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**SCIENCE AND TECHNOLOGY APPLICATIONS ACT
OF 1974**

**JOINT HEARING
BEFORE THE
COMMITTEE ON COMMERCE
AND THE
COMMITTEE ON
AERONAUTICAL AND SPACE SCIENCES
UNITED STATES SENATE
NINETY-THIRD CONGRESS
SECOND SESSION
ON**

S. 2495 Amendment No. 1537

TO AMEND THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958 TO APPLY THE SCIENTIFIC AND TECHNOLOGICAL EXPERTISE OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION TO THE SOLUTION OF DOMESTIC PROBLEMS, AND FOR OTHER PURPOSES, VIZ:

JULY 11, 1974

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**SCIENCE AND TECHNOLOGY APPLICATIONS ACT
OF 1974**

THURSDAY, JULY 11, 1974

U.S. SENATE,
COMMITTEE ON COMMERCE AND
COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES,
Washington, D.C.

The joint hearing of the Senate Committee on Commerce and the Senate Committee on Aeronautical and Space Sciences met at 10:10 a.m. in room 1319 of the Dirksen Senate Office Building; Hon. John V. Tunney presiding.

OPENING STATEMENT BY SENATOR MOSS

Senator Moss [presiding]. The hearing will come to order. We delayed a few minutes because some of the other Senators have been delayed. We have a very full list of important witnesses to hear, and we should get started.

This is a joint hearing between the Senate Committees on Aeronautical and Space Sciences and Commerce on S. 2495, of which Senator Magnuson is the principal sponsor.

A more secure existence for Americans must be based in part on the recognition that science and technology pervade the entire fabric of our society and are among the principal causes of change for better or for worse. The wisdom with which we use our technology will either lead us to further greatness or diminish us among the community of nations.

The National Academy of Sciences has listed examples of current problems which require the most competent and imaginative science and technology that the Nation can muster. Some of the problems listed are:

The threat of worldwide famine and the importance of continuing agricultural research and of related technological development in industry as well as in Government; the need for new technologies to prevent or reverse the deterioration of our environment; the need to find new sources of energy; the modernization of our transportation systems as an essential part of maintaining a benign environment; the need to advance the science and technology required to provide general access to health care of high quality and to reduce the incidence of disease; the maintenance and improvement of Government policies to ensure that American science, technology, and industry continue to flourish.

Staff member assigned to this hearing: Barry I. Hyman.

Considering this list of problems, we begin to realize that a basic tool in their solution—technology—has also become one of our most valuable resources. Like our other resources, its use should be planned to increase efficiency and reduce waste.

The bill being considered today, S. 2495, recognizes science and technology as a primary national resource and provides for their efficient utilization in the resolution of many current and potential national problems.

I would like to place in the record a statement by the chairman, Senator Magnuson, who will be here shortly.

[The statement follows:]

STATEMENT OF HON. WARREN G. MAGNUSON, U.S. SENATOR FROM WASHINGTON

Ladies and gentlemen: I am extremely pleased to see the Senate Commerce Committee proceeding with hearings on the amendment introduced by Senators Moss, Tunney, and myself just before the holiday recess.

The amendment is an outgrowth of a series of hearings by both the Commerce and Aeronautics Committees which discussed the need for an independent presidential panel to advise the White House on scientific and technical matters.

Our amendment would establish a permanent council of advisors on science and technology to advise the President on a broad-range of scientific and engineering matters. The Council will focus policy recommendations in science and technology for the President. It will harness the scientific and technical resources of this country to improve the quality of life of all our citizens. It holds the promise of contributing to the solution of most of our present critical national problems. The council's job would be to advise the President and to coordinate and evaluate the scientific and technological efforts of the Executive Branch of Government. The chairman would be the President's science advisor.

I am extremely pleased that this bill parallels the recommendations of the National Academy of Sciences. On June 26, the day before we introduced our amendment, the academy released a report calling for the establishment of a Science advisory panel. The recommendation was drafted by a blue ribbon Scientific Committee under the chairmanship of Dr. James Killian, Jr., former president of the Massachusetts Institute of Technology.

The need for such a panel has become acute since last year, particularly since the demise of the previous White House machinery to give the President scientific and technology advice. There is not now a capability for an independent scientific technology analysis in the Executive branch. The President is totally dependent upon analyses developed through departmental loyalties and pressures of internal bureaucratic competition.

I hope our bill will solve this dilemma.

Senator Moss. My colleague from the State of California, Senator Tunney, is a cosponsor of the bill before us, and will be presiding at this hearing, since I have to leave to attend a legislative conference with the House within about 45 minutes.

I would ask the Senator from California if he has any opening remarks he would like to make at this point.

OPENING STATEMENT BY SENATOR TUNNEY

Senator TUNNEY. Thank you, Senator, I do.

I believe that these are very important hearings that we are embarking on. We live in a technological world. However, few of us realize just how technological it is, and the extent to which we take this technology for granted.

Our everyday lives are shaped by the adaptation of scientific knowledge to the promotion of human welfare. The clothes we wear are produced by a highly technological textile industry. The paper we

write on, the buildings we live and work in, our means of getting from one place to another, are all the fruits of the development of technology.

Many of us are alive today because of technological developments applied to the field of human health care and preventive medicine.

Advances in science and technology are going to be needed even more than ever to assist in the resolution of many of our existing and emerging national problems, such as the energy crisis, materials shortages, environmental degradation, and overpopulation. Yet, this country has never had an effective organizational framework for long-range planning in science and technology, and for integration of science and technology into the decisionmaking process regarding critical national problems.

This morning's joint hearing of the Commerce Committee and the Aeronautical and Space Sciences Committee represents another significant advance in our attempts to develop such a framework.

After our hearings in March on S. 2495, the comments offered at those hearings and in written statements submitted for the record were carefully reviewed and many of them were incorporated into a new version of the bill, which is before us this morning.

Amendment 1537 to S. 2495 recognizes that long-range planning for science and technology, and the development of policy with regard to science and technology, must take place at the highest levels of the executive branch of the Government.

The establishment of a Council of Advisors on Science and Technology will provide a focus for science and technology that has never before existed in this country. An organizational structure is created which would have an ongoing and continuous responsibility with regard to federal science and technology plans, programs, and policies.

The Council is also given the task of assisting the President in the preparation of an annual Science and Technology Report to Congress.

This morning we will hear from gentlemen who have extensive personal experience with science and technology policymaking at the upper echelons of the executive branch. Their insights into the extremely intricate and delicate process of high-level governmental policymaking will be extremely helpful to use as we continue to refine this extremely important legislation.

I would just like to say in addition, that I can't help but believe as we approach a world with material shortages, with vastly increased costs for energy, with a population that is growing as fast as it is, and with the limitation of food resources, and with pollution problems, that we have a desperate need in this country to start focusing on the technological means to cope with these problems that face society. We need to demonstrate a willingness to put some money up, more money than we have in the past, for research and development so that the human race can survive.

I happen to be one who feels that unless we make major systemic changes worldwide, in the way we handle our affairs, that the future of mankind is not bright.

[The bill and agency comments follow :]

93d CONGRESS
2d SESSION

S. 2495

IN THE SENATE OF THE UNITED STATES

JUNE 27, 1974

Referred to the Committees on Aeronautical and Space Sciences and Commerce,
jointly, and ordered to be printed

AMENDMENTS

Intended to be proposed by Mr. MAGNUSON (for himself, Mr. MOSS, and Mr. TUNNEY) to S. 2495, a bill to amend the National Aeronautics and Space Act of 1958 to apply the scientific and technological expertise of the National Aeronautics and Space Administration to the solution of domestic problems, and for other purposes, viz:

- 1 Strike out all after the enacting clause and substitute in
- 2 lieu thereof the following:
- 3 "That this Act may be cited as the 'Science and Technology
- 4 Applications Act of 1974'.
- 5 "STATEMENT OF FINDINGS AND DECLARATION OF POLICY
- 6 "SEC. 2. (a) The Congress, recognizing the profound
- 7 impact of science and technology on society, and the inter-
- 8 relations of scientific, technological, economic, social, polit-
- 9 ical, and institutional factors, hereby finds and declares that—

Amdt. No. 1537

1 “(1) the scientific and technological capabilities
2 within the United States, if properly applied and di-
3 rected, could effectively assist in improving the quality
4 of life and in anticipating and resolving many critical
5 and emerging national problems;

6 “(2) it is the responsibility of the Federal Govern-
7 ment to assure adequate opportunity for the full and
8 efficient use of such scientific and technological capabili-
9 ties;

10 “(3) the maintenance and strengthening of diver-
11 sified scientific and technological capabilities in the Fed-
12 eral departments and agencies, in State and local gov-
13 ernments, in industry and the universities, and the en-
14 couragement of independent initiatives based on such
15 capabilities, are essential to the most effective use of
16 science and technology in resolving critical and emerg-
17 ing national problems;

18 “(4) a more systematic approach is needed to
19 identify critical and emerging national problems and to
20 analyze, plan, and coordinate Federal science and tech-
21 nology programs, policies, and activities intended to
22 contribute to the resolution of such problems;

23 “(5) the effectiveness of scientific and technological
24 contributions to improvements in the quality of life
25 and to the resolution of critical and emerging national

1 problems depends on the maintenance of a strong base
2 of knowledge in science and advanced technology to-
3 gether with a resource of highly qualified scientists and
4 engineers;

5 “ (6) an annual Science and Technology Report to
6 the Congress would facilitate more effective utilization
7 of science and technology in the resolution of critical and
8 emerging national problems; and

9 “ (7) science and technology can fully serve the
10 Nation only if adequate means are established in the
11 Executive Office of the President to provide a source
12 of scientific and technological analysis and judgment to
13 the President, drawing on the best talents available with-
14 in and outside the Federal Government.

15 “TITLE I—NATIONAL SCIENCE AND TECH-
16 NOLOGY RESOURCES PLANNING AND COOR-
17 DINATION

18 “THE COUNCIL OF ADVISERS ON SCIENCE AND TECHNOLOGY

19 “SEC. 101. (a) There is established in the Executive
20 Office of the President a Council of Advisers on Science and
21 Technology (hereinafter referred to as the ‘Council’). The
22 Council shall be composed of three Members who shall be
23 appointed by the President, by and with the advice and
24 consent of the Senate, from among individuals who, by
25 reason of their training, experience, and attainments, are

1 exceptionally qualified to analyze and interpret scientific
2 and technological developments; to appraise and recommend
3 programs, policies, and activities of the Federal Government
4 in the light of the policy declared in section 2; and are sen-
5 sitive to the economic, social, esthetic, and cultural needs and
6 interests of the Nation.

7 “(b) The President shall designate one of the mem-
8 bers of the Council as Chairman and one as Vice Chairman,
9 who shall act as Chairman in the absence of the Chairman.

10 “(c) Members of the Council shall serve full time and
11 the Chairman of the Council shall be compensated at the
12 rate provided for level II of the Executive Schedule pay
13 rates. The other members of the Council shall be com-
14 pensated at the rate provided for level IV of the Executive
15 Schedule pay rates.

16 “(d) The Council may employ such officers and em-
17 ployees as may be necessary to carry out its functions under
18 this Act. In addition, the Council may employ and fix the
19 compensation of such experts and consultants as may be
20 necessary for the carrying out of its functions under this
21 Act, in accordance with section 3109 of title 5 (but without
22 regard to the last sentence thereof).

23 “(e) The Council shall have the authority, within the
24 limits of available appropriations, to enter into contracts or
25 other arrangements for the carrying on by organizations

1 or individuals, including other Government agencies, of
2 such activities as the Council deems necessary to carry out
3 the purposes of this Act.

4 "FUNCTIONS OF THE COUNCIL

5 "SEC. 102. (a) It shall be the duty and function of the
6 Council to serve as a source of scientific and technological
7 analysis and judgment for the President with respect to major
8 policies, plans, and programs of science and technology of
9 the Federal Government. In carrying out its duties, the
10 Council shall:

11 "(1) seek to define a coherent approach for apply-
12 ing science and technology to critical and emerging na-
13 tional problems and for coordinating the scientific and
14 technological responsibilities and programs of the Fed-
15 eral departments and agencies in the resolution of such
16 problems;

17 "(2) assist and advise the President in the prepara-
18 tion of the Science and Technology Report, in accordance
19 with section 103 of this title;

20 "(3) gather timely and authoritative information
21 concerning significant developments and trends in science
22 and technology, both current and prospective, to analyze
23 and interpret such information for the purpose of deter-
24 mining whether such developments and trends are inter-

6

1 fering, or are likely to interfere, with the achievement of
2 the policy set forth in section 2 of this Act;

3 “(4) initiate studies and analyses, including sys-
4 tems analyses, to identify and assess alternatives avail-
5 able for the resolution of critical and emerging national
6 problems amenable to the contributions of science and
7 technology and, insofar as possible, determine and com-
8 pare probable costs, benefits, and impacts of these alter-
9 natives;

10 “(5) review and appraise the various programs,
11 policies, and activities of the Federal Government in the
12 light of the policy set forth in section 2 of this Act for the
13 purpose of determining the extent to which such pro-
14 grams, policies, and activities are contributing to the
15 achievement of such policy, and to make recommenda-
16 tions to the President with respect thereto;

17 “(6) report at least once each year to the President
18 on the overall activities and accomplishments of the
19 Council;

20 “(7) perform other duties and functions and make
21 and furnish such studies, reports thereon, and recom-
22 mendations with respect to matters of policy and legis-
23 lation as the President may request.

24 “(b) In exercising its powers, functions, and duties
25 under this section, the Council shall;

1 “(1) work in close consultation and cooperation
2 with the heads of the Federal departments and agencies;

3 “(2) utilize the services of consultants, establish
4 such advisory committees, and consult with State and
5 local governmental agencies, with appropriate profes-
6 sional groups, and with such representatives of industry,
7 the universities, agriculture, labor, consumers, conserva-
8 tion organizations, and other groups, organizations, and
9 individuals as it may deem advisable; and

10 “(3) utilize to the fullest extent possible the serv-
11 ices, facilities, and information (including statistical in-
12 formation) of public and private agencies and organiza-
13 tions, and individuals, in order that duplication of effort
14 and expense may be avoided.

15 “(c) Each department, agency, and instrumentality of
16 the executive branch of the Government, including any in-
17 dependent agency, is authorized and directed to furnish the
18 Council such information as the Council deems necessary to
19 carry out its functions under this title.

20 “(d) The Chairman of the Council shall, in addition to
21 the duties and functions set forth in subsection (a)—

22 “(1) serve as the Science and Technology Adviser
23 to the President;

24 “(2) appoint, assign the duties, and fix the compen-
25 sation of personnel without regard to the provisions of

1 title 5, United States Code, governing appointments in
2 the competitive service, and without regard to the pro-
3 visions of chapter 51 and subchapter III of chapter 53
4 of such title, relating to classification and General Sched-
5 ule pay rates, at rates not in excess of the maximum
6 rate for GS-18 of the General Schedule under section
7 5332 of such title; and

8 “(3) perform other duties and functions as as-
9 signed by the President or this Act.

10 “SCIENCE AND TECHNOLOGY REPORT

11 “SEC. 103. (a) The President shall transmit annually
12 to the Congress, beginning July 1, 1975, a Science and
13 Technology Report (hereinafter referred to as the ‘Report’)
14 which shall set forth—

15 “(1) a review of developments of national signifi-
16 cance in science and technology, including, but not
17 limited to, the mathematical, physical, social, and life
18 sciences, and civil, chemical, electrical, and mechanical
19 engineering, and related technologies;

20 “(2) the significant effects of current and foresee-
21 able trends in science and technology on the social, eco-
22 nomic, and other requirements of the Nation;

23 “(3) a review and appraisal of selected science and

1 technology-related programs, policies, and activities of
2 the Federal Government;

3 “(4) an inventory and projection of critical and
4 emerging national problems the resolution of which
5 might be substantially assisted by the application of
6 science and technology;

7 “(5) the identification and assessment of scientific
8 and technological measures that can contribute to the
9 resolution of such problems, in light of the related social,
10 economic, political, and institutional considerations;

11 “(6) the existing and projected scientific and tech-
12 nological resources, including specialized manpower, that
13 could contribute to the resolution of such problems; and

14 “(7) recommendations for legislation on science
15 and technology-related programs and policies that will
16 contribute to the resolution of such problems.

17 “(b) Upon request, the National Science Foundation
18 shall furnish assistance to the Council in carrying out the
19 Council’s responsibilities under subsection 102 (a) (2) in
20 regard to the matters called for in paragraphs (1) and (6)
21 of subsection (a) of this section.

22 “(c) The Report shall be printed and made available
23 as a public document.

1 "TITLE II—THE OFFICE OF TECHNOLOGY
2 APPLICATION

3 "OFFICE ESTABLISHED

4 "SEC. 201. (a) The Administrator of the National Aero-
5 nautics and Space Administration shall establish within the
6 Administration an Office of Technology Application to be
7 headed by an Associate Administrator.

8 "(b) In order to carry out the purposes of this Act,
9 the Administrator, through the Office of Technology Appli-
10 cation, shall utilize the resources of the National Aero-
11 nautics and Space Administration to the fullest extent con-
12 sistent with its areas of scientific and technological com-
13 petence, and shall—

14 "(1) upon request, furnish assistance to the Council
15 in carrying out the Council's responsibilities under para-
16 graphs (2) and (4) of section 102 (a) ;

17 "(2) upon direction of the President, conduct re-
18 search, development, and demonstration projects, in
19 order to carry out the purposes of this Act, consistent
20 with the provisions of section 102 (d) of the National
21 Aeronautics and Space Act of 1958, as amended by
22 this Act; and

23 "(3) conduct exploratory research and develop-
24 ment projects in support of his responsibilities under
25 this Act.

11

1 “(c) Except as otherwise provided in this title, the
2 Administrator shall, in carrying out his functions under this
3 title, have the same powers and authority he has under the
4 National Aeronautics and Space Act of 1958.

5 “AMENDMENTS TO THE NATIONAL AERONAUTICS

6 AND SPACE ACT OF 1958

7 “SEC. 202. (a) Section 102 (d) of the National Aero-
8 nautics and Space Act of 1958 (42 U.S.C. 2451 (d)) is
9 amended to read as follows:

10 ““(d) The Congress declares that the expertise de-
11 veloped by the National Aeronautics and Space Adminis-
12 tration in research and in the development of new and
13 advanced technology to solve complex problems in the con-
14 duct of aeronautical and space activities shall, in addition, at
15 the direction of the President, be made available and be used
16 to further the purposes of the Science and Technology
17 Applications Act of 1974, to the extent not inconsistent
18 with or in diminution of such aeronautical and space
19 activities.’

20 “(b) Section 102 of such Act is amended by adding
21 at the end thereof the following new subsection:

22 ““(c) It is the purpose of this Act to carry out and
23 effectuate the policies declared in subsections (a), (b),
24 (c), and (d) of this section.’

1 "TITLE III—GENERAL PROVISIONS

2 "APPROPRIATIONS AUTHORIZED

3 "SEC. 301. (a) There is hereby authorized to be appro-
4 priated to the Council of Advisors on Science and Tech-
5 nology, such sums as are necessary to carry out its functions
6 under this Act.

7 "(b) There is hereby authorized to be appropriated to
8 the National Aeronautics and Space Administration \$10,-
9 000,000 for the fiscal year ending June 30, 1975, to carry
10 out its functions under this Act. The provisions of section
11 4 of the Act of June 15, 1959 (73 Stat. 75, 42 U.S.C.
12 2460), shall apply to authorizations of appropriations to the
13 Administration to carry out its functions under this Act for
14 fiscal years after June 30, 1975."

Amend the title so as to read: "A bill to provide a
Council of Advisors on Science and Technology, to provide
for an annual Science and Technology Report, and for other
purposes."

NATIONAL SCIENCE FOUNDATION,
Washington, D.C., July 24, 1974.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your request of July 12, 1974, for the views of the National Science Foundation on S. 2495, Amendment No. 1537, the "Science and Technology Applications Act of 1974."

Much of the testimony before your Committee and also the House Committee on Science and Astronautics stresses the continuing importance of introducing science advice into the policy-making activities of the Government. S. 2495 clearly recognizes this need. Indeed, decisionmaking at a national level that does not take account of the best scientific advice, the most careful scientific judgments available, is fool-hardy and often dangerous. Acknowledgment of this and the emphasis laid upon it by you and the other members of the Commerce Committee, the Aeronautical and Space Science Committee, and the Congress-at-Large, are very gratifying. I must introduce a note of caution, however, with respect to this bill. In the last analysis, the value of any advisory mechanism depends upon how and whether it is used. In my opinion, leaving to each President the decision on a particular organizational mode for obtaining science advice will better assure its responsiveness to policy requirements and integration with other Presidential machinery.

The Administration has chosen one particular mode of organization for science advice, one that we believe can be effective. But whatever the arrangement—whether a single individual or a three-member council, whether an Agency head or the head of an Office in the White House—it must make use of all available talents in the Federal Government and elsewhere in tackling civilian problems. The assistance of all of the Executive Agencies, each within its own expertise, is needed and the talents of Congress, as well. Thus, any scientific mechanism, established or used by the President, should call upon all Agencies with high technology capabilities, not just one or two, such as NSF or NASA, as is provided in S. 2495.

The present arrangement for science advice, established a year ago under Reorganization Plan No. 1, is intended to foster maximum use of diverse resources. The NSF's science base is very broad, indeed. As the sole Federal Agency with a mandate covering all of science and with a network of close ties to academic, industrial, and local government communities, NSF has multiple sources to draw upon and it should play an important role in any science advisory mechanism. The National Science Board, composed of 24 eminent scientists, educators, and administrators, which is the policy-making body of the Foundation, by its very composition constitutes yet another strong link with the scientific community. In addition, the Foundation has established the Science and Technology Policy Office and an Office of Energy R&D Policy to form additional links among Federal Agencies and The White House. These Offices have already contributed extensive sound scientific advice at high levels and there is much evidence that this advice has in fact been listened to.

I am aware that the present arrangement, involving the head of an operating agency as science advisor with Government-wide responsibilities, has been criticized on the basis of possible conflict of interests. I believe that this criticism, while plausible, is not well-founded. The Science Advisor at present, as he has been in the past, does not make decisions, but rather draws upon the knowledge of other Agencies to present analyses and options. In this particular circumstance, the NSF's total activities involving as they do only four percent of the total R&D budget, is so small that a serious conflict of interests would seem to be negligible.

I think that the procedures now being followed by the Administration in science policy matters can work and work well. That is not to say that the present arrangement is perfectly effective. In my experience, there have been very few organizations which could not be improved. However, the problems being addressed by S. 2495 are so complex and involve such powerful, diverse, and conflicting forces, that solutions should not be adopted hastily. I would recommend that the Committee explore further the many facets of the complex process of effectively coupling scientific advice into national decision-making before recommending the bill for passage.

The Office of Management and Budget has advised use that there is no objection to the submission of this report from the standpoint of the Administration's Program.

Sincerely yours,

RAYMOND L. BISPLINGHOFF,
Acting Director.

Senator Moss. Several months ago, Senator Mansfield addressed himself eloquently to the kinds of problems we face. In the interest of time, I will not repeat his remarks here, but would ask that they be included at this point in the hearing record. They are part and parcel of the issues we are considering.

[The statement follows:]

STATEMENT OF HON. MIKE MANSFIELD, U.S. SENATOR FROM MONTANA

We are convened at the joint suggestion of the president and the congressional leadership on an issue of surpassing significance. This is an unprecedented gathering, of sorts. I hope that it foreshadows future contacts of a similar nature at the emergent stages of other issues that go to the core of our national well-being.

As to the immediate concern, this meeting represents a step in a process which began last February. Let me start by defining the question before us, at least as I perceive it. Later in my remarks, I will suggest how the necessary legislative framework might be created to begin to come to grips with it.

Scarcity, diminishing resources, expanding usage, cartels, production restrictions, steep price rises and crash-based planning—for many of us these words help to describe the issue. In a more fundamental sense, the question we confront involves the manner in which vital elements of our national economic life have come to be organized. In particular, we need to ask ourselves: How are we equipped—or not equipped—to address the next crisis in resources or materials or commodities that may engulf the nation?

What we are here to explore is the possibility of creating an instrumentality that would, first, perceive what the fundamental needs of the nation will be now and in the years ahead, then sort out the information that relates to these needs and, finally, provide alternative policy recommendations that might help us—in the Congress and in the executive branch—to take the action deemed essential to avert catastrophes and to minimize hardships in the future.

On this very point let me quote briefly from the report of a highly distinguished commission on a major aspect of the problem before us:

"For all its wide diversities the materials problem is indivisible. There must be, somewhere, a mechanism for looking at the problem as a whole, for keeping track of changing situations and the interrelation of policies and programs. This task must be performed by an agency near the top of the administrative structure.

"Such an agency should review all areas of the materials field and determine how they can best be related to each other. It should maintain, on a continuing basis, a forward audit; collect and collate facts and analyses of various agencies; and recommend appropriate action for the guidance of the President, the Congress and the Executive agencies."

The quotation is from the report of the President's Materials Policy Commission—the so-called Paley commission. The date: June 2, 1952, twenty-two years ago. Many of the same conclusions were drawn by the National Commission on Materials Policy whose findings were reported a year ago. Yesterday, the General Accounting Office reported similar conclusions.

In short, for at least a quarter-century experts have warned about coming crises with regard to vital basic materials. What manifested itself so clearly last year when long lines of cars began stacking up for short rations of gasoline was not so much a lack of data and information but, more importantly, the fact that we simply had no systematized method of assessing information in order to determine our needs clearly enough and to move quickly enough to provide a reasoned answer, or even to make the attempt.

What if the government, at any time in the past two decades, had established a central information unit, a data bank so to speak, that was charged with compiling statistics on energy resources, analyzing the status of supply and sources on

a continuing basis, projecting consumption rates, reporting refining capacity, and evaluating current technology and future application, and that was equipped to report anticipated deficiencies directly to Congress and to the president *with specific recommendations*? There is little doubt, I think, that had such an agency existed, there would have been no fuel crisis and, certainly, no reason to have addressed the matter on a crash basis merely to meet immediate requirements for heat, light and transportation.

And if it is energy today, of what will we as a nation be in dire need tomorrow? Three or four years ago, the Interior Department told us that there were at least thirteen basic materials for which we depend largely upon supply sources outside the United States. The figure has now grown to forty or more. They range from aluminum and chromium to tin, lead, nickel and so on. For at least thirty of these materials, the nation has already become over 60 percent dependent upon other countries. In part, the dependence may be answered at some unknown future date by new technologies such as the recapture and recycling efforts that are at present little more than an idea. For now, however, that dependence is with us, and it is complicated by what happens when supplier nations gang together.

I realize full well that the president and Secretary Kissinger are trying to improve the bargaining strength of the consumer nations insofar as petroleum is concerned. But what happened with oil is very likely to happen with bauxite or copper or nickel or zinc or tin or whatever, when the basic needs of heavy consumer societies must be met by sources beyond their national boundaries. At the White House last Wednesday morning, Secretary Kissinger stressed to the Leadership that the interdependence of developed and developing nations with regard to key resources was essential to global stability. But the international instrumentalities he envisioned to accommodate cooperation between producer and consumer nations can be established, it seems to me, only after there is constructed within our nation a mechanism able to grasp what is needed for our own people, not only today but five or ten years hence.

The problem goes well beyond metals or minerals and relates not only to those goods for which we are dependent on foreign sources. In 1973, the nation experienced the biggest boost in the cost of groceries in over twenty-five years. Prices for fibers have risen 93 percent. The story of how inflation continues to wrack our people on every front was written graphically in the double-digit figures released just a couple of weeks ago—10.5 percent from March of 1973 to March of 1974; 14.5 percent for the first three months of this year.

And while Americans are made to pay more, let us not forget that in some areas of the world, the basic commodities are not even available. The problem is worse in Europe, Asia and Latin America. A whole corridor spanning the African Continent is now caught in a struggle for survival under the twin burdens of drought and famine.

In the United States, however, I believe it is largely the question of basic shortages and related matters which will mandate the crises. And the crises, one after another, will most assuredly pounce on us unless and until we are prepared as a nation to adjust our government apparatus to meet the fundamental problem. That problem is not really so much one of the absence of information. At last report, more than fifty federal agencies and administrations were collecting and compiling relevant data, and that was before any apparatus was set up to address environmental concerns or to monitor product safety or to perform a host of other recently legislated activities.

Take a specific example. In the Commerce Department there are some 160 professionals in the Office of Business Research and Analysis, and 20 or 30 of them alone are dealing with information on industrial commodities. Look at it in broader terms. We find that for data on imports and exports, we can turn to the Agriculture, Treasury and Commerce departments, the Council on Economic Policy, the Federal Energy Office (FEO) and Special Trade Representative and more; for production, there are the Interior and Agriculture departments, Housing and Urban Development, FEO and more; for basic regulatory decisions, there are the Department of Transportation, the Interstate Commerce Commission, the Environmental Protection Agency, the Federal Reserve and more; and so it goes. While the mint wants to watch silver for one reason, the Defense Department has a different objective in mind. In some instances, two or three different agencies with overlapping responsibilities arrive at contradicting appraisals of the present state and future prospects of the same industry.

The situation is not very different here in the Congress, except in magnitude. When it comes to our diverse and seemingly insatiable appetites for economic information, our committees reflect the same fractured state as the executive branch. In the Senate, it is Agriculture and Forestry for agriculture, minerals, pesticides, fertilizers and timber and wood materials; Armed Services for strategic materials, stockpile; Banking, Housing and Urban Affairs for materials export policy, foreign trade, and silver and gold production; Commerce for materials recycling, resource development, materials allocation, materials commodity controls; Foreign Relations for the importation of Rhodesian chrome; Interior and Insular Affairs for mining and minerals policy; Public Works for national materials policy, materials recycling; Select Committee on Small Business for materials production; Finance for the gamut of trade; Joint Committee on Atomic Energy for fissionable materials; Joint Economic Committee for materials recycling; Joint Committee on Defense Production for strategic materials, stockpile; Government Operations for any or all of the above; and so on.

In the House, it is much the same story.

So, I repeat, it is not necessarily the lack of knowledge that confronts us. Nor is it that we are seeking governmental intervention, controls or what-have-you. It is, rather, the question of how to coordinate and apply available knowledge in a manner which permits wise and rational policy choices to surface in a timely fashion and at a sufficiently high level of government to make them useful.

In 1952, the Paley commission called for an organization to discharge this overall function which would be neither an operating agency nor a supervisory agency but rather one with the function of "forward audit," concerned with "the total pattern of activities in the materials and energy field; the relationships of individual programs to each other; the scope and dimensions of foreign production materials programs and their relationship to domestic programs; the probable effects of current production programs on the long-term materials position, the selection and development of current programs in the light of long-term requirements; programs for both scientific and technological research on materials, and their interrelations; and the relationship of materials policies to manpower, and to fiscal and foreign policies which may in various measure bear on materials."

Needless to say, little was heard of these suggestions subsequently. At best, portions of these overall functions were scattered through the government in the usual pattern of fragmentation. So we are here today to try once more. What we are seeking to do is to explore whether or not there can be created a meaningful instrumentality to coordinate and interpret and forecast, which will enable the nation to expand its field of vision in this fundamental area of our national life.

The Senate minority leader (Mr. Scott) and I put in these words in our letter to the president proposing this meeting:

"It is our suggestion that we consider bringing together representatives of the Legislative and Executive Branches of the government on a regular basis with those of industry and labor and other areas of our national life for the purpose of thinking through our national needs, not only as they confront us today, but as they are likely to be in five, ten or more years hence, and how they are best to be met. If the government is to intervene in these matters, as it is now doing, an effort ought to be made to put that intervention as far as possible, on a rational and farsighted basis."

To sort our information, look at the whole and identify potential areas of crisis and provide alternative policy recommendations in that perspective—that is how I think the mandate of a new instrumentality, if it were to be established, ought to be envisioned. To this instrumentality would fall the responsibility of perceiving the impact of adversity in one narrow economic segment on other segments; of recognizing how for example, a fertilizer shortage might affect food supplies on down the line, and what might be done to remedy that, since fertilizer depends on such essentials as natural gas, phosphates and nitrogen. Do we not also need the capacity to perceive the whole of federal intervention in the economy, if it must occur, and the relation of the individual parts of that intervention to one another? That such a capacity did not exist when we sold off our wheat reserves is obvious. Did it fail to exist, too, when we sold abroad in the last six or eight months half of our national reserves of tin—a material for which we can be classified as 100 percent dependent on

foreign sources? Does it exist when we overseed our fields with soybeans today knowing that price instability lies even now on the horizon as evidence accumulates of a replenished protein feed source off the coast of South America?

I think all of use here sense that there exists some kind of requirement to deal with questions of this kind or, I daresay, we would not be meeting at all. At the end of this meeting, therefore, it would be my hope that we might at least be able to state that much affirmatively. It would be my hope, too, that we might go on from there and begin to clarify our thinking on some additional questions, I would like to set forth the following points.

First, what kind of instrumentality, if any, might meet this requirement? As proposed in the Leadership letter to the president, it was our thought that such an instrumentality, if it is to be effective, should be one that is representative of the nation; one, therefore, that would embrace representatives not only of the legislative and executive branches but of industry, labor, agriculture and other significant segments of our national life. First, it should be a continuing instrumentality equipped to draw on information from all sources on the status of resources, materials and commodities and other aspects of our economy—tasks performed now by dozens of agencies and organizations across the spectrum of national life, both public and private. Second, it must have the means to forecast the problems by drawing information out of the present massive but fragmented system. Third, it must have the capacity to convert its projections into recommended policy options that might embrace such measures as conservation, research, stockpiling, allocation, modernization, manpower, export controls and whatever else may be necessary to keep vital the nation's economy. Finally, it must be in a position to report its findings authoritatively to the president and the Congress, the ultimate arbiters of policy and the sources of action for the federal government. That is only one possible approach to this question. Others might see the requirement in different terms.

I think it was last December at the annual meeting of the American Economic Association that Dr. Stein said, "Maybe, we need an economic planning agency." The statement reflects for me and for many others a deep frustration with the disjointed way government has tended for decades not so much to act but instead to react when a component of this gigantic, intricate machine of the U.S. economy gets out of whack. It is not only, for example, that a decision to build or not to build a new steel mill or chemical plant or to start a mining operation can have major repercussions throughout a community, the nation and even abroad; it is also that a shortage of raw materials derived from petroleum can shut down auto plants in Detroit and manufacturers of recording tapes in Los Angeles. As one noted economist characterized our present approach not long ago, it is like the old circus act with five clowns in a car, one pressing the gas, another pulling the brake, the third spinning and steering the wheel, the fourth blowing the horn and one sitting on top holding on for dear life. That one on the top, I suppose, is the American public.

As a second focal point of this preliminary discussion, I would note that a number of congressional committees are interested in aspects of this problem and are advancing concepts and proposals which are designed to deal with at least parts of it. There comes to mind, for example, the work in the Senate Commerce Committee and the Senate Government Operations Committee. There are probably other explorations under way in House committees and undoubtedly in other Senate committees. Others, I would assume, are working on the problem in executive agencies, not to speak of the activity of the United Nations, private foundations and universities. In any event, it would be my hope that we would consider in this group whether or not we wish to recommend to the president and the Congress the establishment of a temporary commission of executive and legislative representatives and private citizens to examine all of these proposals and any others having to do with this question. Such a commission might propose the design of a continuing instrumentality which would be capable of giving the president and the Congress the kind of integrated perception of our national requirements now and in the future which has heretofore been lacking. Senator Scott and I have had draft legislation prepared along these lines. In the event that this route of establishing a temporary commission on the question meets with general approval, I would hope that this draft, a copy of which is before you, would be studied and that the group would be prepared to move ahead, to the end that legislation to create a special temporary commission along these general lines might be introduced in the next couple of weeks.

I should like to conclude these remarks on this note. As we have had this draft resolution prepared, it is designed to minimize political factors and to place the consideration of this fundamental national problem on a basis of equality between the branches of government and between government and the private sector. In my judgment, the system under which this nation survives and grows depends as much on cooperation as it does on competition among the cores of power and responsibility within the government and within the nation. If there is any area in which the element of cooperation is imperative, it is in safeguarding the livelihood and well-being of the nation, not only in terms of the needs of today but in terms of the needs of tomorrow and tomorrow. Whatever we do, therefore, let us try to do it in that context, in the context of cooperation between the two parties, cooperation between the two branches and cooperation among the basic segments of our national life. When it comes to the nation's basic economic needs, there is no advantage to be gained for any particular segment in government or private life. If we do not work together today, in this sphere, there will be no need to ask for whom the bell tolls; it will toll for all of us tomorrow.

Senator Moss, I am delighted to be able to call as our first witness, Dr. George Kistiakowsky, professor emeritus of chemistry, Harvard University, who will be able to give us some advice as to how, at the Federal level, we should handle our affairs.

Thank you.

**STATEMENT OF GEORGE B. KISTIAKOWSKY, PROFESSOR
EMERITUS OF CHEMISTRY, HARVARD UNIVERSITY**

Dr. KISTIAKOWSKY. Thank you, Mr. Chairman.

It is a great pleasure to appear before this distinguished committee and to speak on the subject of the bill S. 2495 and the amendment No. 1537 you are considering.

I don't think I would be qualified to speak on this subject by virtue of being a professor emeritus of chemistry. However, I have spent many years in Washington in various positions, including being member, chairman and general consultant of the President's Science Advisory Committee, and for more than a year and a half, as full-time assistant to President Eisenhower on science and technology. These experiences and others, which I won't mention here, have led me to the conviction that it would be to the advantage of the country and also to the benefit of the Presidency, if the President had within his circle of top advisers, an individual representing a science office, who had had experience in the various aspects of science and technology, and who could give a view on the technological aspects of many of the problems which have to be presented to the President.

The range of these problems is large. For instance considerably more than a quarter of that part of the budget that is subject to Presidential choice is of that nature, far more than the \$20 billion of the so-called R. & D. budget.

And so, needless to say, I am welcoming S. 2495 and its amendment wholeheartedly in principle, and what I have to say, although it may sound somewhat critical, refers to specifics rather than to the objectives of the main substance of the bill.

My most important criticism concerns the special relationship, statutory relationship, which is proposed in title 2, with respect to the Council of Advisers on Science and Technology, and the Office of Technology Application.

This special relationship, which comes close to putting management responsibility over the Office, in the Council, means to me that the Council will be very much weakened in its broader role, because it would have a special function, and therefore could not be seen as a dispassionate assessor of other activities of the Government.

I believe that it would be much better if there were no such special relation. My general position in my paper on Presidential science advising which was published in "Science" magazine on April 8, is that such a Council should have an analytical and critical function and be strictly free of administrative and managerial authority, which only weaken that function which the President needs.

I am also not completely convinced that the National Aeronautics and Space Administration, which is an extraordinarily skilled organization in the technology of space, and in special managerial techniques which are involved in this operation were the same agency orders R. & D. and then purchases the finished product, that such an agency is particularly suited to deal with the many civilian problems. Here the Government has to be only a catalyst for technological innovations in which the central issue is not the ultimate height of performance regardless of cost.

As you know, the cost of typical space products runs into thousands of dollars per pound, whereas civilian economy typically operates on products which cost only a few dollars a pound.

The dollar prices, I must say, keep going up rapidly, so a year from now I may have to change these figures. But they are indicative of how different the space and civilian technologies are. But that is secondary to my concern about the special relation to the proposed office, which I believe is bound to weaken the effectiveness of the Council.

My other points are minor. On page 4, the bill states that the Council may employ—and I am not clear whether that implies that it may also use staff by transfer from cabinet departments and independent offices.

I think such transfer would be very useful, in this case and presume this is implied.

On page 6, is an important point: Section 5, which, although it doesn't use the word "budget," speaks of the review and appraisal of the various programs, policies and activities of the Federal Government.

I presume that would involve participation in the budgetary process, and that is of great importance to a Council which is to propose new Federal policies to the President when appropriate. Such involvement in a budgetary process, coordinate rather than subordinate to OMB, is the only way in which the Council could have a clout over the various Executive agencies that is essential to insure cooperation and joint efforts to put into effect Presidential policies.

There is also one minor point on page 8. Section 101(1) speaks of the report which is to deal with developments in mathematical, physical, social, and life sciences, and engineering.

I subscribe to that, except I would like to see the word "social" crossed out, because it takes the report so far out that practically speaking it would not be possible to produce an effective document.

Surely the council should be primarily concerned with the influences

and impact of physical and life sciences, and engineering upon the social structure of our society, but that is different from dealing with social sciences as such.

Well, sir, this concludes my remarks.

Senator Moss. Thank you very much, Dr. Kistiakowsky. We appreciate your appearance and your assessment of S. 2495. We are particularly interested in the specific points where you would recommend some change.

I take it from your statement that you agree with the findings in the declaration of policy very much, but you simply have some rather minor suggestions as to some of the details?

Dr. KISTIAKOWSKY. Yes; I do.

Senator Moss. As you know, the President abolished the Office of Science Adviser in the early part of 1973.

Why do you think he did this?

And what are the advantages in maintaining such an office?

Dr. KISTIAKOWSKY. Well, sir, I am not a psychologist, and therefore I cannot quite fathom mental processes which led to that event.

In my article, I pointed out that Mr. Ehrlichman, in a press interview, when asked about the Office of Science and Technology then existing in the White House and what was its function, remarked that he didn't need any advice on policy. He just needed facts from that office.

Now, when you only ask for facts from an office, you don't have to have it next door. You can move it out. So, I haven't answered your question, but that is the nearest I can come to it, sir.

Senator Moss. It has been our feeling that abolishment of the Office of the Science Adviser constituted something of a downgrading of the whole structure of science and technology in the federal system. Therefore, that was one of the reasons we feel S. 2495 is needed.

Dr. KISTIAKOWSKY. It certainly has downgraded it very seriously.

Senator Moss. One of our problems has been the makeup of the Council proposed by this bill.

Do you feel the composition is contained in the amended version, do you feel that is desirable?

Dr. KISTIAKOWSKY. I believe that 3 members while not magic, is a reasonable number. It certainly shouldn't be big enough to be a committee, and unanimous consent was to be developed.

These have to be individuals, strong, competent, and that number is, therefore, appropriate.

I am troubled by one minor point in title 1, namely, if I read correctly the language, it instructs the President to establish a council and to appoint the members.

Senator Moss. Yes.

Dr. KISTIAKOWSKY. I have a feeling that it is not quite right for Congress to tell a President how he ought to organize his own office. It is a sort of an old ponit that you can take a horse to water, but you can't make it drink. And I remember, for instance, when Congress set up the Space council in President Eisenhower's administration, President Eisenhower privately kept saying he is absolutely against it and he doesn't want to have anything to do with it. He refused to Chair the council, told me to Chair it, and I passed the buck, since I

would be in the middle and be squeezed by the members. The council never amounted to anything during the Eisenhower administration.

I think that this is something which ought to be more in the nature of permissive legislation, making it easy and attractive to set up such a thing.

Senator Moss. Concern has been expressed that the established policy of the agencies might suffer if the council came into existence.

What is your response to that contention?

Dr. KISTIAKOWSKY. I think that is quite an incorrect assessment.

Senator Moss. Do you feel that the annual science and technology report is comprehensive enough, or overly ambitious?

What other recommendations do you have for improving the scope of the report?

Dr. KISTIAKOWSKY. I don't think a report like that should be comprehensive. The scope of science and technology in this country, about \$30 billion of R. & D. annually on the national level, is an activity which it is impossible to summarize effectively in a single readable document.

I think, therefore, such a document should identify the key issues which will be significant to the country in the future and talk about progress achieved, the stumbling blocks, the needs for radical change and so on, but I think it should be a very selective document. Otherwise, it will be quite useless.

Senator Moss. One point of contention is whether the tax money that we spend on our R. & D. ultimately benefits the average citizen.

Do you believe that Federal R. & D. money properly directed gives the average taxpayer a good return on his investment?

Dr. KISTIAKOWSKY. Yes, I do, sir.

I think it gives a considerably better return than some other money that is expended, and I think we have long ago passed the point where we could have chosen not to be a technology-based society. We are technology based, and our future is inextricably dependent upon technology to solve the problems of shortage of raw materials, to spread the higher standards of living, protect the environment and keep strong industrial activity and so on.

That does require R. & D. without any question.

So the only issue is, should the Federal Government be involved in it or not? Of course, actually more than half of Federal R. & D. goes to the military and military-related topics.

Whether all of them benefit the taxpayer, I very seriously doubt. But certainly the rest is essential because the private sector of the economy doesn't have the resources and the willingness to finance, especially the long-range efforts, because they do not bring in adequate returns at the moment.

If we are dealing with a single industrial corporation, there is always the concern that what they spend money on, on inventions, and then put it into production, it will then be copied by somebody else.

I used to be a consultant to a large chemical corporation, which I will leave unnamed, and the cynicism among the research staff was such that in quite a few of the laboratories, there was a big wall sign, "When better products are invented, we will copy them."

Senator Moss. Of course, the problem of the private industry is that they are in a profitmaking business. That is the reason they exist, and therefore, long-range R. & D. is a drain on them. They must pay dividends and consequently the management might be turned off if they spend too much on R. & D.

Dr. KISTIAKOWSKY. That is right.

The argument is that as a Nation we are big enough that what we do in R. & D., what we finance in long-range R. & D. is certainly of benefit to us as a Nation, as distinct from a typical corporation.

Senator Moss. Thank you.

I yield to my colleague from California.

Senator TUNNEY. Thank you.

I was interested in some of the answers to the questions Senator Moss put to you, Doctor. I have a sense that what we are talking about is that it depends a good deal upon the President himself, and his top advisors as to the impact that any science advisor is going to have on national policy.

Perhaps it is fair to say, and correct me if I am wrong, that it doesn't make much difference what the institutional structure is if the President doesn't pay any attention to his top science adviser. If that man is isolated from the decisionmaking process, it would be relatively unimportant what the structure is.

Dr. KISTIAKOWSKY. Yes.

In fact, it would be a waste of taxpayers' money to keep that office going.

I think access to the President, which implies that the President is interested in the views of his advisors, and feels that he is benefiting from them, although not necessarily accepting their advice every time—such access is absolutely indispensable.

When it is lost, the office might as well be abolished, as I said, and I suppose that is essentially what—

Senator TUNNEY. I am obviously interested in this legislation, as I am a cosponsor, as are Senator Moss and Senator Magnuson as well. We all have a very deep interest in seeing that the science adviser to the President is institutionally backed up within the Federal structure in a way that would give him ready access to the President, to the Oval Office.

But one of the things that depresses me a bit from what I have heard from you and from others, is that you can have the structure and have the science adviser in the White House and give him an office in the White House, but if the President won't listen to him, he really is not going to have much value to the President, or the country.

You mentioned the Eisenhower years where the science adviser was pretty well isolated.

Dr. KISTIAKOWSKY. No, sir, I was referring to the Space Council.

Senator TUNNEY. I see.

Dr. KISTIAKOWSKY. No, as the science adviser, I had contact, Dr. Killian, my predecessor, and myself had very good access to the President.

Senator TUNNEY. It was the Space Council you were referring to, I am sorry.

What is your assessment of the current science advisory apparatus and the dual role that the Director of NSF and Science Adviser to the President considers?

Dr. KISTIAKOWSKY. Without criticizing Dr. Stever, personally, because I think he is a very good man, I think he has been put in a difficult position. He has to plead with OMB for the NSF budget, for NSF policies, and the the other half of him is supposedly not dependent on OMB. And the point that I mentioned earlier is that a science adviser must be free of managerial and administrative responsibilities in order to be essentially like Caesar's wife, above suspicion, by the other agencies, of having improper preference to get more money for his projects and so on.

So I think that is a very bad arrangement. Dr. Stever is having some beneficial effect upon the Federal policies, but I would think that as time goes on, his position will become more and more untenable as Government people get irritated by things which he had to do and so on.

It simply is not a Presidential science advising. It is something entirely different.

Senator TUNNEY. Is your opinion, to your knowledge, shared in the science community as it relates to Dr. Stever's dual role?

Dr. KISTIAKOWSKY. I haven't found anybody who doesn't share it with me, but that doesn't mean that there aren't many who do not.

Senator TUNNEY. Are you recommending that the council review all agency R. & D. budget requests?

Dr. KISTIAKOWSKY. I don't think it should be necessarily an across-the-board review, because the details are so many that it could easily sort of make the Council lose itself in a mass of detail, and not see the forest for the trees.

I believe it ought to be given Presidential authority to inquire into any aspect of the R. and D. and related budget and I would like to emphasize that the military and military-related R. and D. budgets should certainly not be excluded.

One of the major weaknesses of Dr. Stever's position is that he has been told that he has nothing to do with those, and thus there is really no technical competence for looking at those budgets outside the Pentagon, which is really an extraordinary situation.

Senator TUNNEY. What interests me is that the military R. & D. effort is certainly the largest share of the Federal R. & D. effort.

What percentage of the total R. & D. effort, both public and private money, does the military R. & D. budget represent?

Dr. KISTIAKOWSKY. A few years ago when Dr. Foster was DDRE, that was 3 or 4 years ago, he delivered a public address in which he deplored the underfinancing of military R. & D., pointing out that it only added to \$13 billion out of a total national sum of \$25 billion.

To me that was really a horrible set of figures. I believe that now the figures are not quite as bad. That is, I think if you include the official military R. & D. which is about \$9½ billion, plus hidden portions, for intelligence and other such agencies, plus military-related NASA budget, plus AEC military-related budget, you will probably come to something less than half of the \$30 billion which is estimated

to be the national R. & D. budget, but not very much under \$15 billion ; \$13 billion is a possible figure.

Senator TUNNEY. Doctor, how does that compare with other countries in the Western World?

Dr. KISTIAKOWSKY. I believe it is relatively higher than in any major industrialized country in the Western World. There is no way of comparing it with the Soviet Union, or China, because we have no ground on which to base such comparisons. Certainly their military budget does not include R. & D. and R. & D. is hidden in the various other items.

Senator TUNNEY. As you know, the legislation that we have before us does not have any language in it that would give to the Council any explicit right to review the military R. & D. budget.

I am wondering if you feel that there should be language contained in the legislation which would give that explicit authority, or do you think that by doing so that we would pretty well have created sufficient controversy surrounding the legislation so that it would be impossible to get it through?

I am asking you now not as a professor emeritus, but as a person who has had experience in governmental infighting.

Dr. KISTIAKOWSKY. What experience I have had does not qualify me to assess the likelihood of passing a bill in Congress. I simply cannot judge it.

I would favor page 6, item 5, where you speak of the programs and policies and activities of the Federal Government, to include those in the domain of national security, or words to that effect, because the exclusion of that, considering that the rest of the language is not permissive, but very explicit, the exclusion of that implies that you don't want them to do it.

Senator TUNNEY. What kind of interface do you think that we ought to have between OMB and the council?

What sort of review should OMB have the Council's recommendations?

OMB apparently reviews every agency's recommendations nowadays. Do you think that we should make an exception in this particular case?

Dr. KISTIAKOWSKY. No, sir.

I think that OMB should continue reviewing all the budget, including R. & D, but I would think that in the review process of R. & D.-related activities, the staff of such a council should participate on a regular basis, and should have the authority also, to make inquiries on its own.

Senator TUNNEY. That is not quite what I meant.

I meant, do you think they should review the Council's report and be in a position where they can make suggestions, not only suggestions, but deletions, in that report?

Dr. KISTIAKOWSKY. Well, I would think that the Council, with the aid of its staff, could and should intervene with OMB in essentially two classes of events.

One is where it feels that a certain activity of the Federal Government should be terminated or downgraded as being unproductive, and maybe a little out of date, and another class, and a more important one comprises those activities which the council feels have extraor-

dinary promise for the future and which, therefore, should be supported regardless of any financial tightness of the budget as a whole. In other words, they should be given the highest priority.

I would think that this kind of advice and recommendation should be done on a staff level. If it is unaccepted, I would assume that the chairman of the council would go to the head of OMB as an equal, not a subordinate, and say essentially, "Look here, my boy, bookkeeping is all fine, but this is an important project, and I believe it should be supported strongly."

If there is a disagreement, I conceive of the issue being carried to the President.

I have participated in just that sort of thing in 1959 and 1960 in the budgeting process, including the presentations to the President, and I see no reason why it shouldn't be restored.

Senator TUNNEY. In other words, what you are saying is that they should be equal in the advice they are giving the President, and the Director of CMB should not be in a position where he makes the final decisions?

Dr. KISTIAKOWSKY. Precisely.

Senator TUNNEY. Thank you very much.

Senator MOSS. The Senator from Ohio?

Senator METZENBAUM. Dr. Kistiakowsky, in examining this proposal with your great experience in government, is there anything that you might suggest that would make it possible not only to move forward with the planning stage, the exploratory stage, but to further implement the actual program aspects so that the Office of Science and Technology would not only be making studies, but would be seeing to it that there would be an implemented kind of program?

Dr. KISTIAKOWSKY. Sir, my own feeling is that it would not be bad to have that office an analytical and planning operation, and let the existing Federal agencies do the management and implementation, which, of course, as we all know, do not always comply with the Presidential wishes. That is one reason why I think that involvement in the budgetary process would provide the council the necessary clout to insure that the implementation is carried out.

I am afraid that giving such a council executive responsibility could weaken its central role.

Senator METZENBAUM. I have no further questions.

Senator MOSS. Thank you, Doctor. We appreciate your testimony and your responses to our questions. Our next witness will be Dr. Edward E. David, Jr., executive vice president, Gould, Inc.

We are very pleased to have you, Dr. David. I must be excused. The Senator from Ohio, Mr. Metzenbaum, will preside. Senator Tunney had to slip out because he had to go to an appropriations markup that is going on. He will be back in a very few minutes. I don't like this revolving door thing, but we all have so many assignments that we have to try to keep all the balls in the air at once.

I am very pleased to turn the chair over to the Senator from Ohio, and we look forward to your statement which I will not be able to hear directly, but I assure you I will read it very carefully.

Senator METZENBAUM [presiding]. You may proceed.

STATEMENT OF DR. EDWARD E. DAVID, JR., EXECUTIVE VICE
PRESIDENT, GOULD, INC., CHICAGO, ILL.

Dr. David. Mr. Chairman and distinguished members of the Senate Commerce Committee, I appreciate the opportunity to appear before you to express my views on Amendment No. 1437 to S. 2495. I would like to make a statement and then would be delighted to answer your questions.

I am much in sympathy with the intent behind the amended bill. In my view, it is in the national interest that scientific and technological influences be manifest in both the upward and downward flow of activity in the Executive Office of the President. By upward flow, I mean the activities leading to policy making and decisions at the highest level. By downward flow, I mean the execution and implementation of those policies and decisions through R. & D. programs in the agencies and departments.

The need for such technical participation is perhaps self-evident. The principal issue concerns what form this participation should take. My thoughts about this matter lead me to a somewhat different image of an effective scientific and technological apparatus than that envisioned in S. 2495.

First and foremost, I believe that any new Executive Office science-based group must be more than merely advisory in character if it is to be effective and survive in the long run. Such a group must become a part of the operating executive mechanisms with recognized responsibilities and the authority to discharge them.

I have described such a group as a Council or an Office of Research and Engineering Management. Of course this title itself is not important. I merely use these alternative words to indicate an enhanced action and operational orientation as contrasted to the contemplative image raised by the title, Council of Advisers on Science and Technology.

The current advisory arrangement involving the National Science Foundation is purely advisory. Nevertheless, the Director of NSF and his staff have been helpful to OMB and other executive elements according to accounts. I have said before that it is too early to just see how effective this arrangement can be.

However, I believe it is essentially unstable. That is if NSF transcends successfully its past concerns solely with basic research and academic science and becomes more worldly it will rise in the executive hierarchy. If this growth does not occur, then the apparatus will atrophy or become completely subservient to other executive elements.

Regardless, I believe the Nation requires a science-based group in the Executive Office which is coequal with other policy and execution mechanisms.

In order for such a new group to be accepted and made legitimate in the eyes of administrators, assistants, and decisionmakers it must not be seen as an advocacy group for the technical community. It must serve the Executive, and it must not depend exclusively upon personal relationships for its influence.

Let me go into greater detail about these matters.

Unless such specific responsibility and authority are legislated or assigned by an executive reorganization plan, I do not believe a science and technology office or council in the Executive Office or as part of the White House can endure.

I appreciate this opportunity of bringing these views to your attention.

[Recess.]

Senator METZENBAUM. Dr. David, you may proceed. I am sorry I had to leave. I have had a chance to peruse your remarks, and I generally understand the thrust of your position, but I would like to ask you about your whole argument with reference to the Department of Science and Technology and your concern that if it exists that there would be a plurality of support for your industry and universities, and therefore there might be some loss as far as the universities and industry are concerned.

I wonder if you can expand on that and tell us whether or not you believe that necessarily has to be so.

Dr. DAVID. Well, Senator Metzenbaum, from the experience I have had in the past with government agencies, I can say that each has its own point of view with respect to the most important research and development programs, and which approaches to national problems are preferred.

Therefore, a proposal by either industry or university groups, or anyone outside the Government, or even proposals from laboratories inside the Government to undertake certain R. & D. programs are judged against the preconceptions of the particular agency which is evaluating the proposal. Programs which are extremely important can be turned down or denied funding because of these preconceptions.

I think it is very important to have more than one source of funding so that a group proposing an R. & D. program can have a second hearing or a third hearing in a different environment and with people who have different conceptions of what the problem is and how to solve it.

I would not think that this would be likely in a single organization.

Senator METZENBAUM. I think that a single organization just could not have that breadth of concern, and that it would have to be pulled apart or that those who have special interests would be able to be more effective?

Dr. DAVID. Well, it is a relative matter, Senator Metzenbaum. But I believe the single organization is likely to be governed strongly by policies from the top levels, and that policy is a constraint upon every element in that organization. Therefore it is easier to maintain the flexibility which I think is desirable in a pluralistic situation.

Senator METZENBAUM. If we were to follow your line of thinking, wouldn't an agency such as the National Cancer Institute or the Heart and Stroke Institute, wouldn't we just dissolve those? Because some might argue that there would be a division between the chemotherapists and the virologists and the radiologists, and yet isn't it in the national interest to try to bring all of these specialties together?

I have difficulty in following your thinking that you do better when you disperse and have no centralized kind of program as far as science and technology are concerned.

Dr. DAVID. I would say again that I think it is a matter of degree. I would not like to see all programmatic aspects of science and technol-

ogy abandoned, and I think the National Institutes are reasonably well organized to maintain a balance between diffusion and pluralism on the one hand and programmatic activities on the other.

However, when one program becomes too large, then the fabric of biomedical research does suffer. As a matter of fact, I think it is the opinion of many people that the medical and biological community is suffering because the national cancer program has gotten to be a very substantial fraction of the total funding in the National Institutes of Health.

Senator METZENBAUM. That is a division of the NIH vis-a-vis its separate participating agencies. I was addressing myself to divisions in the National Cancer Institutes itself. As the executive vice president of a multi-faceted company that it has to bring together a coordinated type of effort, I just wonder whether you aren't suggesting for government a different kind of program than that which you would advocate in the business world, because in the business world, your own corporation, you believe, is in a large number of areas, and I don't think they all relate exactly one to the other.

You seem to be doing a good job of it, and probably by your own direction, but isn't government in the same position?

Dr. DAVID. Yes. The corporations take the view I am talking about, namely that a great deal of research and development must be tied to a customer base, and therefore must be done by the divisions of the company which serve those customers. This is a diffuse effort related primarily to serving specific markets and specific customers. It is a pluralistic effort.

The central research laboratories spend a relatively small fraction of the R. & D. funds of our corporation, and I think that is true in most corporations. We look at that central R. & D. activity as a backup to the people who are serving customers, and as a means for infusing new ideas and vigor into the people who are serving the customer base.

Senator METZENBAUM. What do you think of the role Dr. Stever plays in the NSF?

Dr. DAVID. I have the same problems with it that I think Dr. Kistia-kowsky expressed. I want to go out of my way, as he did, to say that I think Dr. Stever is doing a fine job given the constraints under which he labors.

I do believe, as I said in my testimony, that the situation that he has is essentially unstable. He is purely an adviser to an unspecified mechanism in the Executive Office of the President. In order for a viable and effective mechanism to exist, the apparatus has to be more than merely advisory.

Senator METZENBAUM. Thank you very much, Dr. David.

Dr. Lee DuBridge.

We are pleased to have you with us this morning, Dr. DuBridge.

**STATEMENT OF DR. LEE A. DuBRIDGE, PRESIDENT EMERITUS,
CALIFORNIA INSTITUTE OF TECHNOLOGY**

Dr. DuBRIDGE. Thank you, Mr. Chairman.

During the period that has intervened since I first heard about this hearing and was asked to participate, I have been traveling, and I

have not had an opportunity to prepare a statement in advance, so I will simply make some remarks. I will be glad to answer any questions that you have.

As the previous two speakers have said, I also agree with the introduction and the policy formulation aspects of this bill. I agree with the thesis in the bill on the importance of science and technology to the United States and to the welfare of the people. I believe, also, the finding that it is desirable to have in the Executive Office of the President a suitable mechanism for insuring not only the health of science and technology, per se, but insuring that the best results and the best talents in the fields of science and technology are brought to bear on national problems, issues, and policies.

As Dr. David said, one must have a policy for science and also use science in the formulation of national policy. Both of these are important, and I think a council of the sort that is proposed here should and can perform both of these functions to insure that science is incorporated in, and is considered and is made a part of, national policy.

At the same time, the policies of the country are such that science can strengthen them and contribute more and more to the strength of the country.

I have been in favor of creating in the Executive Office of the President a council for science advisers, or for science and technology, or with some similar name. Therefore, I endorse completely the idea proposed in this bill, that there be such a council, and that it be constituted about as you indicate in the bill, and that it be of the size and in general perform the functions that you outline.

So I think I would say that I am in general in support not only of the import, but of most of the specific provisions of this bill.

I have not had the time, however, to review every sentence. I do hope that the committee and the staff will check carefully with the recommendations of the Killian report, which outlines, I think, in an effective and comprehensive way the kinds of functions and relationships that such a council should have to the other offices within the Executive Office of the President, and to the other agencies of Government.

I think many of the recommendations in the Killian report, which I subscribe to, are possibly not appropriate to include in legislation, because they specify relationships which in fact have to be left to the President when the council is created. But I think if the legislative history of this bill includes the general thoughts that the Council of Science and Technology should have relations to the Domestic Council, the National Security Council, the Office of Management and Budget, and other agencies in the White House as well as close relationships to all departments and agencies of government which had to do with research and development, this will be helpful to the President and to the council members themselves eventually, in implementing and expanding and carrying out the intentions of the Congress.

The portion of this bill that has to do with the creation of an applications office in NASA, I have serious reservations about. NASA has a particular area of technological interest and concern and competence, and NASA has already been doing what it feels it can do in transfer-

ring this new knowledge and new results of their technology into the civilian and nonspace sector.

As has been mentioned by Dr. Kistiakowsky, this is not easy, because a navigation device that will go on a spacecraft may cost hundreds of thousands or even millions of dollars, and it is not quite feasible as a navigation device on a commercial airplane, although the functions it performs may be exactly what the commercial airplane needs. The cost involved is too great.

This is a tremendous task, not an impossible task, of converting the space instrumentation and equipment to commercially adaptable equipment, and I think NASA is trying to do this, and should do it.

I would prefer that the Congress authorize any agency of government, NASA, the Department of Defense, the Atomic Energy Commission, the National Science Foundation, HEW, and any other agencies that are heavily involved in technological R. & D. to spend money and hire staff for the specific purpose of transferring into the private sector the results and the ideas and the equipment that have been developed by these agencies with government funds, so that there can be a continual transfer of knowledge and ideas and technologies from the government into the private sector.

This ought to be flowing freely—not just allowed to happen, but to be encouraged. So, rather than just say it would all be done by NASA, I would prefer that every agency of government be authorized to seek appropriations for the purpose of carrying out this function of the transfer of technology from the public into the private sector.

I think it is important now, going back to the Council of Science and Technology, that two things be noted: First, that the policy aspects of its duties be emphasized, and that it be authorized to have funds to hire adequate staff and to enter into contracts with study agencies to develop policy recommendations for the President and for the Executive Branch of the Government.

I think this is provided, and I just want to emphasize how important it is that policy aspect be strengthened.

While I was in OST, we did try to build a stronger policy study group. However, our budget was inadequate to do that to the extent that we would have liked to have done it.

This brings me to a second point which probably cannot be accommodated in this legislation, but I hope in the legislative history it will be emphasized, that this office of the council must be adequately financed. That doesn't mean that it is going to be hundreds of millions of dollars. I do know that the OST in my day had a budget of something like \$2 million. I regarded this as quite inadequate. There were many staff positions that we wanted to fill; we wanted to get higher level people. I wished to have a second deputy as well as a single deputy in the Office of Science and Technology. We wished to organize a policy study staff, and we did not have funds, or authorization for personnel for that purpose.

We often ran short of fees for consultants that we wanted to bring in to form advisory panels. We even ran at times short of travel funds to take care of the travel of the members of the advisory consultants that we wanted to bring in.

So I do emphasize the importance of an adequate budget. What it should be, I don't know. I think \$2 million is too small. Maybe \$4

million is as much as could be used after the office gets organized and going.

I would like to comment, though, I hesitate to do so extensively, on Dr. David's remarks about what he called the management function of an office in the Office of the President.

My definition of management, I think, must be different from the one that he has in mind, because I do not think that an office within the White House can have real management responsibilities in the sense of running laboratories, hiring scientists and technologists, formulating and directly managing research and development programs.

I do think, however, that management oversight of the type that is done now by the OMB to check on the management of R. & D. by Government departments and agencies is a feasible function and is a function that we tried to do in OST where we saw programs falling on their faces or inadequately being pushed forward because of inadequate management.

We tried to bring pressure on the departments or even inform the President that something needed to be done to improve the management.

I think this is an important function, but the actual putting of a White House agency into the direct management of research, I don't think that is what Dr. David meant, and I hope you don't interpret his remarks that way if I am correct in my interpretation.

I think, Mr. Chairman, those are the only points. There is one other remark: It has been often said that there is no use creating a council or office of science and technology or anything else in the White House unless the President wants it. This is indeed true. I trust that in the deliberations of the Congress, both in the House and the Senate, that there will be, as soon as these bills have been drafted, there will be close liaison with the White House staff so that when the bills are prepared, the White House will indeed go along.

I know this has happened in the past. The White House may initially have been doubtful or opposed to a bill being considered in the Congress, but when the facts were out and the discussions were pushed forward, an agreement was reached.

I believe liaison with the White House on the kind of structure you are here proposing would be good.

The question of how close the science adviser has to be personally to the President is not an easy one to make flat assertions about. I think there have been cases where the personal relations between the science adviser and the President have not been terribly intimate, or terribly continuous, or terribly frequent, and yet in which the adviser and his office were very effective in dealing with other agencies of government, with the DOD, and HEW, and other agencies having R. & D. responsibilities.

The fact that this office is in the White House gives it a great deal of influence with other agencies and departments of government, and it can exert a large and wholesome effect upon the effectiveness of the Government's R. & D. program even though the science adviser personally is not seeing the President every day or every week.

There must, however, be a clearcut indication that the President is interested in the work of this office and the other departments must know this.

I think that concludes my statement.

Senator TUNNEY [presiding]. I was wonder, Dr. DuBridge, if you had an opinion, and maybe you expressed it already—on the functions of the Office of Technology Application which in the legislation is, of course, put under NASA.

I was wondering if you thought that that Office of Technology Application should be separate, or should exist at all?

Dr. DuBRIDGE. I find it difficult to imagine how a single central Office of Technology Application of the sort that you visualize here can be effective. I am sure you don't intend that such an office be located in the Executive Office of the President; on the other hand, if it is within any single department or agency, then it can be inadequately effective on a broad enough scale, a wide enough range of technologies to do the job that you would like to do. That is why it is my feeling that every department or agency having substantial research and development responsibilities and activities be authorized and encouraged to do its utmost to transfer its technology into the private sector as rapidly and effectively as possible.

I have been told that some agencies would like to do this more actively, but they do not feel it is within their authorization, and they can't get the funds and staff to do it. It is by no means easy to transfer technology into a new area and for new purposes. A great deal of effort, writing reports, consultation, rewriting descriptions of technological developments so they are suitable and understandable by other agencies is a big job and takes money and staff.

I would like to see the authorization and encouragement for that placed in every department, and not in any single one.

Senator TUNNEY. One of the things that I have heard caused the greatest difficulty in transferring technology from the Federal sector to the private sector is our patent laws, and could you just—I mean that is a whole other area that I know we could spend hours on, but would you just care to briefly describe that problem as it relates to the question of technology application and transfer?

I am probably asking the impossible, but would you quickly summarize your thoughts on that?

Dr. DuBRIDGE. I must say it is an impossible question for me to answer. The patent law and provisions have always been among the great mysteries in my life, and I have not had very much contact with them.

I do feel that there is much misunderstanding about the purpose and function of a patent and the patent law. For example, for the Government to take a patent in its own name over some device that has been developed under Government contract has always seemed to me illogical. That is because Government funds were used for a public purpose.

If an invention is made under a Government contract, the Government should want that invention to be used for the public good. The only way the invention could be used for the public good is for it to be produced and made available to the public; and the only production mechanisms in this private capitalism system that we have is for an industry, a company, to get the idea and to put it into practice; and to make the goods, produce the goods, or equipment and whatever it is, and make it available for the public. If patents

prevent this sort of thing happening, then your funds are not being adequately used for the public good; and though you think, when a patent is used by the Government to hold onto information, it is exactly the inverse of what the patent law ought to be doing. The patent law ought to make wide use possible within the private sector.

Now, in a private program, a patent is a different thing. They would like to hold onto that information and the rights to use that patent until they have had the chance to develop it and get it into use and recover their development costs. This is a perfectly proper thing for a private company to do. I don't think it is proper for the Government to adopt this same attitude.

I am afraid that is all that I could say in answer to your question.

Senator TUNNEY. I understand what you are saying. Your statement is very good. I am concerned about the problem, and I serve on the Judiciary Committee as well as on the Commerce Committee, and we are now undertaking to study patent laws; and there will be a reform bill soon reported by the patent subcommittee. I am concerned about the problem as it relates to public funds being used to promote research by private concerns. When there is a breakthrough that would be subject to patent, what type of profit incentive should be given to the company or the individual in the private sector that developed the new process for the purposes of perhaps encouraging others in the future to contract with the Government for similar purposes? I don't know whether there should be some kind of mandatory licensing scheme, which seems to me at this time to be a good approach, and then give some royalty to the developer of the invention.

There are others that suggest that what we ought to do is to just have the Federal Government own it under all circumstances, and disseminate it and distribute it without any kind of royalty payment being made to the developer, that his payment was adequate at the time he made the contract.

One of the things that I do know within my own limitations in the subject matter, as you have expressed yourself—I just have not had enough experience in the field to really have a valid judgment—but do you think this new council could be effective in helping to reform our patent policy?

Dr. DuBRIDGE. I think it is very important that the patent policy of the country be considered. The Office of Science and Technology has been engaged in deliberations and has made proposals for changes in the patent policy of the Government for a number of years, and a report on this was issued while I was here, making some recommendations on U.S. Government patent policy. I have forgotten what the specific recommendations were, but they were comprehensive and seemed to be acceptable to all departments of the Government represented on the Federal Council, and I hope by now those recommendations have gone into effect. I do not recall to what extent they required changes in the law.

Senator TUNNEY. The only thing I can say is that I have had several governmental employees who are inventors and are developing new processes, tell me that they thought that the Government patent policy was a nightmare as it related to them, and that it was inhibiting breakthroughs and new discoveries. I am ashamed to say that it was impossible for me to follow up on that problem, because

of the multitude of other responsibilities that I have, but it seems to me that if there is that kind of criticism by Government employees, that we ought to have a policy that is sensitive to the viewpoints of those employees. Maybe the new council could look into it, and in a way that would develop a policy that would be more adequate.

Dr. DuBRIDGE. My experience at Cal Tech was that the Government patent policies, particularly as they applied to the Jet Propulsion Laboratory, were, in the word you used, a nightmare. We felt they were a damper on the free, creative instincts of the people on our staff.

Senator TUNNEY. Do you think the Council should get involved in military R. & D. matters?

Dr. DuBRIDGE. I certainly do. It seems to me a primary weakness of the present arrangement is that Dr. Stever in his capacity as science adviser has no authority in the field of military research and development. I think one of the greatest achievements of the President's Science Advisory Committee throughout its history has been its contribution to better technology in our defense system.

Mr. David Packard, shortly after he retired from his position as Deputy Secretary of Defense a couple of years ago, told me privately that the Defense Department was going seriously to miss the advice of the President's Science Advisory Committee, because he felt the independent advice on weapons technology which had come through the years from the Science Advisory Office and the President's Science Advisory Committee were invaluable to the Department of Defense. It helped them to evaluate and examine from an external point of view the technological values, the technological soundness and potentialities of various weapons systems that were being discussed or developed.

Furthermore, the defense technology is in many areas closely related to technologies in other areas, such as space, atomic energy, and even certain areas in the biomedical field.

Technology is interrelated across the board. To suppose that a separate office of military technology is one thing, and all other technology is something else, is a misapprehension. I think the two should be covered in the White House.

Senator TUNNEY. How close do you think that the relationship between the President and the Council should be? Do you think there has to be a ready access to the President?

Dr. DuBRIDGE. Well, I think the greater access the better from the point of view of the work of the Council and its effectiveness in the Government.

As I said a while ago, the intimacy of that relationship will depend very much on the personality and the tastes and the habits of the President himself, and on the qualities and personalities of the staff people around him. I don't think one should expect this relationship to be the same from one administration to another, or even from time to time in the same administration. But the existence of such a council, its attachment to the White House structure, and the knowledge that it is the President's instrument, I think gives it the necessary clout that it will need.

You can't legislate the intimacy of the relations between the President and anybody on his staff, and it will change, and I think it can be expected to change.

But I do think leaving the structure in the White House will give the President opportunities to use it which any President, I am sure, will do to a greater or lesser extent. More important even than just advising the President is the advice and help that such an agency can give to all the other agencies and departments of our vast Government, nearly all of which are concerned in some aspect or another with the problems and potentialities of science and technology.

Senator TUNNEY. What relationship should there be between the existing Federal Council of Science and Technology and the new Council that is envisioned in the bill?

Dr. DuBRIDGE. I think the confusion of names is unfortunate, and maybe one or the other should find a different name, but the functions are very clear and the compositions are very different.

The Federal Council is a committee which meets once a month or whatever it is, with many subcommittees—a committee composed entirely of officers of the Government, members of the Federal establishment that have scientific and technical responsibilities within their departments. In some cases, the member of the committee may be the head of the agency, such as Dr. Glenn Seaborg, when he was head of the AEC, and so on.

The Federal Council is a committee of Federal officers responsible for scientific and technology R. & D. management. I think that is very important for them to have meetings and exchange ideas, and getting their ideas together on specific problems or proposals, such as this patent issue. This is a very important and specific coordination function within the Government R. & D. establishment. As you know, this other new Council of Science and Technology has a very different function. The confusion about names may be something you would like to look to.

Senator TUNNEY. Of course, the new Council would be a participant in the Federal Council?

Dr. DuBRIDGE. I would assume the Chairman of the new Council might continue, as in the past, to be the Chairman of the other Council, yes. The science advisor was always ex officio Chairman of the Federal Council, and now Dr. Stever is Chairman of it.

Senator TUNNEY. Thank you very much, Dr. DuBridge. It is a real pleasure having you here. I have had the opportunity to visit Cal Tech on a number of occasions, and also have had the opportunity to be a frequent visitor at the Jet Propulsion Laboratories.

Dr. DuBRIDGE. Please come again.

Senator TUNNEY. Thank you.

Dr. Donald Hornig, president, Brown University, Providence, R.I.

**STATEMENT OF DR. DONALD F. HORNIG, PRESIDENT,
BROWN UNIVERSITY, PROVIDENCE, R.I.**

Dr. HORNIG. Mr. Chairman, I appreciate the invitation to present my views with respect to amendment No. 1537 to S. 2495, the Tech-

nology Resources Survey and Applications Act. My views are based on my experience on the President's Science Advisory Committee under Presidents Eisenhower and Kennedy and the 5 years I spent in Washington as President Johnson's science adviser. Circumstances have changed since then and I recognize that structures which are appropriate under one set of historical circumstances become inappropriate with the passage of time. Nonetheless, on the basis of my experience and observations of the Government process I feel that some conclusions remain valid.

The Science and Technology Applications Act, in my view, provides a sound answer to a most difficult problem, the provision of scientific and technical advice at the highest levels of our Government and the incorporation of scientific and technological considerations into political, social, economic, and security policies. In all of the discussion I have heard of this subject there seems to be no dissent from the proposition that the science and technology are central forces which will shape the future of the world, on the one hand, and provide powerful tools with which, intelligently used, we can meet our problems and shape our destiny on the other. They enter into a host of national positions and policies, which we do not think of as scientific in themselves. We just have to find a way of introducing these considerations to the President and those close to him, most of whom are trained in law, economics, business and so on.

I am very pleased, therefore, that this outlook is clearly and forcefully put in the policy statement of the amendment. It recognizes also that if this be true it is the responsibility of the Federal Government to insure that science and technology are fully used to assist in meeting current and prospective national problems. More than that, it recognizes that to do so the Federal Government must nurture and cultivate the capabilities of its departments and agencies, of State and local governments, and of universities and industries. Furthermore, it must lay the groundwork through education, training and research for the availability of these resources in the future.

Finally, it recognizes that under these circumstances the President, his staff, and all of the top executive officers of the Government ought to be well-informed as to the probable impact of scientific and technical developments on national security and national welfare as well as on other Federal programs. They should also understand the opportunities science and technology may provide to attain new goals. The question is how the Executive Office should be structured to provide and use advice so that we may have wise leadership for the country in an age when scientific and technological considerations enter almost every major policy decision.

The question is also what the management role of such an agency in the Executive Office should be vis-a-vis departments and agencies, and how responsibilities within the Executive Office should be divided.

When I left office in 1969 I recommended the establishment of a three to five member Council of Scientific and Technical Advisers. That suggestion still seems sound to me and I am pleased that this amendment would provide a statutory base for a much better version of that suggestion.

It lays a correct emphasis on the close tie the Council must have to the President. To me this is essential. The Council will only carry

weight in its various roles and duties to the extent that the head of the Council has access to the President and his immediate staff and is perceived by others to have this access. Others in and out of the Government pay attention to the President's advisers to the extent that they believe them to have the confidence and support of the President and his close associates. This is a point to which the bureaucracy is very sensitive and the influence of the Council will depend heavily on the support it receives from the President. For this reason, I see no point in establishing the Council unless the President can be persuaded that he needs it to meet his responsibilities and that it will be an asset to him, or at least that he gives it his benevolent consent.

It was also my conclusion when I left office that it would be wise to ask the Council to submit to the President and the Congress an annual report on the state of U.S. science and technology, roughly analogous to the annual economic report. I still believe that this is an important function. I only caution that such a report must be carefully planned and researched. It cannot be an incidental task of an overloaded staff with other responsibilities. This may be a danger, since the Council is given a great many responsibilities but with the assistance of NSF this danger can, I believe, be overcome. The report will lend a focus to the activities of the Council and provide a specific tool for identifying those major problems which concern the President and the Congress and the public, and should provide a vehicle for the discussion of the major issues with the President and his staff.

As to the functions of the Council, goal setting and coordination are badly needed as is the collection of information and the performance of analyses. I can only concur in the instruction to work with Federal departments and agencies, professional groups, representatives of universities, industry and so forth. What is not said but I hope is understood is that it must not merely consult but bring to the assistance of the President the very best thinking that exists in every relevant sector.

Whether all of this can be done by a small executive staff causes me some concern, but the ability to call on NSF and other Federal agencies, but particularly NSF, may provide the appropriate answer to my question.

My main concern is with the programs review and appraisal function of the Council. It offers a temptation for bureaucratic tinkering and meddling rather than intelligent broad oversight and direction. It is a role which competes for time with policy advising to the President so that it must be done selectively and with discretion. The Council must not be asked to exercise a degree of supervision which is incompatible with a small, flexible, high quality office. And I should add, which is not compatible, I think, with the role of the Executive Office in any case. This has been touched on before. Nonetheless, if the supervision is directed toward major programs, either in terms of size or significance to the President and the Nation, this difficulty can be avoided. It is in this function that the Council must work very closely, with the OMB. I might say it is in this function, also, that the analogy with the Council of Economic Advisers breaks down somewhat. The Council of Economic Advisers is charged with macroeconomic policy questions, taxes, fiscal policy, monetary policy, unemployment and so

on; it is not charged with reviewing, the effect of every agency and its programs on the unemployment situation, for example.

In the case of economics, this detailed overview function, of course, is given to OMB. It is a division of labor.

In this case, I think it is appropriate to give this responsibility with discretion to the new Council, but it must not attempt to have an overview of everything, because the OMB, after all, has an enormous staff.

I am not prepared at this time to comment in detail with respect to title II—the Office of Technology Application. The charter of the office is so broad that it is hard to evaluate the potential impact it may have. The charter it has is so broad that I have the same reservations mentioned by previous witnesses. NASA is enormously competent, and it has an enormous body of skills. On the other hand, technology application is what approximately \$12 billion of industrial research is about. I don't think that NASA has a particular background or ability to translate advanced technology into economically workable applications. Furthermore, it seems to me that the extent to which title II indirectly involves the Council in the direction of experimental projects, and dilutes the function of an organization which is already assigned an overpowering list of responsibilities weakens the Council. I suppose my main concern about the bill as a whole is that if the Council can selectively do all the things that are mentioned, it is very good. I think no reasonable Council can really be expected all the time to do all the things that are described. Anyway, I therefore confess to some reservations as to whether title II strengthens or weakens the amendment.

In conclusion, I strongly support the statutory creation of a Council of Advisers on Science and Technology to advise and assist the President. We are in the midst of a continuing revolution based on the systematic application of knowledge and skill to the problems of our society. It cannot be ignored in the political process and must play a part at the highest levels of our Government. I hope the chief executive will concur in this view and that the Congress will give a strong statutory base to a Council by passage of this amendment.

The CHAIRMAN [presiding]. Thank you very much. I am sorry I was a little late getting here today, but I have been on an airplane returning from Washington State and we had some technological difficulties.

Don, what we are trying to do, and you can throw some light on this since you were a President's science adviser, we had the advisers to the President on these various matters, and I found and I think that you must have found, that you were mainly dealing with Government agencies, were you not?

Mr. HORNIG. That is correct.

The CHAIRMAN. So you were tied up with something that might have been an intergovernmental agency matter. This is the problem we had in oceanography over the years. What we are trying to do here is to see if we can't get some form of independence established, if it is by a Council or otherwise, to advise the President, rather than have it all come from a Government agency.

Do you agree with that? Now you have to work with the agencies, I understand that.

Mr. HORNIG. I think it is absolutely essential that there be someone close to the President, who is independent of the agencies, who can get advice and assistance and studies from any quarter whatever, so that the President and the Congress, for that matter, have access to an unbiased point of view. Because agencies, no matter how good, as you know, have their own history to contend with, they have the responsibilities for the programs they have built up over a period of years, so they always have a position. The President has got to be a free man.

The CHAIRMAN. Yes. I was hoping that by setting up this kind of council—we haven't any particular pride of authorship, whether it should be 3 or 10 or what—but to get some independence and some outside views and not be tied to the parochial interests of the agencies.

I suppose all of the people here this morning that were down there as the adviser spent 90 percent of your time meeting with agencies, is that right?

Mr. HORNIG. No, I don't think so.

The CHAIRMAN. Well, not your spare time, but your time down there.

Mr. HORNIG. Well, we had a lot of contacts with groups from outside of the Government. But I think within the Government there was a great part of the effort, yes, spent with the agencies.

The CHAIRMAN. Not that this is wrong, you have got to have this liaison and dialog with the agencies. But they seem to take it over and then they get into arguments, feuds.

I know what happened on oceanography. It got slowed up at least 5 years, because everybody wanted to get into the act.

This is what we want to avoid with this bill. We are glad to get your suggestions. The Senator from California has done so much work on it. So has Senator Moss.

The reason we have been doing this—and doing it so quickly—is that apparently the old office down there that was reporting to the White House is gone. And I don't think this is right in this day and age.

So I thank you very much for coming. The Senator from California and I have had many conferences on these matters and discussions over the past few years.

I have no other questions.

Mr. HORNIG. Thank you, Senator.

The CHAIRMAN. We will recess for 5 minutes. We have a vote on the floor. I will be back shortly.

[Recess]

The CHAIRMAN. Mr. Chairman, I asked Mr. Hornig a few questions, and I had no more to ask him, unless you do.

Senator TUNNEY [presiding]. I have just a couple of questions, Mr. Chairman.

I was wondering, Doctor, if you would comment on the difference between science policy and the policy for science.

Do you feel that this council should be involved in both?

Mr. HORNIG. Well, with the analogy to economics I gave in my statement, they are of course the Council of Economic Advisors that are principally involved in generating policy, macroscopic economic policy, and are not involved in the management function.

I think it has to be involved in both here, but it presents, I think, the biggest difficulty, because I think the problem of managing, helping to manage R. & D. can be a trap for a small group.

It is a big job. I think it is essential, I think the most essential function in the management of science is the goal-setting and coordination role and particularly working together with OMB in setting priorities in the budgetary process.

Senator TUNNEY. How about with respect to OMB? Do you feel that there should be a co-equality?

Mr. HORNIG. Absolutely. I think I could not have functioned except for the fact that at times I could disagree with the then Director of BOB, and we would both take our case to the President for resolution. If it weren't for the fact that occasionally I was invited down to the ranch to sit in on final budget decisions in parallel with department heads and the Director of BOB, I wouldn't have carried any weight.

This co-equality is terribly important, just in the ambiance with which the director will deal with agencies.

Senator TUNNEY. You indicate that you view the annual report as a critical function, but you also commented that perhaps other functions of the council would be diluted in importance.

Do you have any suggestions as to the structural form or the status of the council that would perhaps make the report a significant aspect of the council's work without creating problems that you suggest could otherwise occur?

Mr. HORNIG. I think the problem you raise with respect to the report occurs generally, that the task is almost too big for what you can do in the Executive Office as we now conceive of it.

I think there is a limitation which goes beyond the report and to me it looks like this: I don't believe that while we are trying to restrain the size of the Executive Office of the President any organization with more than 25 or 30 people fits the Congress' or anyone else's idea of what ought to be in it.

I think it will be hard to give it as part of the Executive Office a budget of more than \$2, \$3, or \$4 million. So there is a restraint there.

So what do we do? I think the answer both for the report and for these other functions is to fall back on the studies conducted primarily in the National Science Foundation, but also in other agencies, to rely on expertise wherever it exists in the Government. I think it can be done.

Senator TUNNEY. One final question, and that is with respect to title II.

You have expressed reservations about title II. Other witnesses also have expressed reservations and you have identified with the remarks they have made.

I wonder, do you feel that title II should be deleted from the legislation?

Mr. HORNIG. As I indicated, I don't think I have thought that through adequately. I don't think the legislation would be weakened without title II.

Senator TUNNEY. You don't think it would be weakened without title II?

Mr. HORNIG. That is right.

Senator TUNNEY. Some of the witnesses, or at least one of the witnesses, suggested that it is very difficult to give to NASA the responsibilities that are suggested in title II. It was mentioned that in a capitalistic society, technology application to a considerable extent is dependent upon the mechanisms of the marketplace and the ability of a private corporation to utilize the technology and science for the purpose of putting out a product that could be sold. NASA just does not have any special expertise in this particular area, although they have great expertise in other areas.

I understand that you agree that NASA does not have any particular expertise in this area.

Mr. HORNIG. Well, NASA has some very great skills and in some very specialized areas, but it is not used to developing things for the marketplace. I suppose that within our Government the technological agency which has the most expertise in technological application, if you like, is the Department of Agriculture.

Senator TUNNEY. Right. Thank you very much. I appreciate your testimony. It is very kind of you to have come down and given us the benefit of your thinking at this hearing.

Mr. HORNIG. I appreciate the opportunity to be here.

Senator TUNNEY. Thank you.

Our next witness is Dr. Edward Wenk, Professor of Engineering and Public Affairs, University of Washington.

**STATEMENT OF DR. EDWARD WENK, PROFESSOR OF ENGINEERING
AND PUBLIC AFFAIRS, UNIVERSITY OF WASHINGTON, SEATTLE,
WASH.**

Dr. WENK. Thank you very much. Mr. Chairman, members of the Senate Commerce and Aeronautical and Space Sciences Committees: The Science and Technology Application Act of 1974 that is before your committee could well prove one of the most salient measures of national technological policy of this decade, and it is thus a very special privilege to have been invited to testify on its provisions. May I add that it is also a great pleasure to renew an association with both committees. As Executive Secretary of the National Council on Marine Resources and Engineering Development, I reported to the Commerce Committee. That Council, incidentally, was designed by this committee as a presidential advisory body devoted to marine technological affairs, and in this commentary I shall try to share insights as to its track record which could provide guidance for the measure now under consideration. I also had the privilege of undertaking policy studies for the Aeronautical and Space Sciences Committee while on the staff of the Legislative Reference Service, and regard that association as instrumental in my own education in technology policy.

This review is thus based on a perspective of direct involvement in science and public policy since 1959, that includes an appointment to the White House Science Advisor's Office, and currently vice chairmanship of the Congressional Technology Assessment Advisory Council, and a continuing analysis now from outside government at the University of Washington.

As I understand the thrust of this measure, it is to correct a critical shortfall in the contributions which science and technology could make

toward improving the human condition. That proposed remedy involves institutional reform, primarily by creation of a new statutory Council of Advisors on Science and Technology located in the Executive Office of the President, "To provide a direct and effective source of analysis and judgement to the President, drawing on the best talents available within and outside the Federal Government." Title II would also establish a Technology Application Office in the National Aeronautics and Space Administration, ostensibly to direct that agency's technical resources to a broader area of public service.

I should like to endorse both the intent of the measure and the proposed advisory machinery of title I. However, I should like to suggest several changes in specific provisions of the bill so that Congress does not inadvertently reinvent older and perhaps obsolete mechanisms. And I should like to add a further set of considerations that go beyond structural reform, but which I believe to be crucial to effective implementation, if new instrumentalities are to meet your expectations and those of the Nation.

By way of introduction, I should like to explain premises which underpin these remarks, particularly as to the social and political context of Presidential advisory apparatus dealing with science and technology, and with changing circumstances that may prompt different approaches from the past.

THE CHALLENGE TO THE PRESIDENT—SOCIAL MANAGEMENT OF
TECHNOLOGY

Within its rich and varied legislative agenda, both committees have been particularly aware of how our society copiously employs specialized technical knowledge to achieve its needs and wants, and to protect man from the harshness and caprice of his natural environment, to facilitate life free from hunger, poverty, and disease, and to provide high standards of living to a steadily increasing fraction of our population. There is ample evidence, however, of grievances inadvertently prompted by technology on the one hand, and on the other, of unrealized opportunities to deploy science and engineering because of conflicts in goals and because of institutional constraints in a pluralistic, democratic society.

As several public opinion polls have shown, our technical prowess has not always been matched with social satisfaction. For most citizens, the problem is not whether science and technology can be servants of society, but toward which goals, and how.

Accepting as we have that technology served as an amplifier of man's muscle and more recently of man's mind, we have been late discovering that technology has also served as amplifier of defects in our social organization. Indeed, technology has revealed a number of significant attributes:

(1) It promotes growth in scale of human enterprise, in fact, becomes an organizing principle for capital and enterprises which tend to follow well known principles of self preservation.

(2) It produces inadvertent, unexpected second and third order consequences which may be either harmful or benign. Indeed, the arena for innovation has become so crowded that narrowly conceived developments do not mature in isolation but collide with other initiatives.

The consequences are often not detected until an enterprise has developed such momentum that remedies are economically expensive, politically difficult, or both.

(3) It inextricably intermingles nature and man. The ancient distinction between artificial and natural influences becomes even more elusive as we prolong life through organ transplants, steer hurricanes, and simulate man's intervention with nature on our computers.

(4) It couples otherwise disparate-social organizations and may bring them into conflict (as urban freeways bring together the black community and the highway lobby).

(5) It has historically fostered unwitting and swift use of non-renewable resources.

(6) Finally, technology increases the role of Government. It is difficult to find any technology today in which Government is not significantly involved. There are incentives to private industry through tax writeoffs, grants, and subsidies; Government regulates occupational safety, food and pharmaceuticals. Government defrays social overhead by sponsoring research. Finally, at all levels, Government engages in many key enterprises which employ technology.

At one time, the Government's conscious technological involvement was directed toward principally defense, atomic energy, and space. For these missions, the Federal Government determined the scale and mode of R. & D. and directly applied these discoveries. It was its own R. & D. client. But today, to contribute to economic growth and industrial productivity, to improve transportation, prevent or control crime, to manage the environment, provide health care, or assure a stable supply of energy, the Federal Government is given a vital role in reflecting collective needs and aspirations of society and as a steward for protecting the environment where the people themselves are the clients. That government role in civilian technology was illuminated at least as early as 1962; yet it has since stuttered and staggered in bursts of unproductive attempts to function in the civilian arena.

Because of the Government's pervasive role, the President has in effect become the systems manager of all our Nation's technology. He occupies the central position of power to set national priorities of public purpose and public purse, to harness the energy of a variegated people with a delicate balance among different interest groups. He invokes key decisions for nourishing science resources of research and manpower, for deploying these resources toward priority objectives, and for exploiting technology to meet public needs. By virtue of the pace and complexity of decisions, and potency of consequences, the technological age has injected a new order of complexity in public administration. It has also increased pressure on the budget. Inevitably some of this incremental burden of administrative pressure falls on the President.

It is therefore appropriate that your examination of the effectiveness of our Nation's science and technology enterprise focus on the Office of the President and the capabilities which surround him, to advise and assist in carrying out his constitutional duties.

Any analysis of decisionmaking by the President on technology policy issues should evoke fundamental questions on the dynamics of reciprocal interaction of technology and society. With considerable

insight, section 2(a) of the statement of findings and declaration of policy recognizes not only "the profound impact of science and technology on society," but also the complex web of "the interrelations of scientific, technological, economic, social, political and institutional factors."

One way to convert to operational terms this important holistic and multidisciplinary approach taken in the bill is to consider the notion of a technological delivery system. Such a concept serves to portray how the intricate processes by which technical knowledge from the research bench is utilized to achieve desired outputs of consumer amenities and social values. The system involves an ensemble of institutions and processes which invest and blend inputs of technical information, capital, natural resources and manpower with inputs of society's value preferences. The array of institutional components include both public and private. They interact through nominal legal economic, social and political processes, animated and differentiated by each special output desired. The technological delivery system concept thus sets forth in a unified way all aspects needed to comprehend how the system works—to deliver oil, to produce TV sets, to transport passengers from coast to coast, or to provide health care.

Scientific discovery and engineering innovation are key, necessary inputs. But they are not sufficient. While technology through its delivery systems may have impacts on society and the physical environment, the social structure and its processes also affect the performance of technological delivery systems. Of special importance are the social context and political influence on public decisionmaking. Thus, the consequences of a technological development are only partially determined by inherent technical attributes, and by the core of specialized knowledge. I would strongly emphasize that the system of concern is not the "hardware" alone, but also the "software." The social structures and processes, the institutional actors in the system and their motivation and behavior, the subtleties of internal and external milieu all affect the outcome.

This point was made in a comprehensive study for the NSF by the National Academy of Engineering of priorities for research applicable to national needs. Before setting out a shopping list of research projects, they noted that many delivery systems have broken down or fallen far short of expectations in terms of intended results, distribution or balance of social costs and benefits, not because of inadequate scientific or engineering inputs but because of:

Faulty definition of objectives and expectations; insufficient resource allocations to make the delivery system work; lack of incentives to implement policy or misguided application of policy; inadequacy of organizational arrangements or lack of management ability; failure to make use of existing technology or to develop new technology to cut costs or improve quality; lack of consideration paid to indirect policy impact; division of responsibility for problem-solving; attempts to force change within too short a time.¹

Because policy guidance critically influences the outputs and performance of technological delivery systems to produce socially satisfactory outcomes, the role of the President becomes even clearer and the scope of inquiry broader.

¹ Priorities for Research Applicable to National Needs. Committee on Public Engineering Policy, National Academy of Engineering, Washington, D.C. 1973.

To summarize:

(1) Effective utilization of research and development extends well beyond the processes and practices governing knowledge generation; that is, science and technology subsume but are much more than research and development.

(2) Effectiveness of the knowledge transfer mechanism critically depends on strengths (and weaknesses) of institutional arrangements.

(3) Beyond the structure of operations, individuals who apply technical knowledge must authentically consider and integrate social fabric of the Nation and its diverse values which operate to influence political goals and strategies.

(4) Those in positions of responsibility for public decisionmaking, including those in advisory roles, must combine with technical expertise a familiarity with legal, economic, social, political and institutional processes which affect technology utilization.

(5) The focus of policy decisionmaking including that of the President must be on social ends, as well as technical means; on objects of R. & D. as well as subjects of R. & D.

(6) As a sixth general principle, the specialized subject matter involved, complexity of issues and need for advice independent of parochial departmental advocacy clearly suggest the need for separate staff apparatus to assist the President.

PERFORMANCE OF PRESIDENTIAL ADVISORY APPARATUS

I would next like to consider specific implications for such future advisory apparatus that can be drawn from a diagnosis and evaluation of the machinery that was previously established beginning in 1957 by President Eisenhower and dismantled in 1973. Four entities were involved: (1) Special Assistant to the President for Science and Technology in the White House; (2) President's Science Advisory Committee; (3) Federal Council for Science and Technology; (4) Statutory Office of Science and Technology. The first three were established by President Eisenhower in 1959; the last, by Congress.

It is often forgotten that the concepts of a channel through which broad results of the Federal research and development program as a whole can be brought to the top policy councils of government were clearly articulated in a five-volume report in 1947 under John R. Steelman. In response to Executive Order No. 9791 of October 17, 1946, that study called for a thorough investigation of the Federal scientific program, with recommendations for coordination and improving efficiency. Steelman's proposals included designation of a White House staff officer as scientific liaison and as executive officer of an interdepartmental coordinating group. Indeed, all three steps by President Eisenhower, which were triggered by defense needs of the Korean conflict and the Soviet space surprise in 1957, can be traced to Steelman's original propositions.

In June 1961 through the Senate Subcommittee on National Policy Machinery, the Congress deemed that the initial troika of Presidential arrangements was inadequate and proposed what was to become by a Reorganization Act initiative by President John F. Kennedy the Office of Science and Technology. For the first 3 years, it functioned with high effect.

Only a few years later, however, Congress was asking questions again about adequacy of Federal science management. Doubling every 3 years, the R. & D. enterprise was so large as to be conspicuous, so exotic and complex as to be hard to understand, and so diffused throughout Government as to be difficult to monitor, yet so close to the President as to circumvent usual strictures on power. One major issue was accountability. Other issues concerned: lack of focus of science on national goals; inadequate leadership to focus on civilian application; lack of long-range planning; lack of evaluation of Government organization for science; need to identify gaps left between agencies; poor communication with Congress; lack of review of program performance; failure to clarify roles of the private sector; imbalance in geographical distribution of research and graduate education.

By 1967, one committee of the Congress undertook a staff review of OST that led to a diagnosis expressed as a set of additional key questions on its performance:

- (1) Did OST meet needs of the President?
- (2) Was there loss in objectivity or vitality when reviewing competing, self-serving claims of special interests and Government agencies?
- (3) Had the Office become a conspicuous protagonist of science for its own sake, thus mixing advocacy with advice?
- (4) Was the Office prepared to operate on technology as well as science-based issues in which a new mode of public information and debate may be needed, and should the Office initiate measures to facilitate public understanding?
- (5) Should OST be given additional statutory authority to reflect technological as well as science-based responsibilities and thus go beyond scope of the Reorganization Act authority that was extracted from 1950 NSF legislation?
- (6) Can the Office maintain adequate relationships with the Congress when its Director is protected by Executive privilege—by virtue of other White House hats he wears?
- (7) How should OST work more closely with other Executive Office agencies on matters of national security, foreign policy, economic policy? What should the relationship be to the National Science Board?
- (8) Should OST exert more effort in selecting and stimulating particular programs of great promise to meeting national needs? Should these priority fields be designated (or endorsed) by Congress?
- (9) Should the Office engage proportionately more in long-range precrisis planning and operate less as a fire brigade?
- (10) Should OST be obliged to prepare annual reports?
- (11) Should the coordinating role be given legislative underpinning by changing the status of FCST that was established by Executive order?
- (12) Should advisory apparatus for military and civilian issues be separated?²
- (13) Should a broader mix of disciplines and experience be represented in staff?

²The Office of Science and Technology: House of Representatives, Government Operations Committee, 90th Congress.

Although the Congress did not follow up this inquiry, it was clear from the nature of these questions that OST was not fulfilling expectations.

One reason lies in the changing political and social consciousness of the Nation, a new demand for citizen participation, and for balance between economic growth and quality of life.

Thus, this inquiry undertaken by the Commerce Committee would have been warranted and potentially valuable even if the OST-related advisory apparatus had not been disestablished.

In reviewing past performance of technical advisory apparatus, it has to be said that almost all outside observers agree that it distinguished itself in the field of national security affairs, especially weapons and intelligence technology. The entire Defense Establishment as well as the President appeared to benefit, notwithstanding their possession of sizeable in-house technical capabilities. The advisory bodies propelled a policy that with the potency of new armaments and the possibility of surprise delivery, our national security could no longer afford the old luxury of peacetime decline of its innovative technical core, with frantic mobilization in the event of a new conflict. The cutting edge of scientific research had to be kept sharp, in a state of constant readiness to guard against the unpredictable. Government became the patron of American science and the scientific community welcomed the prestigious hot line of communication established between them and the President. But as the requests for advice evolved from military to civilian affairs, the advisory apparatus itself failed to change, and that rigidity proved disabling.

The advisory apparatus could not seem to broaden its grasp of civilian technology as it had previously with science and military technology. It could not deal with technological priorities of public goals and conflicts in values settled in the cauldron of political debate as it had science priorities settled in private executive councils. It seemed unable to cope with priorities stemming from new expressions of human need rather than from the pressure of scientific discovery seeking application; it did not equip itself (despite congressional attention to this new topic) to deal with unwanted effects of technology in a new era of environmental concern and consumer protection. And it abdicated the rough, sensitive and energy-consuming task of herding the wild horses of the bureaucracy toward common, Government-wide goals.

In short, while many of the advisers believed that they dealt with the engine of social change, they inadvertently overlooked the general state of our society that sets the destination and timetables, and commits resources. Changes had occurred in value preferences, with emphasis on environmental conservancy. Changes had occurred in problem priorities reflected in attention to energy and resource consumption. And changes had occurred in policy orientation with emphasis in long range policy planning. There was little recognition of the role of the citizen in public decisionmaking and the need for public understanding and engagement with the issues involved.

It should thus be clear to your committee that in reentering this area of policy need, it is important not to re-create an Office of Science and Technology.

Is there another model to consider?

I suggest first you examine the track record of the National Council on Marine Resources and Engineering Development that was established in 1966 under Public Law 89-454—landmark legislation introduced and stubbornly defended by you, Mr. Chairman, against opposition. On a smaller scale, that Council had advisory responsibilities similar to OST, but there were major differences in style. It focused far more on civilian than on military issues; it formulated program proposals to the President nominating maritime solutions to meet broad social problems that the President had singled out for priority attention. It maintained decorous relationships with Congress and consulted them on key issues. With vigorous leadership of the Council chairman—the Vice President of the United States serving as an “assistant President”—it did not hesitate to rock the bureaucratic boat and generate consensus on a Government-wide program. It attempted to integrate efforts of diverse competing agencies to gain total effect greater than the sum of individual parts. It published an annual report that served as a planning document not only for 23 constituent agencies of Government, but also for industry and universities who were key partners in the marine affairs enterprise.

In its staffing and techniques of policy planning, it emphasized software as well as hardware, blending economics, law, public administration, foreign affairs, resource and environmental management. The Secretariat was a multidisciplinary problem rather than science oriented.³ Outside analysis of coordinating mechanisms gave the Council unusually high marks for performance,⁴ both in terms of an activist and effective advisory role for the President and in terms of policy initiative.

The Council was permitted to lapse in 1971, and now there are noises of regeneration, both in Congress and in the White House. What is believed most critically needed is machinery to integrate separate public delivery functions from different members of the Federal family into a system, when the program goals so require.

LEGISLATIVE ANALYSES OF CURRENT PROPOSALS
FOR STRUCTURAL REFORM

Turning to specific provisions of the proposed Science and Technology Application Act of 1974, by and large they are compatible both with the general principles set forth earlier and with remedies implicitly needed to correct deficiencies in the operation of OST that Congress earlier identified.

First, as to the statement of findings and declaration of policy, it is difficult to take issue with any of the seven itemized purposes of the act. They assert that science and technology should be utilized to improve the quality of life and resolving national problems; that such endeavor falls conspicuously on Government, and that implementation depends on statutory roles and strengths of resources in its various operating arms. The statements focus on planning and better

³The Politics of the Ocean. E. Wenk, Jr., University of Washington Press, 1972. P. 373-393.

⁴Testimony of William Carey on Presidential Advisory Committee House of Representatives Government Operations Committee, 91st Congress.

coordination; on the need to maintain a strong base of science resources; on the requirement for an annual report to Congress, and finally on reinforcement of Presidential advisory apparatus. Minor changes in language could add emphasis to the future orientation of planning, especially through techniques of technology assessment; to underscore the blending necessary of social preferences with technical opportunities, through multidisciplinary approaches which draw on social as well as natural science, law and public administration; to emphasize the role of public awareness of issues, facts and action alternatives that affect their welfare.

The objectives of better coordination could also be spelled out more definitely.

As to title I, section 101 creates a Council of Advisers on Science and Technology to serve the President toward which I find myself in substantial agreement. The committee is aware of similar proposals I made several years ago as an evolutionary step for OST, then still in existence. The preponderance of emphasis was on technology, however, rather than science. I have found no recent development altering a rationale for such measures. The organizational arrangements for a three-member Council and their interdisciplinary orientation make sense.

Sections 101(d) and 102(a) deal with staffing arrangements. To meet points listed earlier, it is essential that the composition range widely across science and engineering, including a balanced representation of social sciences, public administration, and law. Experience in technology policy planning has also indicated that eminence in technical disciplines is not a sufficient qualification to undertake interdisciplinary functions in a governmental milieu. The legislative provision for staff might also spell out a few details as to how the Congress expects staff to blend technical competence with social awareness.

Provisions for contract studies are of special value, if favorable experience with such studies by the Marine Science Council serve as a guide.

As to section 102 concerning Council functions, while I generally support the stated provision, three aspects are of concern.

The first question regards the breadth of commitment to advise the President "with respect to major policies, plans and programs of science and technology of the Federal Government." Recalling science and technology substantially transcend the ambit of activities defined as research and development, and using the Federal budget level of potential activities of the Council as a measure of its workload, the Council would be involved potentially not with the \$20 billion annually associated with R. & D., but perhaps 5 to 10 times that effort representing the full range of technological activities of government. To be effective in all areas, the supporting staff for the Council might well have to be five times the size of OST staff when it was closed out. Such a large operation has the hazard of being cumbersome and in trying to do too many things might end up doing none well. Such a massive operation is politically unrealistic.

There are viable alternatives, by limiting somewhat the scope of the Council, and by depending on other existing advisory units to rein-

force and collaborate in carrying out the function intended by the bill.

The policy planning agenda of OST was often defined as comprising two elements—of “policy for science” and of “science for policy.” The first component pertains to policy for nourishing scientific research and its capabilities of laboratories and manpower. The second concerns activities where science—and technology—are potent ingredients contributing to public purposes across the full spectrum of human needs. Implicitly, according to the draft bill, the Council is expected to deal with both. On the other hand, the President has available a National Science Board created by statute that could well perform the first function. It is of high level, with members appointed by the President with advice and consent of the Senate.

Moreover, it is currently required to report annually to the President on the health of science resources and thus could well accept part of the burden for the report called for in the legislation. The Director of the National Science Foundation who currently serves as the President's Science Adviser and his staff would have a key role in analysis and in programing to meet new and unexpected Government-wide needs and to fill gaps.

A second example of adjusting the Council's workload lies in a deliberate separation of military from civilian issues. The National Security Council was created by legislation to advise the President in this key area. Clearly contemporary strategic options critically depend on ingredients of science and technology. Some observers contend that the NSC staff is thin regarding technological competencies, and it has no systematic way of picking brains from the technical community. As a consequence, it may be outmaneuvered and outgunned by technical expertise of the parochial defense establishment. A counterbalance to such pressure existed previously in the Science Adviser's office and could be ledged in the proposed Council. As an alternative, along the lines of section 2(a)3, Congress could provide explicit authority to the President to create a Science Advisory Committee to serve him through NSC that would provide a pipeline of assistance of a quality found so portentous in the advisory apparatus of earlier administration.

By carrying out these two functional areas, the Council would still be left with a sizable set of tasks—in a wide range of areas, including energy, transportation, health, housing, environmental management, food production, materials conservation, etc. These are areas of civilian technology, more than science. Moreover, they involve difficulties not encountered in military issues, because technical prescriptions are likely to be less quantitative, the play of the marketplace is ambiguous, customer consensus is less assured, the locus of decision-making is diffuse, the transfer route for technical information between knowledge producer and knowledge consumer is undefined in organizational hierarchy and time.

The second concern I have over section 102 is the relatively meager emphasis given in section (a)1 on coordination.

Adding horizontal warp to the woof of vertical government structure is a longstanding problem in public management. There are very few major national goals where achievement rests on the missions and underpinning of specialized research and development of a single agency.

Indeed, mobilizing all of the technological engines of Federal bureaucracy to focus on common social goals is one of the most bewildering enigmas of modern democratic government. The problem is how to gain a sense of unity and direction when the compartmented bureaucracy, created one step at a time, is constantly stressed by pluralistic goals of our society and outside clientele. Under such battlefield conditions, the fragmentation leads to ineffective management in achieving goals; worse, it can generate stalemate. The fundamental process for gaining coherence is coordination.

But few carrots and sticks are available to the President to foster coordination. Each agency is expected to advocate its functions in the face of impediments. The constellation of Federal agencies, however, may be thought of as multiprogram instruments that can be wired together in new ways to accomplish unprecedented requirements. Some of the most creative moves of the Marine Science Council arose from recognition of the potency of such cross-connections, rather than creation of new organizations.

Coordination becomes the proving ground of effective public administration. It is the sense of community, suppression of parochial interests to a common weal, the systemic rather than sectorial approach that ultimately tests the degree to which a public enterprise can fulfill its purpose. The Council cannot intervene between the President and Cabinet officers, but it should have a license to serve as more than an umpire in helping the President to adjudicate disputes, by constructively harmonizing relevant elements in a systems approach to public administration. In an environment of departmentalism, coordination must operate through consensus. In the context of commonly developed fact, techniques employ mediation and persuasion.

The Federal Council for Science and Technology was created by executive order in 1959 to serve these coordinating tasks. It has had a chequered career. Among other factors, the President's science advisor as its chairman has often been too busy or sparing of his energies in stubborn, time-consuming persuasion to make it work. And it has suffered by lacking statutory support. Paradoxically, the Congress which has a long record of intent about exorcising the devils of waste and duplication, has never taken initiatives to underpin the FCST with legislative authority. This present legislation could be greatly strengthened by some modification toward that end.

A third concern I have over section 102 relates to the recitation in (a) 2, 3, and 4, regarding information gathering, analysis and reporting without mention of technology assessment. Congress has equipped itself with such a capability to serve its own needs; this bill could assure that the President has symmetrical capabilities. If society is to manage its technology to produce the desired outcomes, it will need to collect facts and estimate in advance whether a technological initiative will produce the desired results; or whether alternatives are likely to produce better performance. In the presence of a historically venturesome spirit of rugged individualism, we have set the stage for everybody doing his own thing. Technological strategies and tactics, policies and programs, have been narrowly directed toward individual, isolated goals, with a blithe tunnel vision as to interaction. But now,

everything seems to affect everything else. Room for technological maneuver has been sharply circumscribed.

We must look ahead at future impacts and ways to preserve future choices. And we must look sideways to identify social or environmental impacts beyond the boundaries of the nominal technological transaction.

Technology assessment is thus more than a new instrument of systems analysis. Its value lies in reducing the range of uncertainty, or in the presence of uncertainty, to help distribute risk equitably. Technology assessment can increase the range of options, reduce arbitrariness and expedience of solutions, and increase accountability. It should identify who wins, who loses, and how much. It can identify what we do know; what we don't know; what we could know and what we should know. Indeed, it can identify technical research needed to be supported by Government to reduce uncertainty, a twist on usual nominations of such topics by researchers from their desire to advance frontiers of knowledge or by those having narrow end applications.

It is thus a key element needed by the President in the political process because it can potentially alter the distribution of benefits and costs; by limiting penalties of poor choices, it can improve allocation of public resources which is much of what Presidential decisionmaking is all about.

Section 103 concerns the science and technology report to be prepared by the President with assistance of the Council and transmitted annually to the Congress.

Except for President Nixon's special message in 1972, Presidents have dealt with technology policy on an issue-by-issue basis, thus contributing to fragmentation and confusion. An overall evaluation could foster coherence.

Again, I find myself in hearty agreement. The record shows that a Committee of Congress first proposed in 1964 that OST prepare a similar report. Individual analysts have so urged since 1965. The President publicly requested such a report of OST in 1970 but none was completed or at least issued. It may be worth while discovering why.

By way of analogy, the Marine Council was required by Public Law 89-454 to undertake such a task for the President, and its products constitute some of the most valuable contributions of the Council to advancement of a coherent program in marine affairs. Among other uses, it was a fundamental source of information to many committees of the Congress because it reported activities in so many agencies in one place and in coherent relationship to each other. Such a report, incidentally, could go a long way toward identifying inherent conflicts in our various national policies that are exacerbated by actions of technology.

Finally, the proposed Technology Council could go a long way to contribute to public understanding, not simply through a single report annually, but with frequent releases on current issues, using the techniques of technology assessment to pinpoint implications for affected parties.

Finally, may I comment on title II to establish an Office of Technology Application in the National Aeronautics and Space Administration. The intent here seems to be a directed effort to extract and

deploy the fruits of advanced technology developed for space objectives, where results could be applied to more catholic objectives of the act to meet general national needs.

One can only agree with the objective. But there are serious questions as to whether this is the appropriate action. NASA initiated a technology utilization program with this purpose in mind in 1962. Toward similar objectives of the current act, an Office of State Technical Service was created in 1965 in the Commerce Department, then abolished in 1970. In 1971 NSF's RANN program was established to accelerate problem-focused research, also directed toward objectives of this act. The President's science and technology message of March 16, 1972, was directed toward marshalling "science and technology in the work of strengthening our economy and improving the quality of life," visualizing a stronger Federal role, applying Government-sponsored technologies, improving the climate for private innovation, and fostering partnerships at the State, local and international levels. Three new programs related to these goals were established in 1972:

One. The national R. & D. assessment program (NSF).

Two. The experimental R. & D. incentive program (NSF).

Three. The experimental technology incentives program (NBS).

In the meanwhile a wide variety of technical information and technology utilization activities have been underway in HEW, Interior, Transportation, Labor, EPA, Agriculture, AEC, Commerce, Defense, SBA, and Smithsonian. (A study of the overall functioning of these programs is currently under study by the National Academy of Engineering.)

To accomplish the objectives set forth in this title, it would seem worthwhile to integrate all of these technology utilization programs under direction of the Council. I would urge the committee to defer action on title II and to undertake a careful review of the entire array of governmental programs that could be integrated, at least for management purposes, under a single coordinator.

I do want to underscore the motivation for better utilization of technology, which springs from two separate clientele. One is the private sector, where concerns have emerged on needs for improved industrial productivity, especially to meet foreign competition. The second is in the field of State and local government. These entities have a technology interest not only because of national policies of grant-in-aid federalism, but also because the diversity of problems involving technology require a diversity of solutions.

Examples range from environmental management through solid waste disposal, law enforcement, health care, shoreline management, and so forth. Although the draft legislation makes a casual reference to States, their needs and direct involvement in formulation of technology policy—but could well deserve a special provision.

NEEDS BEYOND STRUCTURAL REFORM

In concluding this statement, you will find strong support for the institutional reform set forth in the proposed legislation. I should like, however, to note that creation of a new governmental structure cannot by itself assure solution of the problems it was created to tackle. It is like the construction of a hi-fi amplifier of such general

purpose; its existence says very little about the quality of music being played, or about who is listening.

The bare skeleton set forth in legislation needs to be advanced with some qualitative assertion as to the spirit of a new instrumentality of government. It is my belief that they should be thought of in terms not of more government, but better—more responsible to the public, to sort out goals in the face of pluralism, ambiguities, conflict, and inequities, to forecast effects of technology and illuminate choices, to counter the understandable preference for instant political satisfaction versus future benefits, and to identify new possibilities to circumvent a zero-sum game. This looks to a healthy evolution in our miracle of self-government, where we extend the experiment of almost 200 years by better steering of a powerful socio-political-technological engine, rather than using technological levers in an old-fashioned game of political power.

We must begin to anticipate, rather than always react to crisis, and we must be more sensitive to what the citizen wants without assuming that planning is the prerogative of the technical elite.

By such apparatus proposed by the bill, and implementation along lines suggested, the council could well help the President ask better questions, make better decision, help defy forces that threaten to impair humanity.

Clearly he must want to utilize such assistance. While this measure is directed at reinforcing advisory function to serve the President, I am sure the committee is aware of the potential for a properly functioning Council to concomitantly serve the Congress. Many of the advisory activities should be protected by privacy of communication with the Presidential client. But the Congress must have access to similar body of fact and analysis so it can evaluate issues and make up its own mind. The Congress could well hold a set of hearings annually to review the President's annual science and technology report.

I believe that a convincing case could be made for this bill simply in terms of the alternatives—a society made pathological by its technology, because we did not seek ways to survive in a technological world with self-respect.

Senator TUNNEY. Thank you very much.

Chairman Magnuson?

The CHAIRMAN. I am always pleased to have Dr. Wenk here, because he and I are old friends and he has contributed so much to this whole field of science policy. He has a great record in helping us accomplish a lot of things in oceanography that never would have been started without his efforts. So I respect his viewpoint.

Ed, I get the feeling from your statement that we should make this council, and particularly the staff—this is going to be the important part of it, as you well know—to be as independent as possible and not to be tied up too much with the Government agencies. We should use the agencies for what they are worth. They have good expertise, you have served in them, so you know this.

But the agencies are never going to correlate themselves, I know that. Somebody has got to be looking over their shoulder in this field

and have some authority, or at least a semblance of authority through the Presidency, if need be.

Now do you agree with that on the basis of your long experience?

Dr. WENK. I agree with that fully, Senator. I think you made two key points.

One is that the President needs the benefit of independent advice, and secondly, that there be some mechanism to assist him in getting a full benefit from all of the independent agencies, I think this proposed Council can do both.

The CHAIRMAN. And that the goals and the approaches should be broader than they have been in the past, where some agency or group had just one mission and that was it. Because as you so well point out, what we are talking about not only involves technology, it involves the social progress of humanity. We are talking about some of our great social issues, such as housing and transportation.

So I think your statement was very good, and very helpful to us, because it pinpoints, what we hope that this council would be able to do.

As I understand it, Dr. David suggested that the council be given be given the responsibilities of reviewing and evaluating all of the agency R. & D. budget requests.

Do you agree with that?

Dr. WENK. Senator, in part. I believe that in order to get the integrated effect of all of these bits and pieces of research, it is necessary to have some overview as to priorities. I believe this office could do it. As a matter of fact, the Marine Council that we referred to earlier did do that in the marine field.

But to look at every R. & D. dollar, as indeed the OMB may look at it, could bog down the staff in bookkeeping exercises. Among other things, the office needs to get involved in public technology policy that goes beyond R. & D. and I would hate to see that vital function diluted.

So I hate to sound like I am hedging, but I believe there are really two considerations here.

The CHAIRMAN. Well, if we could achieve a happy balance there, that would be fine.

Dr. WENK. I think there is every reason for you to want this office to clearly have that responsibility, and in fact you could request it by being specific in your language for the annual report which the office prepares.

Then leave to their devices or their decision just how much of their staff energy they would invest in the process of evaluating the whole government's R. & D.

The CHAIRMAN. I noted what you said about title II, and we will take a look at that. But there is a study being conducted by the Academy of Engineering of three new technology applications programs of this administration.

Have you any information about when that study will be completed?

Dr. WENK. Senator, that is a study being conducted by the Committee on Public Engineering Policy. I would say it is in the second draft form. It does bear quite specifically on the objectives of title

II. Ordinarily I wouldn't be able to speak for the academy, but by coincidence I chair the committee that is preparing the report, and if it should be your wish, I think we could make certain this is available and at an early date for your study.

The CHAIRMAN. Yes.

Well, I am glad that you feel that this is the main objective of this effort, because I think the situation has been slipping in the last few years. It has been piecemeal, and even the academy or the National Science Foundation just never had a handle on it like they should.

I want to make this Council and its staff as independent as possible, and I want them to have some muscle, so they can do something. Because we are losing ground all of the time, we are not keeping up.

You mentioned what we know, what we can know, and we can know a lot of things, but we are losing ground. As we look around us at some of our major social problems, we see that scientists and engineers have to be part of the efforts to solve them.

We would like to gather these efforts together and bring some direction and authority to them.

Dr. WENK. Senator, on that question of the authority of this Council, one brief point: If indeed this Council is going to be creative, it is going to be looking ahead and seeing areas that need urgent attention before a crisis occurs. It is very difficult if they have no money at their direct command to make the necessary efforts to deal with those problems, because very often all the individual agencies are committed to programs that were established years before.

You might want to consider giving this Council some authority of a budget, not for its own staff, but some funds that could be directed, under their direction, to the agencies, to carry out new programs that the agencies themselves would be very slow at doing, or felt they couldn't do, or those programs which cross agency lines.

The CHAIRMAN. Well, I think you sum up what we are thinking. As you understand the thrust of the measure, you say it is to correct a critical shortfall in the contribution which science and technology could make for improving the human condition. And that is what it is all about.

Thank you, Mr. Chairman.

Senator TUNNEY. Thank you, Senator Magnuson.

The CHAIRMAN. I have to leave, I have to start another hearing. These are busy days around here. Appropriations for HEW, the human condition.

Dr. WENK. Thank you, Senator.

Senator TUNNEY. Dr. Wenk, I was interested in two of your suggestions, one as it related to the NSB, and secondly, as it related to the separation of the military from civilian issues.

Now your suggestion with regard to having the National Science Board responsible for establishing a policy for science, and taking away from the proposed Council the responsibility for this type of work would represent a rather significant change in the legislation as it is presently drafted.

I wonder if you are satisfied that by doing that there could be a proper coordination of the science for policy and policy for science problems?

Dr. WENK. Mr. Chairman, your point is an extremely important one.

I think this is somewhat a matter of degree. First, this new Council should be in a position to take on any responsibilities which the President assigns to it. It therefore potentially occupies a role where it could always synthesize, integrate, coordinate the whole range of considerations, policy for science and science for policy.

The thrust of my suggestion had two objectives in mind. One was to try to put some of the burden of the staffing load somewhere else because of the tremendous number of issues that need to be dealt with in that office. Incidentally, these are of a new dimension of complexity, because they involve the economic, social, political, and legal aspects that transcend science and engineering per se. And I believe if they are to be carried out satisfactorily, working from social ends, there isn't going to be time to invest in the agenda that OST used to do regarding policy in science.

There is a second reason for this, however, with regard to my proposal, and that is I have a view that the Office of Science and Technology operated as though the word "science" were in capital letters and the word "technology" in lower case.

It is the purpose of my testimony to reverse that past procedure. It is not to make science unimportant; as a matter of fact, it is the end applications that give the very point to science. But it is to say that today the new needs, the new demands on the President, put this heavier emphasis on technology, as many of us define it. The science aspect, I think, could be handled with real competence if the National Science Board or NSF were not only adequately buttressed, but directed to undertake these tasks.

I do not believe, however, that your Council need be out of that.

Senator TUNNEY. The problem of course is that we are dealing with agencies that have organic characteristics, and as such they tend to expand and to contract, dependent upon the leadership that one finds in both or each, depending I suppose on whether or not the Congress creates this Council.

It would seem therefore that if we left too great an ambiguity in the legislation as it relates to the new Council's functions in the area of policy for science we might create all the ingredients for strife and contention, confrontation, between NSF and this new Council.

And I am not sure that I understand how we could achieve the goals that you suggest and at the same time not have a fair degree of precision in the language as it relates to the new council's role in policy for science.

I am just speaking from certain experience that I have had in the Congress, having watched the way congressional committees sometimes attempt to take jurisdiction away from other committees.

I think probably the toughest battles we have around here are the jurisdictional battles between the committees. I am wondering if, if we accept your suggestion, we might not create the same kind of problem here.

Dr. WENK. Senator, this is a very telling point you have made, and I am sympathetic both to the substance of the remarks and the implications in terms of the contemporary jurisdictional questions.

I don't think I have a very simple answer. I do feel that perhaps by maintaining the title of the Council as the Council of Scientific and Technological Advisers, you will have made your point, and indeed it deserves to be made, that you are not excluding any important related area anywhere within the Federal Government, including basic science, from a necessary integration and purview of this Council.

But section 2(a)3, as I recall it, and this is from memory, and I may be wrong about that, but my recollection was that it underscores the importance of buttressing the capabilities throughout the whole Federal Government.

I think it is on page 2 of the bill: "The maintenance and strengthening of diversified scientific and technological capabilities in Federal departments and agencies, State and local governments," and so on. I was much struck with that phrase.

I know it is not an operational phrase; it is in your statement of findings and declaration of policy. But I would like to say that you cannot compensate for weaknesses in the agencies by strengths in this Council unless the agencies have the staff capabilities, the independence from special interest groups, personal integrity, unless they have a laboratory and research capability to buttress the knowledge of the staff positions, it cannot be compensated for in the Executive Office of the President.

Therefore I think that that provision of your bill is extremely important. It relates then specifically to saving—I don't know whether this need be done in the bill or maybe in your committee report—that one way to deal with policy for science is make sure that the greatest possible strength exists in the agency of Government that is responsible for it, which is the National Science Foundation, and the Science Board.

Senator TUNNEY. The other problem, of course, is the separation of the military from the civilian.

We had witnesses testify today that they thought this Council ought to have oversight responsibility of the military R. & D., and apparently you disagree with that.

Dr. WENK. I guess I do, Mr. Chairman, and I am bothered by the disagreement, because I do respect the judgments of these other witnesses.

I arrived at this point of view from two directions, however.

First, again with some insight as to that advisory apparatus when I was associated with the staff, noting the effectiveness with which it dealt with the military issues, the corresponding ineffectiveness in dealing with the civilian issues.

I am afraid within the reasonable limits of staff and funding for that council, it boils down a little bit to an either-or proposition.

I simply do not believe both can be done. Now in the meanwhile the staff of the National Security Council has grown enormously over what it was when OST, for example, was first formed. The National Security Council is established by legislation; it has some advisory roles here that are very explicit.

But so far as I can recall, there was never any initiative by the Congress to buttress it with an outside advisory board. There are such statutory boards elsewhere to serve the NSF, to serve the NIH, to serve the DOD establishment.

It may well be that that is some way, Congress could make the point that it wants the staff of the National Security Council to maintain the same independence, vis-a-vis the Defense Establishment, that the President's science adviser did in earlier years, and that it wants that staff to pick brains, the best brains this country has to offer, outside of the governmental establishment.

Senator TUNNEY. Just one last thought. What is your assessment of the current science advisory apparatus and the new role Dr. Stever plays as the Director of NSF and as the President's adviser?

Dr. WENK. First, I have the highest regard for Dr. Stever personally. I have known him many years in professional associations, and I hold him in the highest esteem.

I believe, however, that there are some structural limitations that interfere with his being effective. His association with one agency of Government makes it very difficult for him to supervise others, even in the name of the President.

Secondly, there is reason to believe that the channels of communication are not as direct with the President as one might hope for.

Finally, I think this is very clear he does not have at his fingertips the staff resources needed to carry out the duties for the President, not the Science Foundation, but the Presidential duties, the kind of resources you have in mind in your bill.

I don't think the present arrangements fulfill your needs.

Senator TUNNEY. Thank you very much, Dr. Wenk, for your viewpoint. It has been very helpful. I particularly appreciate the fact that you dealt in some detail and specifically with the language of the legislation in the recommendations that you made.

As you know, we here are in the position of having to translate ideas into legislation, and sometimes it is difficult to take opinions of witnesses which are not specific and refine them to the point that they are capable of being placed in the legislation. And I think your statement, whether the committee will agree or disagree with the specific objectives which you outline, is benefitted by the detail with which you express it.

Dr. WENK. Thank you very much, Senator Tunney. In turn let me underscore how important I think your initiative is to get this legislation through. Many of us hope you success in passing it.

Senator TUNNEY. Thank you.

The committee will adjourn subject to the call of the Chair.

[Thereupon, at 1:40 p.m. the hearing was adjourned, subject to the call of the Chair.]

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