for Industry

Government, however, cannot be expected to act alone because the nation's performance in advanced technology is determined in large part by the efforts of individual firms. Successful international competition, the panel noted, will require a resolution of the "often adversarial relationships of U.S. government and business." "Industry and government," it declared, "have to be prepared to work more cooperatively in order to achieve national goals." Industry managers should also consider, the panel said, new institutional arrangements, such as joint industry-university research relationships, cooperative research ventures among firms, or industry consortia to seek information and ideas systematically from overseas. In addition, they must become willing to make long-term investments to support technological innovations, which ultimately lead not only to new products and processes but also to increased productivity throughout the industrial sector.

Support Free International Trade

Some of the problems American industry faces in advanced technology, the panel pointed out, go beyond the general economic conditions here and abroad. For example, some countries have designed comprehensive national policies to help ensure successful international competition in certain sectors. Consequently, explained the panel, individual U.S. firms often find themselves competing internationally not with single firms, but with countries or consortia of firms with their country's backing. The second prong of U.S. strategy should then be to foster an open international trading system. The cornerstone of U.S. policy, urged the panel, should be free competition in international markets. Innovation, it pointed out, proceeds most rapidly and efficiently when new products have access to the widest possible markets. World markets should be open to entrepreneurs wherever they may be based, said the panel, and actions that distort free market operation should be eliminated.

The panel advised the United States to continue negotiating in international forums, such as those established under the General Agreement on Trade and Tariffs (GATT), when problems arise with patently unfair trade practices of other countries. Only as "a step of last resort"--after following a gradually escalating negotiating strategy and exhausting GATT and other channels--should the United States take unilateral actions against a country whose practices threaten the nation's advanced technology capacity. Moreover, the panel stressed that action should be taken in time to prevent irreversible harm. A basic requirement for negotiations will be that countries, including the United States, be prepared to consider altering traditional practices that seriously distort the market.

One of the first targets for negotiation should be "some of the more debatable tactics that cause clear danger...(as) protectionist, trade distorting, or harmful to world welfare." This group includes systematic predatory pricing and other actions which make up a strategy of targeting important industrial sectors by one nation to the detriment of another, domestic content requirements, restrictions on foreign investments, tying agreements, export subsidies, among others. Efforts to evaluate and respond to these practices, the panel said, would be "protracted and difficult, but (are) essential."

Howard W. Johnson, chairman of the corporation at the Massachusetts Institute of Technology, chaired the 22-member Panel on Advanced Technology Competition and the Industrialized Allies. (A list of panel members is attached.) The panel's work was initiated and conducted by the National Research Council, which is the operating arm of the National Academy of Sciences and National Academy of Engineering. Funding was provided by the Office of Science and Technology Policy and by a consortium of private foundations, including the Carnegie Corporation of New York, the Charles E. Culpeper Foundation, the William and Flora Hewlett Foundation, the John D. and Catherine T. MacArthur Foundation, the Andrew W. Mellon Foundation, and the Rockefeller Foundation.

Panel on Advanced Technology Competition and the Industrialized Allies

HOWARD W. JOHNSON, Chairman of the Corporation, Massachusetts Institute of Technology, Chairman
HARVEY BROOKS, Benjamin Peirce Professor of Technology and Public Policy, Harvard University
ROBERT A. CHARPIE, President, Cabot Corporation
RICHARD N. COOPER, Maurits C. Boas Professor of International Economics, Harvard University
ROBERT A. FULLER, Corporate Vice President, Johnson & Johnson
RALPH E. GOMORY, Vice President and Director of Research, IBM Corporation
NORMAN HACKERMAN, President, Rice University
N. BRUCE HANNAY, Vice President, Research, Bell Laboratories (retired)
THEODORE M. HESBURGH, President, University of Notre Dame
WILLIAM R. HEWLETT, Chairman of the Executive Committee, Hewlett-Packard Company
WILLIAM N. HUBBARD, JR., President, The Upjohn Company
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ROBERT S. INGERSOLL, Former U.S. Ambassador to Japan
CARL KAYSEN, David W. Skinner Professor of Political Economy and Director, Program in Science, Technology & Society, Massachusetts Institute of Technology
ALLEN E. PUCKETT, Chairman and Chief Executive Officer, Hughes Aircraft Company
DAVID V. RAGONE, President, Case Western Reserve University
JOHN S. REED, Vice Chairman, Citibank
WALTER A. ROSENBLITH, Institute Professor, Massachusetts Institute of Technology
ROBERT M. SOLOW, Institute Professor, Department of Economics, Massachusetts Institute of Technology
JOHN E. STEINER, Vice President, Corporate Product Development, The Boeing Company
WILLIAM J. WEISZ, Vice Chairman of the Board, Motorola, Inc.
LEONARD WOODCOCK, Former U.S. Ambassador to China

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