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STATEMENT OF  
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BEFORE THE  
SUBCOMMITTEE ON DOMESTIC AND INTERNATIONAL  
SCIENTIFIC PLANNING AND ANALYSIS  
OF THE  
HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY  
ON  
COORDINATION OF GOVERNMENT RESEARCH AND DEVELOPMENT

Mr. Chairman and Members of the Subcommittee:

My concern for the subject of today's hearings dates back to World War II. Since then, as both an observer and a participant, I have been involved in nearly all the steps in the evolution of various Federal mechanisms for coordination and central oversight of science and technology in the executive branch. I have been interested in the role of the Federal Council for Science and Technology since its inception, and I testified in support of the establishment of the Office of Science and Technology in 1962 which also formalized a staff support base for the Federal Council and the President's Science Advisory Committee.

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Since you have commissioned the Congressional Research Service of the Library of Congress to perform a historical review of the Council, I will not discuss this background in detail. But it may be helpful if I offer some perspective for examining the role of the Council as one element of the structure involved in central focus and coordination of our efforts in science and technology.

My statement will cover five topics:

- The nature of our traditional pluralistic system for Government support of R&D and the need to supplement this with central coordination and oversight.
- Results of recent GAO case studies and reviews concerned with Federal coordination of R&D and Government-wide issues involving science and technology.
- Aspects and essential ingredients of central coordination.
- A retrospective look at the limitations of the Federal Council.
- Recent efforts to strengthen central coordination and oversight of science and technology.

NATURE AND LIMITATIONS  
OF THE PLURALISTIC SYSTEM

Traditionally there has been a strong consensus favoring our decentralized or pluralistic system for Federal support of

R&D. The essence of the pluralistic system is to encourage each Federal agency to support the R&D essential to meet its specific mission requirements, with the National Science Foundation primarily responsible for sponsoring basic research. The Foundation also is authorized to support selected applied research in the areas and disciplines not otherwise adequately covered by mission agencies. The pluralistic system depends heavily upon consideration, frequently by more than one agency, of ideas and proposals initiated by individual scientists and research institutions, rather than a directed approach from one central authority. It is generally believed that this system has enabled the United States to maintain a strong scientific leadership.

Science and technology are important components in the accomplishment of program objectives in such fields as transportation, medical care, national defense, and food production. Program objectives and goals are the principal considerations in establishing budgetary plans, rather than the amount of money contemplated for the science and technology component per se.

As head of the executive branch, the President is responsible for the effective execution of programs approved by the Congress. The President holds the heads of departments and agencies accountable to him and the Congress for establishing organizations, selecting staff, mobilizing resources to carry out assigned responsibilities, and achieving results.

Each Federal agency should develop a strategy and priorities for the support and use of R&D to fulfill its mission objectives. However, our pluralistic system has some inherent imperfections. Although the diversity of opportunities is generally regarded as a strong characteristic, the associated permissiveness can result in unwarranted duplication in some areas and insufficient coverage in others. This duplication arises in part from conflicting missions of various agencies. The number and importance of crosscutting and overlapping areas of interest of individual agencies make a central focus not only desirable but essential to insure mutually compatible and coherent R&D programs.

In connection with hearings before the House Committee on Science and Technology in 1975, I cited instances of these program interrelationships and the need for central and inter-agency coordination. I should like to repeat these instances because they are quite relevant to today's hearings. For example, energy source development and conservation objectives are constrained by environmental protection requirements. Public transportation, crime prevention, law enforcement, and housing and urban development are all mutually interactive and constrained by energy and material shortages as well as by environmental concerns. Also, the pressures of inflation and budgetary constraints tend to squeeze the allocations for basic

and longer-range applied research for which each agency's return on investment is uncertain in both results and time.

There are other issues involving science and technology that transcend individual Government agencies. Among them are the impact of science and technology on the economy and the environment, the Federal role in assisting State and local governments, Government-industry relations to foster technology innovation, and Federal support of basic science and assistance to graduate education.

Also, the science and technology component of international relations is emerging with growing importance. For example, in coping with the energy crisis, and dealing with the shortages of critical materials, and world food supply, it is clear that central coordination and oversight need to be established. Such policy issues are also involved in striking an appropriate balance among protecting technological advantages for military preparedness, fostering international sharing of technological resources to help developing nations, and strengthening negotiations for world peace.

#### GAO CASE STUDIES AND REVIEWS

During the past 10 years, my observations have been derived to a large extent from the work of the General Accounting Office. Accordingly, this phase of my testimony will be based on recent reviews performed by GAO and directed, at least

in part, toward examining the effectiveness of and need for improvement of Federal R&D coordination and central focus involving science and technology that transcend individual agency lines. Although we have not specifically directed attention toward evaluating the role and effectiveness of the Federal Council per se, we have noted what appeared to be some inherent limitations.

#### Materials R&D

Our report to the Congress entitled "Federal Materials Research and Development: Modernizing Institutions and Management" (OSP-76-9, December 2, 1975) includes observations on the lack of overall Federal materials R&D coordination, as well as a discussion of the limitations of a previous Federal Council coordinating committee.

In this report, there are several observations on materials R&D coordination:

- We lack clear national materials policy goals against which the effectiveness of related R&D activities can be measured.
- There is no overall Federal materials R&D program. Rather, there exists a large number of specific mission-oriented R&D activities. In fiscal year 1974, there were 23 Federal agencies with 90 subdivisions sponsoring materials R&D. It would be

incorrect to conclude that the sum of these activities constitutes a viable national program.

--The National Commission on Materials Policy Study in 1973 recommended several Federal actions to complement materials R&D. These included tax incentives to spur industrial use of recycled materials and acceleration of technology transfer on resource recovery.

--Little data regarding private materials R&D activity is included in the Federal information system. Thus, we can only appraise that part of national materials R&D activity associated with the Federal Government.

Concerning the Federal Council's Coordinating Committee for Materials R&D, our report states:

"\* \* \* the Coordinating Committee was limited in approach. First, it had a strong basic science orientation with little or no engineering or other input. Second, it was composed of representatives of only selected agencies, \* \* \*. Third, the representatives were at the chief-scientist level; consequently, they were not active in policy determination. Finally, the Coordinating Committee operated entirely with borrowed staff."

However, the report continues that, in its relatively brief history (1963-1970), the Coordinating Committee for Materials

R&D did identify significant program and problem areas needing more attention.

Marine Science  
and Oceanic R&D

A GAO report on "The Need for a National Ocean Program and Plan" (GGD-76-97, October 10, 1975) noted that the United States has no comprehensive national ocean program.

Federal marine science and other oceanic activities are conducted by 21 organizations in 6 departments and 5 agencies. Many of the activities of these organizations are closely related and must be effectively coordinated to insure efficient use of Federal resources. Several methods have been used in attempts to achieve coordination.

The Interagency Committee on Marine Science and Engineering was established by the Federal Council in April 1971 in recognition of the need for a continuing interagency mechanism to consider policy-level issues in the field of marine affairs. The Committee, composed of officials from 11 Federal departments and agencies, is chaired by the Administrator of the National Oceanic and Atmospheric Administration. We found that, for the most part, the Committee studies did not result in specific recommendations to the agencies. When recommendations were made they were of a general nature calling for either continuous monitoring by the Committee or for consideration by the Federal Council or the Office of Management and Budget.



However, within this framework, the Committee has provided a forum for member departments and agencies to exchange information.

The Congress established the National Advisory Committee on Oceans and Atmosphere by Public Law 92-125, dated August 16, 1971. Responsibilities of the Advisory Committee include undertaking a continuous review of the progress of U.S. marine and atmospheric science and service programs and reporting annually to the Congress and the President on the results of its reviews. The Advisory Committee, however, plays no role in coordinating agency programs or establishing priorities.

We concluded that, because of the vital role the oceans play in the Nation's economy and national security, a concerted effort should be undertaken to establish a national ocean plan and program. Such a program should (1) identify marine-related needs and establish specific national objectives; (2) establish priorities to accomplish these objectives; (3) evaluate program results, including relevance to national needs; (4) periodically update needs, objectives, and priorities; and (5) provide for adequate funds to effectively carry out the plan and program.

#### Air Pollution R&D

In a report to the Chairman, Subcommittee on the Environment, Senate Committee on Commerce, entitled "Federal Programs

for Research on the Effects of Air Pollutants" (RED-76-46, December 11, 1975), we concluded that there was need for improved coordination of Federal air pollution research programs. In addition to the Environmental Protection Agency (EPA), we identified six agencies in three Federal departments which were conducting and/or supporting research on the effects of air pollutants on health and the environment.

The Clean Air Act directs EPA to promote research coordination, but the agency had taken little positive action and had no written policies, procedures, or regulations for coordination. Some coordination occurred on a scientist-to-scientist basis and through meetings of various committees. We noted several instances in which EPA scientists were unaware of research similar to their own which was being funded by other Federal agencies. We also noted that no control point existed for disseminating air pollution research information, and as a result, there was no assurance that a potential user would become aware of all completed and on-going research in his area of interest.

We recommended, among other actions, that the Administrator, EPA, establish criteria or guidance for setting air pollution research priorities and develop written policies and regulations that will enable EPA to fulfill its responsibility to coordinate research under the Clean Air Act.

## Land Satellite Project

The need for a somewhat different type of coordination is discussed in our report on the Land Satellite Project (PSAD-76-74, January 30, 1976).

We stated that none of the Federal agencies involved in the LANDSAT project has developed a long-range comprehensive plan which includes user requirements to assist in deciding if and when LANDSAT should become an operational system. We recommended that NASA take the initiative to lead the other participating agencies in developing a plan which includes requirements, milestones, and dates for evaluating progress being made toward the goal of deciding if and when there should be an operational earth resources satellite system. We recognized that such a plan must postulate a Federal Government policy role in satellite-based remote sensing technology. Accordingly, we said that the plan could address (1) the assignments of roles and responsibilities to the involved agencies; (2) interrelationships among oceanographic, meteorological, and earth resources satellite systems; (3) alternative organizational arrangements for operational systems reflecting differing degrees of Government, private sector, and international participation; and (4) estimated resource and funds requirements to be filled by the Federal Government.

In addition, because the potential users have expressed a need for training in the use of LANDSAT data, we recommended that NASA take the lead, in conjunction with potential users, in developing a plan to provide formal training.

#### Other GAO Reports

A list of some of our reports dealing with different aspects of Federal coordination of R&D or with issues involving science and technology is attached to my statement. Mr. Chairman, you may recall that two of these were discussed in my testimony before this Subcommittee on "Research and Development and the Economy" in May of this year.

In our report "Manufacturing Technology--A Changing Challenge to Improve Productivity" (LCD-75-436, June 3, 1976), we concluded that there is a need to create a national focal point to assist U.S. industry in acquiring and diffusing the most advanced manufacturing technology. We recommended that the National Center for Productivity and Quality of Working Life, in close cooperation with the Department of Commerce, take the lead in carrying out this objective. This Center would perform a leadership, coordinating, and catalytic role--not an operating or funding role.

Finally, our report entitled "The Government's Role in East-West Trade--Problems and Issues" (ID-76-13A), February 4, 1976) pointed out the need for centralized coordination, policy

delineation, and monitoring the export of technology and international technology exchange agreements.

EFFECTIVE COORDINATION:  
ASPECTS AND INGREDIENTS

One may distinguish four aspects of central coordination as follows:

- Participation in R&D budget planning and analysis to examine resource allocations in relation to national goals and priorities, including early recognition of opportunities and anticipation of future needs.
- Interagency comparison of potentially related Federal programs to identify
  - . incompatibilities
  - . unnecessary duplication, and
  - . insufficient coverage.
- Analysis of functional crosscutting issues, policy questions, and R&D administration matters not intrinsically related to any single program but generally pervasive of all efforts involving science and technology. Examples are patent policy, procurement policy, Federal regulations, Federal incentives for technology innovation by the private sector, administration and utilization of Federal laboratories, education and use of human resources,

and international issues involving the sharing of scientific and technological resources.

--Analysis of needs and involvement of users in the R&D planning process to assure coupling between R&D performers and ultimate users, and to facilitate technology delivery and utilization. The needs of users in both the Government and the private sector should be considered as appropriate and different mechanisms may be needed in each case.

Effectiveness of a central coordinating mechanism depends on some essential ingredients:

--It requires highly qualified people with differing disciplines and experience.

--It must have adequate resources available to cope with the issues involved in a timely manner.

--Its charter and authority should be clearly defined.

--Its reports should present the issues and recommendations involving science and technology in the context and terms of socio-economic and political decision alternatives.

--Finally, it must have a clearly identified customer with implementing authority to whom it may address its recommendations.

Notwithstanding the need for central focus and leadership, coordination cannot be fully effective unless it is also achieved at the working levels--staff to staff and unit to unit. This involves participation by individuals in conferences, workshops, professional society meetings, and other associations through which they develop mutual understanding and personal rapport, leading to frequent telephone communication and exchange of correspondence, including reports and other documents.

Bearing in mind these aspects and essential ingredients of effective coordination, I shall now consider the Federal Council's role in central coordination of federally directed or supported science and technology.

#### THE FEDERAL COUNCIL

Opinions vary widely as to the effectiveness of the Council and the kinds of functions or tasks most suitable for Council involvement. Some observers believe that the Council has never fulfilled the expectations implied in its mandate.

There are several intrinsic limitations which impede its effectiveness, notably the following:

- Each member of the Council represents an agency which has its own mission and a vested interest,

and hence it has been restrained from reaching agreement on matters which might be construed as impinging adversely on the prerogatives of any of the agencies represented. Consequently, on controversial issues, the Council has only been able to agree on recommendations of a general nature.

--The reports issued by the Council or under its sponsorship frequently have not had a recipient who would or could exercise authority to implement actions recommended.

--Because of these two limitations, the members of the Council have tended to downgrade its importance as evidenced by frequent absenteeism and delegation of alternates to attend meetings.

--Because it had no budget of its own and, therefore, depended on staff loaned from or studies funded by other agencies, the Council has not always been able to examine issues in sufficient scope and depth.

--The Council's resources, to a large extent, have been members of the governmental scientific and engineering community who could deal effectively only with scientific and technological aspects of program coordination or deficiencies in Federal R&D support.



Because of these limitations, the Council has found it extremely difficult to deal forcefully with substantive inter-agency coordination of Federal R&D programs. In this area, its major contribution has been to survey and identify fragmented R&D efforts among different agencies and to surface the need for more formal centralized leadership.

On the positive side, the Council is credited with being relatively effective in dealing with administrative matters and policy questions of common interest to all of the agencies, and in identifying needs for increased R&D in selected areas. The Council has also provided a useful forum for discussion of matters of concern to the various agencies involved in R&D. It has issued or commissioned a number of useful reports on Government-wide R&D, some of which include policy and administrative recommendations.

According to knowledgeable observers, the Council has been effective in dealing with policy issues and administrative problems, especially when detailed studies were performed on specifically defined problems with subsequent review and debate by the full Council. Some of the most effective studies were those performed at the specific request of the President or OMB. The Council was least effective when it initiated studies without a particular recipient in mind.

## RECENT COORDINATION EFFORTS

One of the most effective means for leadership and coordination is to pull together and fragmented efforts that are or should be in the same umbrella and into a new organization with a clear purpose and mission.

The most recent major reorganization of this type was the creation of the Energy Research and Development Administration (ERDA) by the Energy Reorganization Act of 1974 to bring together and direct Federal activities relating to R&D in energy. It also established an Energy Resources Council to coordinate energy policy and management matters and to advise the President and the Congress on future reorganizations of energy and related functions in the Federal Government. Prior to the establishment of ERDA, energy R&D was highly fragmented and spread among a number of agencies. This act pulled together all the R&D elements of the Atomic Energy Commission and portions of the Department of Interior, the National Science Foundation, and the Environmental Protection Agency. The formation of ERDA was a step in the right direction but, in our view, it does not go far enough. We continue to favor establishment of a Department of Energy and Natural Resources.

Another major initiative was the enactment, in May, of the "National Science and Technology Policy, Organization, and

Priorities Act of 1976." As you know, this act includes a formal statement of Federal policies for science and technology and establishes in the Executive Office of the President an Office of Science and Technology Policy. Since you are all familiar with the provisions of this act, I shall not dwell on it. I strongly supported this legislation and believe it could be a major step forward in strengthening our central coordination and oversight of science and technology as well as serving as a mechanism to advise the President, assist OMB, and couple science and technology into executive planning throughout the highest levels of Government. For the first time, it establishes a congressional mandate for the entire central coordination and oversight structure. Thus, continuity is assured with sufficient flexibility to accommodate preferences of different Presidents. The statutory base also provides assurance that the Congress has access to call upon leaders to testify as necessary.

Another recent initiative is the GAO effort to introduce a new unified objective-oriented budget classification structure to assist both the Congress and the executive branch. This system is intended to provide information on all Federal R&D activities and is being structured to indicate Federal R&D allocations in relation to specific problems and objectives.

The presentation will facilitate identifying elements of work conducted by all agencies which are aimed at the solution of specific national problems or the accomplishment of national objectives. In this way, it can be used as an additional tool for relating the R&D budget to policies and priorities.

Mr. Chairman, this concludes my statement except to mention one more attachment. We have prepared a list of questions which might be of use to the Subcommittee in obtaining the views of others who are knowledgeable concerning the work of the Federal Council.

I will be happy to answer any questions you or other members of the Subcommittee may have.

PARTIAL LISTING OF GAO REPORTS  
CONTAINING REFERENCES TO R&D COORDINATION

Manufacturing Technology--A Changing Challenge to  
Improved Productivity (LCD-75-436, June 3, 1976)

(Summarized in text of testimony.)

Agricultural Research--Its Organization and Management  
(RED-76-92, April 9, 1976)

The study describes the principal techniques employed by the  
U.S. Department of Agriculture and State institutions to plan  
and coordinate their research programs.

General Accounting Office Reviews of Federal  
Environmental Research and Development  
(RED-76-95, April 7, 1976)

The reviews confirm that there is no overall Federal leader-  
ship for environmental research nor does there appear to be  
adequate coordination of the water, air, and pesticide re-  
search efforts.

SEASAT Project (PSAD-76-76, February 25, 1976)

This report discusses, among other things, the need for firm  
commitments by users to participate in the project during its  
planning and development.

The Government's Role in East-West Trade--  
Problems and Issues (ID-76-13A, February 4, 1976)

(Summarized in text of testimony.)

Land Satellite Project (PSAD-76-74,  
January 30, 1976)

(Summarized in text of testimony.)

Federal Programs for Research on the Effects  
of Air Pollutants (RED-76-46, December 11, 1975)

(Summarized in text of testimony.)

Federal Materials Research and Development:  
Modernizing Institutions and Management  
(OSP-76-9, December 2, 1975)

(Summarized in text of testimony.)

Opportunities for Improved Management of the  
Research Applied to National Needs (RANN)  
Program (MWD-75-84, November 5, 1975)

Primary areas for improvement are in research program development (views of major public and private interest groups are not always obtained), proposal evaluation (researchers suggested major changes in peer review system), and planning for use of research (early and active user involvement is needed).

The Need for a National Ocean Program and  
Plan (GGD-75-97, October 10, 1975)

(Summarized in text of testimony.)

Federal State Solar Energy Research, Development,  
and Demonstration Activities (RED-75-376,  
June 10, 1975)

One of the major findings of this report is that the executive branch has not issued guidelines on the allocation of solar energy R&D funds to avoid duplication of activities.

Need for a National Weather Modification Research  
Program (RED-74-176, August 23, 1974)

During fiscal year 1974, seven Federal departments and agencies conducted weather modification research. This report discusses these fragmented research programs, as well as the role of the Federal Council for Science and Technology in weather modification research.

QUESTIONS CONCERNING  
THE ROLE AND EFFECTIVENESS OF THE  
FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY

1. What has been the major thrust of the Council's activities during the period of your involvement: (a) by subject areas, and (b) by types of issues or problems addressed?
2. What studies did the Council complete during the same period? Which of these were requested by the President, OMB, the President's Science Advisor, another agency, or were self-initiated by the Council? Of those studies which were self-initiated, what were the objectives and who were the intended users?
3. What have been the major accomplishments of the Council during this period and what have been the resulting impacts? For example, strengthened coordination of interagency R&D programs, improved administration of R&D, adoption of enlightened or new policies, new or revised legislation?
4. What criteria does the Council use to select the subjects for its studies?
5. What studies, if any, deemed important by the Council were not undertaken or were dropped for lack of resources or because they were considered inappropriate for the Council?

6. What progress has been made in establishing means to identify and effectively present early warning of potential major problems before they become crises?
7. What factors have limited the effectiveness of the Council and what types of issues is it best designed to address?
8. How has the Council and its committees been restructured recently in the light of changing priorities for its attention and in view of lessons learned from its past experience?
9. How will Public Law 94-282 impact on the Council's effectiveness?
10. How has the Council benefited its member agencies?
11. How could the Council be more effective in performing its central coordination function:
  - (a) to be of greater value to your agency?
  - (b) to better serve the Government as a whole?
12. To what extent have the Council recommendations impacted on the budget? How can the Council's role in the budget process be more effective?



13. In its consideration of science and technology issues, has the Council dealt adequately with their political, social, economic, and ecological aspects? Should the Council's ability to formulate its recommendations in this broader context be improved? If so, how?