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NATIONAL SCIENCE FOUNDATION AUTHORIZATION LEGISLATION, 1976
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HEARINGS

BEFORE THE

SPECIAL SUBCOMMITTEE ON NATIONAL SCIENCE FOUNDATION

OF THE

COMMITTEE ON LABOR AND PUBLIC WELFARE UNITED STATES SENATE

NINETY-FOURTH CONGRESS

SECOND SESSION

ON

S. 3202

TO AUTHORIZE APPROPRIATIONS FOR ACTIVITIES OF THE NATIONAL SCIENCE FOUNDATION FOR FISCAL YEAR 1977, AND FOR OTHER PURPOSES

MARCH 1 AND 3, 1976

Printed for the use of the Committee on Labor and Public Welfare

AUTHENTICATED
U.S. GOVERNMENT
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CONTENTS

Text of: Page

S. 3202 ---- 3

H.R. 12566 ---- 29

CHRONOLOGICAL LIST OF WITNESSES

MONDAY, MARCH 1, 1976

Stever, Dr. H. Guyford, Director, National Science Foundation, accompanied by Dr. Norman Hackerman, president, William Marsh Rice University, and Chairman, National Science Board; Dr. Richard C. Atkinson, Deputy Director; Dr. Harvey A. Averch, Acting Assistant Director for Science Education; Charles F. Brown, General Counsel; Dr. Eloise E. Clark, Acting Assistant Director for Biological, Behavioral, and Social Sciences; Dr. Edward C. Creutz, Assistant Director for Mathematical and Physical Sciences, and Engineering Dr. Alfred J. Eggers, Assistant Director for Research Applications; Dr. Robert E. Hughes, Assistant Director for Astronomical. Atmospheric, Earth, and Ocean Sciences, and Acting Assistant Director for Scientific, Technological and International Affairs: Dr. Jack T. Sanderson, Acting Director, Office of Planning and Resources Management; Eldon D. Taylor, Assistant Director for Administration; and Theodore W. Wirths, Director, Office of Government and Public Programs, a panel ---- 39, 198

Mead, Dr. Margaret, curator emeritus of the American Museum of Natural History and chairman of the board of the American Association of the Advancement of Science ---- 841

WEDNESDAY, MARCH 3, 1976

Hereford, Dr. Frank, president, University of Virginia ---- 256

Wenzlau, Dr. Thomas E., president of Ohio Wesleyan University, Delaware, Ohio ---- 262

Silber, Robert L., executive director, National Science Teachers Association ---- 285

Cobb, Dr. Jewel Plummer, member, National Science Board ---- 293

Nixon, Dr. Alan C., past chairman, Committee of Scientific Society President, and former president, American Chemical Society; Dr. James B. Sullivan, research director, National Council for the Public Assessment of Technology and codirector, Center for Science in the Public Interest; and Dr. Joel Primack, coauthor of "Advice and Dissent," a panel ---- 295

Jackson, Dr. William, National Organization for the Personal Advancement of Black Chemists and Chemical Engineers, accompanied by Dr. Alonzo Atencio, president, Society for Advancement of Chicanos and Native Americans in Science, and Dr. Shirley Mahaley Malcom, specialist, Office of Opportunities in Science, American Association for Advancement of Science, a panel on minorities and women in science ---- 341

STATEMENTS

American Association for the Advancement of Science, Dr. Margaret Mead, chairman, prepared statement ---- 191

American Association of State Colleges and Universities, the Association of American Colleges, and the National Council on Independent Colleges and Universities, Dr. Walter B. Waetjen, president, Cleveland State University, Cleveland, Ohio, prepared statement ---- 376

American Chemical Society, prepared statement ---- 396

Cobb, Dr. Jewel Plummer, member, National Science Board ---- 293

Hamilton, Dr. Franklin D., associate professor, University of Tennessee, Oak Ridge graduate, School of Biomedical Sciences, ORNL, and Dr. Vijaya L. Melnick, associate professor, Department of Biology, Federal City College, Washington, D.C., prepared statement ..... Page 380
Hereford, Dr. Frank, president, University of Virginia 256
Jackson, Dr. William, National Organization for the Personal Advancement of Black Chemists and Chemical Engineers, accompanied by Dr. Alonzo Atencio, president, Society for Advancement of Chicanos and Native Americans in Science, and Dr. Shirley Mahaley Malcom, specialist, Office of Opportunities in Science, American Association for Advancement of Science, a panel on minorities and women in science 341
Prepared statement 349
Malcom, Dr. Shirley Mahaley, specialist on minorities' and women's affairs, Office of Opportunities in Science, American Association for the Advancement of Science, prepared statement 368
Mead, Dr. Margaret, curator emeritus of the American Museum of Natural History and chairman of the board of the American Association of the Advancement of Science 184
Prepared statement 190
National Organization for the Professional Advancement of Black Chemists and Chemical Engineers, William M. Jackson, treasurer, prepared statement 349
National Science Board, Dr. Norman Hackerman, chairman, prepared statement (with enclosure) 52
National Science Teachers Association, Robert Lee Silber, executive director, prepared statement 290
Nixon, Dr. Alan C., past chairman, Committee of Scientific Society, president, and former president, American Chemical Society; Dr. James B. Sullivan, research director, National Council for the Public Assessment of Technology and codirector, Center for Science in the Public Interest; and Dr. Joel Primack, coauthor of "Advance and Dissent," a panel 295
Prepared statement 321
Primack, Joel, assistant professor of physics, University of California, Santa Cruz, prepared statement 305
Silber, Robert L., executive director, National Science Teachers Association 285
Prepared statement 290
Society for Advancement of Chicanos and Native Americans in Science, Alonzo C. Atencio, Ph. D., president, prepared statement 362
Stever, Dr. H. Guyford, Director, National Science Foundation, accompanied by Dr. Norman Hackerman, president, William Marsh Rice University, and Chairman, National Science Board; Dr. Richard C. Atkinson, Deputy Director; Dr. Harvey A. Averch, Acting Assistant Director for Science Education; Charles F. Brown, General Counsel; Dr. Eloise E. Clark, Acting Assistant Director for Biological Behavioral, and Social Sciences; Dr. Edward C. Creutz, Assistant Director for Mathematical and Physical Sciences, and Engineering; Dr. Alfred J. Eggers, Assistant Director for Research Applications; Dr. Robert E. Hughes, Assistant Director for Astronomical, Atmospheric, Earth, and Ocean Sciences, and Acting Assistant Director for Scientific, Technological and International Affairs; Dr. Jack T. Sanderson, Acting Director, Office of Planning and Resources Management; Eldon D. Taylor, Assistant Director for Administration; and Theodore W. Wirths, Director, Office of Government and Public Programs, a panel 39, 198
Prepared statement 78
Sullivan, James B., Ph. D., codirector, Center for Science in the Public Interest, prepared statement 338
Wenzlau, Dr. Thomas E., president of Ohio Wesleyan University, Delaware, Ohio 262
Prepared statement 266

ADDITIONAL INFORMATION

	Page
Articles, publications, etc.:	
Chairman, Science Curriculum Review Team recommendations	245
Minorities in science, conference on, from the American Association for the Advancement of Science, Feb. 19–21, 1976	387
National Science Board review of projects and programs, staff memorandum from H. Guyford Stever, director (with attachments)	214
National Science Foundation fiscal year 1977 budget	104
Report of the Science Curriculum Review Team, memorandum from H. Guyford Stever to Assistant Director for Education, and the Assistant Director for Administrative Operations (with attachment)	250
Communications to:	
Kennedy, Hon. Edward M., chairman, Special Subcommittee on the National Science Foundation, from Glenn T. Seaborg, president, American Chemical Society, Washington, D.C., Mar. 4, 1976	394
Question and answers:	
Questions submitted by Senator Kennedy and Senator Pell to the National Science Foundation along with responses	130
Selected charts:	
Federal obligations for conduct of R. & D. by major program area, fiscal 1966–77	42
National basic research expenditures by performer: 1965–75	43
NSF program summary fiscal year 1971–77, by major program activity (obligations)	44
Trends in R. & D./GNP ratios by leading industrial countries: 1965–75	40

NATIONAL SCIENCE FOUNDATION AUTHORIZATION LEGISLATION, 1976

MONDAY, MARCH 1, 1976

U.S. SENATE,
SPECIAL SUBCOMMITTEE ON THE
NATIONAL SCIENCE FOUNDATION
OF THE COMMITTEE ON LABOR AND PUBLIC WELFARE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 4232, Dirksen Senate Office Building, Senator Edward M. Kennedy (subcommittee chairman), presiding.

Present: Senators Kennedy, Laxalt, and Stafford.

Senator KENNEDY. The Subcommittee will come to order.

This morning the subcommittee opens its hearings on the proposed budget for the National Science Foundation for fiscal year 1977.

It is a budget which includes significant and necessary increases for funding of basic research. It is also, however, a budget which provides no new initiatives in science education; which proposes a marked decrease in applied research; and which holds all other programs at or below last year's levels.

It is a budget developed during a year in which the Foundation has taken some important steps to strengthen its management and to improve the participation of nonscientists in the development and implementation of policies and priorities. Much remains to be done in these areas, but I welcome the initial efforts that have been made.

We have just received the National Science Board's report, "Science Indicators." That report found that 75 percent of the American people view science and technology as having changed life for the better. Of particular interest to me, because of my responsibilities both as chairman of this subcommittee and of the Health Subcommittee was the report's finding that 69 percent of those surveyed named medical advances as the area in which they would most like to see their tax dollars for research and development spent. This area currently receives about 9 percent of Federal R. & D. funds, while defense and space related R. & D. receives over 60 percent. This is a distribution of funds which the Congress will be examining closely this year.

The NSF budget, and the support it provides for the advancement of science, is just about 3 percent of the total Federal R. & D. budget—but it is an important part. There are several issues in the NSF budget to which we want to give particular attention in this subcommittee and which will help us build on the fine record already established during the House hearings under the able leadership of Jim Symington. They include:

The role of the National Science Board, and all the implication that has in terms of staffing and responsibility for overview and oversight.

The integrity of the peer review system which we feel is extremely important.

The role of private industry in basic research.

We know that private industry has participated in only a very small percentage of NSF research programs. With the enormous evolution in the capability of the private sector the abilities of scientists particularly in small R. & D. companies, we want to look into the possibility that additional research funds should go to those companies.

The set-aside of applied research funds for small businesses has worked well, the 7½ percent, and should we consider expanding that.

The potential for a continuing role for NSF in the solar energy area.

Strengthened international research and policy analysis programs.

Let me mention at this point that we have been very much interested in the whole area of nutrition and food, and its implications for our country and the developing world. It involves many different aspects of governmental policy. We had an interesting hearing, which I conducted as chairman of the Health Subcommittee, on the international implications of food and nutrition, and what was being done in AID. We know there is a role here for the NSF, and we want to continue to press that particular issue: Efforts to improve participation of minorities and women in careers in science and policymaking positions at NSF.

We know there have been some resources available in that area, approximately $5 million, but primarily directed toward institutions. The real need to get women and minorities involved in the whole area of science and science policy has not been addressed effectively.

We want to go into that a bit.

The continuing education for scientists and engineers. This is extremely important to our national interest.

The direction of the science for citizens program; we want to hear more about that.

The guidelines for the ethics program, primarily in the areas of biomedical research and clinical medicine. We know Dr. Stever is well aware of our interest and support for these efforts and we note that you have requested $1 million for the ethics program in your budget.

Senator Pell and I are currently working on a draft bill which will be introduced in the near future. I order it printed in the record at this point after it is introduced along with the bill the House expects to pass shortly.

[The bills referred to follow:]

94TH CONGRESS
2D SESSION

S. 3202

IN THE SENATE OF THE UNITED STATES

MARCH 24, 1976

Mr. KENNEDY (for himself and Mr. PELL) introduced the following bill; which was read twice and referred to the Committee on Labor and Public Welfare

A BILL

To authorize appropriations for activities of the National Science Foundation for fiscal year 1977, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Science Foundation Authorization Act, 1977".

TITLE I—APPROPRIATIONS AUTHORIZED

AUTHORIZATION FOR ACTIVITIES OF THE NATIONAL SCIENCE FOUNDATION

SEC. 101. (a) There is authorized to be appropriated to the National Science Foundation for the fiscal year 1977, for the following categories:

(1) Mathematical and Physical Sciences and Engineering, $236,250,000.

(2) Astronomical, Atmospheric, Earth and Ocean Sciences, $249,000,000.

(3) Biological, Behavioral, and Social Sciences, $135,350,000.

(4) Science Education Programs, $81,200,000.

(5) Research Applied to National Needs, $74,100,000.

(6) Scientific, Technological, and International Affairs, $26,000,000.

(7) Program Development and Management, $43,500,000.

(b) Notwithstanding any other provision of this or any other Act—

(1) of the amount authorized under category (2) of subsection (a) of the first section, $22,200,000 shall be available for the program "Oceanographic Facilities and Support";

(2) of the amount authorized under category (4) of subsection (a) of this section—

(A) $18,000,000 shall be available for the programs "Graduate Fellowships in Science and Engineering" and "National Needs and Fellowships";

(B) $15,000,000 shall be available for the program "Comprehensive Assistance to Undergraduate

Science Education", of which not less than 66⅔ per centum shall be available on a competitive basis for four-year institutions of higher education which do not grant a doctor's degree;

(C) $6,000,000 shall be available for the program "Research Initiation and Support";

(D) $5,500,000 shall be available for the programs "Instructional Improvement Implementation" and "Elementary and Secondary School Materials Development, Testing, and Evaluation", with special emphasis on the support of activities to improve the general level of scientific literacy and to increase the ability of students to make use of the methods of science and the results of scientific discovery;

(E) $2,000,000 shall be available for the program "Minorities and Women in Science" for programs and research designed to improve scientific literacy and to encourage and assist minorities and women to undertake and to advance in careers in scientific research and science education; and

(F) $1,000,000 shall be available for the program "Ethical and Human Value Implications of Science and Technology", including ethical and

value issues arising in the context of physical science, biological science, and clinical medicine;

(3) of the amount authorized for category (5) under subsection (a) of this section—

(A) $10,000,000 shall be available for the program "Earthquake Engineering";

(B) $6,000,000 shall be available for the support of especially promising proposals for small scale research on advanced forms of energy: *Provided,* That such research proposals do not duplicate programs supported by the Energy Research and Development Administration and are fully coordinated with the Energy Research and Development Administration; and

(C) not less than 10 per centum of such amount shall be expended to small business concerns.

PROGRAM ADMINISTRATION

SEC. 102. (a) (1) The Director of the National Science Foundation shall report on the activities of the Foundation in carrying out the provisions of section 552 of title 5, United States Code, commonly known as the Freedom of Information Act, and the Federal Advisory Committee Act.

(2) With respect to section 552 of such title 5 the

report shall include, but not be limited to, for each inquiry received—

(A) the source of each inquiry and the nature of the material requested from the Foundation;

(B) the basis on which each such inquiry was granted or denied;

(C) the time and personnel resources required by the Foundation to compile and furnish the material so requested together with the cost of that requirement; and

(D) the amount of the charges made, if any, for complying with such request, and the basis for granting or denying each waiver.

(3) With respect to the Federal Advisory Committee Act, the report shall include, but not be limited to—

(A) a listing of all Advisory Committees serving the Foundation and their membership;

(B) the number of such Advisory Committee meetings held since January 1, 1975;

(C) the number of such Advisory Committee meetings held since January 1, 1975, which were closed or partially closed to the public;

(D) a statement of the subject matter covered by each such Advisory Committee at a closed or partially

closed meeting, the specific reason why the meeting was closed or partially closed and whether a transcript of such a meeting was made;

(E) a statement of each denial of a request to appear before, or to attend or to file a statement with any such Advisory Committee made pursuant to the provisions of the Federal Advisory Committee Act, the basis on which the request was denied, the source of the request, and the nature of the Advisory Committee meeting involved.

(4) The report required by this section shall be submitted to the Committee on Science and Technology of the House of Representatives and the Committee on Labor and Public Welfare of the Senate within ninety days after the date of enactment of this Act.

(b) Whenever any material is published, which is based upon or developed under a project assisted by the National Science Foundation, the publication shall contain an acknowledgment of National Science Foundation support and a statement that the author or grantee is solely responsible for the findings, opinions, conclusions, or recommendations contained in that material.

(c) Copies of all publications and reports based upon or developed under any project assisted by the National Science Foundation shall be furnished to the National Tech-

nical Information Service of the Department of Commerce by the National Science Foundation within thirty days of receipt of the report by the Foundation, or of notification of its publication.

(d) Not later than one year after the completion of research projects assisted under the program "Research Applied to National Needs", or any similar program, the Director of the National Science Foundation shall report to the Committee on Science and Technology of the House of Representatives and the Committee on Labor and Public Welfare of the Senate on—

(1) the extent to which the results of the research conducted under such project have been utilized, and

(2) any barriers to such utilization which have been identified with respect to each such project.

(e) The Director of the National Science Foundation is directed to notify the Committee on Science and Technology of the House of Representatives and the Committee on Labor and Public Welfare of the Senate and subsequently make available to the public a monthly report on all grants or contracts completed during the previous thirty-day period. The report required by this subsection shall include, but not be limited to—

(1) the organization, name and address, and principal investigator conducting the grant or contract; and

(2) the title, duration and amount of the grant or contract.

(f) No funds may be transferred from any particular category listed in section 1 to any other category or categories listed in such section if the total of the funds so transferred from that particular category would exceed 10 per centum thereof, and no funds may be transferred to any particular category listed in section 1 from any other category or categories listed in such section if the total of the funds so transferred to that particular category would exceed 10 per centum thereof, unless—

(1) a period of thirty legislative days has passed after the Director or his designate has transmitted to the Speaker of the House of Representatives and to the President of the Senate and to the Committee on Science and Astronautics of the House of Representatives and to the Committee on Labor and Public Welfare of the Senate a written report containing a full and complete statement concerning the nature of the transfer and the reason thereof, or

(2) each such committee before the expiration of such period has transmitted to the Director written notice to the effect that such committee has no objection to the proposed action.

TITLE II—NATIONAL AND INTERNATIONAL NEEDS AND RESOURCES

INTERNATIONAL SCIENTIFIC RESEARCH, EDUCATION AND POLICY ANALYSIS

SEC. 201. To make the results of scientific research conducted abroad more readily available to United States scientists, engineers, and technologists, to further the Nation's foreign policy objectives, to promote international cooperation in science and technology, and to assist in the resolution of critical and emerging problems with significant scientific or technical components, such as the world food and population problems, the National Science Foundation is authorized and directed to support basic and applied research and education programs, and to conduct and support policy analysis, information dissemination, and international cooperative programs designed to—

(1) improve understanding of international science and technology issues involving the needs of the developing world and the opportunities which exist for United States science and technology to further United States foreign policy objectives by contributing to the resolution or alleviation of international problems, particularly problems relating to agriculture and nutrition;

(2) develop comparative data among nations in

70-027 O - 76 - 2

areas of particular concern such as environmental problems and policies, energy resources, food nutrition, and health care, and facilitate the dissemination of such data;

(3) identify significant international implications of United States research activities;

(4) improve understanding of the international institutional requirements required by international scientific and technological developments;

(5) support basic and applied research, including interdisciplinary research, in agriculture and nutrition related fields which is oriented to the socioeconomic, technical, and cultural characteristics and resources of the developing world, and encourage the utilization of the results of such research;

(6) improve the capability of United States research institutions and facilities to adapt and apply new research findings in science and technology to the agriculture and nutrition related problems of the developing world;

(7) provide United States scientists and engineers with necessary financial support and special education to enable them to conduct effective research on agriculture and nutrition related problems in laboratories and

research institutions in the United States and abroad; and

(8) design and initiate international cooperative programs of scientific and technical research and education in international problem areas, particularly food and nutrition.

INTERDISCIPLINARY RESEARCH

SEC. 202. The National Science Foundation is directed to encourage and promote the conduct of interdisciplinary research through the support of broadly based undergraduate interdisciplinary education programs, interdisciplinary research projects which provide for apprenticeship training, interdisciplinary fellowship programs, and arrangements for degree training, including postgraduate degrees in more than one discipline, in institutions of higher education.

SCIENCE FOR CITIZENS

SEC. 203. (a) The National Science Foundation is authorized and directed to conduct a "science for citizens program", which shall be designed to—

(1) improve public understanding of public policy issues involving science and technology;

(2) facilitate the participation of qualified scientists and engineers in public activities aimed at the resolu-

tion of public policy issues having significant scientific and technical aspects;

(3) facilitate the participation of undergraduate and graduate students in scientific and technical aspects of community and citizen group activities aimed at the resolution of public policy issues; and

(4) enable nonprofit, citizens, public interest groups to acquire necessary scientific and technical expertise to assist them in dealing with the scientific and technical aspects of public policy issues.

The program required by this section shall include awards and planning grants in accordance with the provisions of this section.

(b) Awards made by the National Science Foundation in the conduct of the science for citizens program shall include support for—

(1) qualified scientists and engineers to work on public policy issues with significant scientific and technical components in conjunction with public interest groups, units of State and local government, or nonprofit media organizations;

(2) internship programs for science and engineering undergraduate or graduate students to work on public policy issues with significant scientific and technical components in conjunction with public interest groups,

units of State and local government, or nonprofit media organizations, as part of their academic training;

(3) forums, conferences, and workshops on public policy issues with significant scientific and technical components;

(4) new and existing independent journals for the publication of research and for commissioning or publishing reports or papers generated by public interest activities to be circulated among scientists and engineers, and among public interest groups in a form understandable by the general public;

(5) new and existing media programs utilizing radio or television to increase public understanding of public policy issues with significant scientific and technical components;

(6) public interest groups to acquire necessary technical expertise relating to the scientific and technical expertise relating to the scientific and technical aspects of public policy issues and to enable such groups to bring together in appropriate forums experts whose research has been directed to the resolution of such issues; and

(7) travel and related expenses incurred by scientists, engineers, or members of public interest groups to facilitate the exchange of information regarding the

scientific and technical components of public policy issues.

(c) Planning grants under this program shall be available for—

(1) the design and use of registries of scientists and engineers to serve as a resource to local decision-makers, community and citizens public interest groups, including the study of past and present registries and their effectiveness;

(2) the establishment of at least one regional center to support projects involving public policy issues with significant scientific and technical components, which have been proposed by State and local organizations and institutions; and

(3) the establishment of a national clearinghouse with at least one regional branch to facilitate access by scientists, engineers and the general public to research and other information and material related to the scientific and technical components of public policy issues.

(d) The evaluation of applications for awards and planning grants under this program shall be conducted by review panels which include a balanced group of scientists and engineers, representatives of public interest groups, representatives of minority groups, representatives of women's groups, and nonscientists.

(e) The Director of the Foundation shall appoint an advisory committee for the science for citizens program to participate in the development, planning and implementation of the programs required by this section. The advisory committee shall consist of fifteen members, not less than eight of whom shall be representatives of public interest groups, minority groups, and women's groups, and not less than three of whom shall not be scientists or engineers.

(f) Of the amount authorized for category (4) of section 101 (a) $5,000,000 shall be available for the science for citizens program.

CONTINUING EDUCATION IN SCIENCE AND ENGINEERING

SEC. 204. (a) The National Science Foundation shall initiate an educational program of continuing education in science and engineering in order to enable scientists and engineers who have been engaged in their careers for at least five years to pursue courses of study designed to—

(1) provide them with new knowledge, techniques, and skills in their special fields; or

(2) acquire new knowledge, techniques, and skills in other fields which will enable them to render more valuable contributions to the Nation.

(b) The program developed under this section shall include, but not be limited to—

(1) the development of special curriculums and

education techniques for continuing education in science and technology; and

(2) the award of fellowships to scientists and engineers to enable them to pursue courses of study which provide continuing education in science and engineering.

(c) The Foundation is authorized and directed to make grants to, and to enter into contracts with, institutions of higher education and other academic institutions, nonprofit institutes and organizations, and private business firms, for the purpose of developing courses and curriculums specially designed for continuing education in science and technology under this section.

(d) (1) The Foundation is authorized to award continuing education fellowships to scientists and engineers to enable them to pursue appropriate courses of study.

(2) The Foundation shall allocate fellowships under this subsection in such manner, insofar as practicable, as will—

(A) attract highly qualified applicants; and

(B) provide an equitable distribution of such fellowships throughout the United States.

(3) The Foundation shall pay to persons awarded fellowships under this section such stipends (including such allowances for subsistence, health insurance, relocation expenses, and other expenses for such persons and their

dependents) as it may prescribe by regulation designed to accomplish the purposes of this Act.

(4) Fellowships shall be awarded under this section upon application made at such times and containing such information as the Foundation shall by regulation require.

(e) Of the amount authorized under category (4) of section 101 (a) $3,500,000 shall be available for the activities authorized by this section.

MINORITY CENTERS FOR GRADUATE EDUCATION IN SCIENCE AND ENGINEERING

SEC. 205. (a) In order to promote increased participation by minorities in careers in science and engineering, the National Science Foundation is authorized and directed to establish and provide continuing support to Minority Centers for Graduate Education in Science and Engineering in accordance with this section.

(b) The Centers shall be established at six geographically dispersed educational institutions which—

(1) have substantial minority student enrollment,

(2) are geographically located near minority population centers,

(3) demonstrate a commitment to encouraging and assisting minority students, researchers, and faculty, and

(4) have an existing or developing capacity to offer doctoral programs in science and engineering.

(c) Each Center, established under this section, shall—

(1) support basic research and the acquisition of necessary research facilities and equipment;

(2) serve as a regional resource in scince and engineering for the minority community which the Center will serve; and

(3) develop joint educational programs with nearby undergraduate institutions of higher education which have a substantial minority student enrollment.

(d) The Director, after consultation with groups which have been active in seeking greater recognition of the scientific and technical capabilities of minorities, and with the Committee on Science and Technology of the House of Representatives and the Committee on Labor and Public Welfare of the Senate, shall appoint a seven-member National Advisory Board to patricipate in the development and implementation of the program established by this section. At least five members of the Advisory Board shall be minority scientists.

(e) (1) For the purpose of this section the term "minority" refers to (A) persons who are Negro, American Indian, Spanish-surnamed American, Portuguese, Oriental, Alaskan natives, and Hawaiian natives and (B) as deter-

mined by the Director, persons who are from environments in which a dominant language is other than English and who, as a result of language barriers and cultural differences, do not have an equal educational opportunity, and (2) the term "Spanish-surnamed American" includes persons of Mexican, Puerto Rican, Cuban, or Spanish origin or ancestry.

(f) From funds authorized under category (4) of section 101 (a), $6,000,000 shall be available to carry out the provisions of this section.

OFFICE OF SMALL BUSINESS RESEARCH AND DEVELOPMENT

SEC. 206. The National Science Foundation is authorized and directed to establish within the Office of Government and Public Programs an Office of Small Business Research and Development. The Foundation through the Office of Small Business Research and Development shall—

(1) foster communication between the National Science Foundation and the small business community, monitor all awards made to small business concerns by the Foundation, and insure that the small business concerns set-aside provided under this Act or any other Act authorizing appropriations for the National Science Foundation is fully and effectively utilized;

(2) collect, analyze, compile, and publish information concerning grants and contracts awarded to small

business concerns by the Foundation, and the procedures for handling proposals submitted by small business concerns;

(3) prepare a list of scientific and technical expertise and capability in the small business community in collaboration with organizations representing small business concerns;

(4) assist individual small business concerns in obtaining information regarding programs, policies, and procedures of the Foundation, and assure the expeditious processing of proposals by small business concerns based on scientific and technical merit;

(5) recommend to the Director and to the National Science Board such changes in the procedures and practices of the Foundation as may be required to enable the Foundation to draw fully on the resources of the small business research and development community; and

(6) make quarterly reports to the Congress concerning the activities of the Office of Small Business Research and Development.

MINORITIES AND WOMEN

SEC. 207. (a) The Director of the National Science Foundation shall initiate an intensive search for qualified women, blacks, Chicanoes, American Indians, and members

of other minority groups to fill executive level positions in the National Science Foundation. In carrying out the requirement of this section, the Director shall work closely with organizations which have been active in seeking greater recognition and utilization of the scientific and technical capabilities of minorities and women. The Director shall improve the representation of minorities and women on advisory committees, review panels, and all other mechanisms by which the scientific community provides assistance to the Foundation.

(b) The Director of the National Science Foundation shall report quarterly to the Committee on Science and Technology of the House of Representatives and the Committee on Labor and Public Welfare of the Senate on the status of minorities and women and activities undertaken pursuant to this section.

ADVISORY COUNCIL TO THE NATIONAL SCIENCE FOUNDATION

SEC. 208. (a) The National Science Foundation is authorized to establish an Advisory Council on the National Science Foundation (hereinafter in this section referred to as the "Advisory Council") composed of twenty-four members appointed by the Director.

(b) No such Advisory Council may be established, unless—

(1) at least twelve members appointed to the Advisory Council are individuals who are not scientists;

(2) the Advisory Council furnishes advice to the Board and the Director on broad policy matters relating to the activities of the National Science Foundation, particularly science research and education policy, and promotes public understanding and access to information concerning activities of the Foundation; and

(3) The Advisory Council selects its own Chairman and Vice Chairman.

(c) Each member of the Advisory Council authorized by this section who is appointed from private life shall receive $50 per diem (including traveltime), for each day during which that member is engaged in the actual performance of duties as a member of the Advisory Council. Any member of the Advisory Council who is in the legislative, executive, or judicial branch of the United States Government shall serve without additional compensation. All members of the Council shall be reimbursed for travel, subsistence, and other necessary expenses incurred by them in the performance of their duties.

TITLE III—NATIONAL SCIENCE AND TECHNOLOGY POLICY

NATIONAL SCIENCE FOUNDATION

SEC. 301. Section 3 (d) of the National Science Foundation Act of 1950 is amended to read as follows:

"(d) The Foundation shall recommend and encourage the pursuit of national policies designed to foster research and education in science and engineering, and the application of scientific and technical knowledge to the solution of national and international problems.

NATIONAL SCIENCE BOARD

SEC. 302. (a) Section 4 of the National Science Foundation Act of 1950 is amended—

(1) by inserting before the period at the end of subsection (a) a comma and the following: "within the framework of applicable national policies as set forth by the President and the Congress" and

(2) by striking out subsection (c) and inserting in lieu thereof the following:

"(c) The persons nominated for appointment as members of the Board (1) shall be eminent in the fields of science, social science, engineering, agriculture, industry, education, or public affairs, (2) shall be selected solely on the basis of established records of distinguished service, and (3) shall be so selected as to provide representation of the views of leaders from a diversity of fields and points of view from all areas of the Nation. The President is requested, in the making of nominations of persons for appointment as members, to give due consideration to any recommendations for nomination which may be submitted to him by the National Acad-

emy of Sciences, the National Academy of Engineering, the National Association of State Universities and Land-Grant Colleges, the Sea Grant Association, the Association of American Universities, the Association of American Colleges, the Association of State Colleges and Universities, by other scientific, technical, public interest or educational associations, and by organizations committed to the advancement of minorities and women in science.".

(b) Section 4(b) of such Act is amended—

(1) by inserting after "the Director," the following: "after consultation with the Chairman of the Board";

(2) by striking out "GS–15" and inserting in lieu thereof "GS–18"; and

(3) by inserting after the second sentence in such section the following: "No individual may be appointed under this subsection who has been employed by the Foundation during the twelve-month period prior to the appointment under this subsection.".

ASSISTANCE TO THE OFFICE OF SCIENCE, ENGINEERING, AND TECHNOLOGY POLICY

SEC. 303. In order to carry out the purposes of the National Policy, Organization, and Priorities for Science, Engineering, and Technology Act of 1976, the National Science Foundation is authorized to—

(1) gather and analyze information regarding Federal expenditures for research and engineering activities, and the employment and availability of scientific, engineering, and technical manpower, which the Foundation has assembled pursuant to paragraphs (1), (5), (6), and (7) of section 3(a) of the National Science Foundation Act of 1950 in order to appraise the implementation of the policies set forth in section 2 of the National Policy and Priorities for Science and Technology Act of 1976;

(2) provide such information and appraisals to the Office of Science, Engineering, and Technology Policy; and

(3) provide such additional information and staff assistance to the Office of National Policy and Priorities for Science and Technology Act of 1976.

TITLE IV—GENERAL PROVISIONS

FOREIGN EXPENDITURES LIMITATION

SEC. 401. In addition to such sums as are authorized by section 101, not to exceed $6,000,000 is authorized to be appropriated for fiscal year 1977, for expenses of the National Science Foundation incurred outside the United States to be paid for in foreign currencies which the Treasury Department determines to be excess to the normal requirements of the United States.

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CONSULTATION AND EXTRAORDINARY EXPENSE LIMITATIONS

SEC. 402. Appropriations made pursuant to this Act may be used, but not to exceed $5,000 for official consultation, representation, or other extraordinary expenses upon the approval or authority of the Director of the National Science Foundation, and his determination shall be final and conclusive upon the accounting officers of the Government.

OBLIGATION LIMITATION

SEC. 403. Appropriations made pursuant to this Act shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

INFORMATION REQUIREMENT

SEC. 404. Notwithstanding any other provision of this or any other Act, the Director of the National Science Foundation shall keep the Committee on Science and Technology of the House of Representatives and the Committee on Labor and Public Welfare of the Senate fully and currently informed with respect to all of the activities of the National Science Foundation.

94TH CONGRESS
2D SESSION

H. R. 12566

IN THE SENATE OF THE UNITED STATES

MARCH 26, 1976
Received

MARCH 29, 1976
Read twice and referred to the Committee on Labor and Public Welfare

AN ACT

Authorizing appropriations to the National Science Foundation for fiscal year 1977.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. There is hereby authorized to be appropriated to the National Science Foundation for the fiscal year ending September 30, 1977, to enable it to carry out its powers and duties under the National Science Foundation Act of 1950, as amended, and under title IX of the National Defense Education Act of 1958, out of any money in the

Treasury not otherwise appropriated, for the following categories:

(1) Mathematical and Physical Sciences and Engineering, $230,400,000.

(2) Astronomical, Atmospheric, Earth and Ocean Sciences, $242,700,000.

(3) Biological, Behavioral and Social Sciences, $128,500,000.

(4) Science Education, $64,000,000.

(5) Research Applied to National Needs, $63,900,000.

(6) Scientific, Technological and International Affairs, $22,000,000.

(7) Program Development and Management, $43,500,000.

SEC. 2. (a) Notwithstanding any other provision of this or any other Act—

(1) of the total amount authorized under section 1, not less than $16,100,000 shall be available for the purpose of "Graduate Student Support";

(2) of the total amount authorized under section 1, not less than $37,400,000 shall be available for the purpose of "Science Education Support";

(3) of the total amount authorized under section 1, not less than $10,500,000 shall be available for the purpose of "Science Education Innovation";

(4) of the total amount authorized under section 1, category (5), not less than 10 percent of such amount shall be expended to small business concerns;

(b) As used in this Act, "Science Education Innovation" means projects aimed at the development of new approaches to the teaching of science to student, teachers, and professionals, including but not limited to new technologies, new methods, and retraining or other efforts to make the existing scientific manpower pool better able to fulfill the Nation's manpower needs. As used in this Act, "Science Education Support" means projects aimed at building a capability to teach science, including but not limited to awards for equipment, conferences, and institutional development.

SEC. 3. In the conduct of the energy research and development activities under the "Research Applied to National Needs" category, the National Science Foundation shall coordinate all new project awards with the Administrator of the Energy Research and Development Administration or his designee.

SEC. 4. Appropriations made pursuant to this Act may be used, but not to exceed $5,000, for official consultation, representation, or other extraordinary expenses upon the approval or authority of the Director of the National Science

Foundation, and his determination shall be final and conclusive upon the accounting officers of the Government.

SEC. 5. In addition to such sums as are authorized by section 1, not to exceed $6,000,000 is authorized to be appropriated for fiscal year ending September 30, 1977, for expenses of the National Science Foundation incurred outside the United States to be paid for in foreign currencies which the Treasury Department determines to be excess to the normal requirements of the United States.

SEC. 6. Appropriations made pursuant to authority provided in sections 1, 2, and 5 shall remain available for obligation, for expenditure, or for obligation and expenditure, for such period or periods as may be specified in Acts making such appropriations.

SEC. 7. No funds may be transferred from any particular category listed in section 1 to any other category or categories listed in such section if the total of the funds so transferred from that particular category would exceed 10 per centum thereof, and no funds may be transferred to any particular category listed in section 1 from any other category or categories listed in such section if the total of the funds so transferred to that particular category would exceed 10 per centum thereof, unless—

(1) a period of thirty legislative days has passed after the Director of the National Science Foundation

or his designee has transmitted to the Speaker of the House of Representatives and to the President of the Senate and to the Committee on Science and Technology of the House of Representatives and to the Committee on Labor and Public Welfare of the Senate a written report containing a full and complete statement concerning the nature of the transfer and the reason therefor, or

(2) each such committee before the expiration of such period has transmitted to the Director written notice to the effect that such committee has no objection to the proposed action.

SEC. 8. (a) The National Science Foundation is authorized to continue, during the fiscal year ending September 30, 1977, the Alan T. Waterman Award for research or advance study in the mathematical, physical, medical, biological, engineering, social, or other sciences. The award authorized by this section shall consist of a suitable medal and a grant not to exceed $50,000 per year for a period not to exceed three years to support further research or study by the recipient.

(b) Awards under this section shall be made to recognize and encourage the work of younger scientists whose capabilities and accomplishments show exceptional promise of significant future achievement.

(c) No more than one award shall be made under this section in the fiscal year ending September 30, 1977.

SEC. 9. This Act may be cited as the "National Science Foundation Authorization Act, 1977".

Passed the House of Representatives March 25, 1976.

Attest: EDMUND L. HENSHAW, JR.,
Clerk.

Senator KENNEDY. I am pleased to welcome Dr. Stever, Director of the National Science Foundation, and Dr. Hackerman, the Chairman of the National Science Board, and other representatives of NSF who are with us. I also want to extend a special welcome to Dr. Atkinson, who joined the Foundation as Deputy Director last year, and who is appearing before the subcommittee for the first time. We will also hear this morning from Dr. Margaret Mead, whose experience as an anthropologist, author, and leader of the scientific community places her in a unique position to advise the subcommittee on policies and priorities for scientific research and education.

We look forward to her appearance here.

Dr. Stever, we would like to ask you to begin.

I do want to say that a very active member of our committee, Senator Laxalt, who, as you know, has attended all of our hearings in the past and has worked very closely with us on NSF matters and also in the development of our science policy and priorities legislation, was unable to be here this morning.

We have made arrangements for time this afternoon. He is interested in a feature of it which we will touch on in the course of the morning's program, but I know he will want to develop more completely in the course of the afternoon.

I have just mentioned, Dr. Stever, some of the areas that we hope you will develop and address. We will include all of the prepared statements in the record.

My comments have outlined some of the areas in which we are particularly interested.

[The opening statement of Senator Kennedy follows:]

OPENING STATEMENT BY SENATOR EDWARD M. KENNEDY

Senator KENNEDY. This morning the subcommittee opens its hearings on the proposed budget for the National Science Foundation for fiscal year 1977.

I am pleased to welcome Dr. Stever, Director of the National Science Foundation; Dr. Hackerman, Chairman of the National Science Board; and the other representatives of the NSF who are with us. I also want to extend a special welcome to Dr. Richard Atkinson, who joined the Foundation as Deputy Director last year, and who is appearing before the subcommittee for the first time.

This morning we will also hear testimony from Dr. Margaret Mead, who has made time in her demanding schedule to come to Washington to share with the subcommittee her views on the Foundation's proposed budget. Dr. Mead's experience as an anthropologist, author, and leader of the scientific community, places her in a unique position to advise the subcommittee on policies and priorities for scientific research and science education. Dr. Mead's appearance is also especially timely in view of the recently released report of the National Academy of Sciences on the NSF's social and behavioral science programs. I want to extend a warm and personal welcome to Dr. Mead and look forward to her testimony later this morning.

We begin these hearings just 1 week following the release of the National Science Board's annual report, which provides valuable information on the state of science in the United States, our position relative to other nations, and the perceptions of our citizens of the

strengths and weaknesses of science and technology. There is a wealth of important data in this report, and I want to call particular attention to the finding of its survey that 75 percent of the public perceives science and technology as having changed life for the better. Those surveyed, who were asked to rank nine professions, ranked scientists and engineers second only to physicians. When asked to list those areas in which they would most like to have Federal funds invested in science and technology, 69 percent placed the improvement of health care at the top of the list. The allocation of Federal research and development funds to reducing and controlling pollution, crime reduction, prevention and treatment of drug addiction, and improvement of education, ranked second, third, and fourth. At the bottom of the list were the development and improvement of weapons for national defense and space exploration, which were endorsed by only 11 percent of those surveyed.

These findings are particlarly interesting when measured against overall Federal research and development priorities proposed in the President's budget. In that budget, 62 percent of research and development support will go into defense and space related efforts; 34 percent will go into civilian programs, including only 9 percent for the improvement of health care. These priorities merit the close attention of the Congress—attention I am confident they will receive as we implement new budget procedures and as the committees with jurisdiction develop authorization and appropriation legislation.

The National Science Foundation budget, for which our subcommittee has major responsibility, provides $802 million in new funding for fiscal year 1977. This level of support—an 11 percent increase over last year—is part of an overall Federal budget for research and development of $24.7 billion—also up 11 percent over last year. The Committee on Science and Technology, which has jurisdiction over the NSF in the House, has already completed extensive hearings on the authorization under the able leadership of Congressman Jim Symington. I view these Senate hearings as an opportunity to build on that record and to discuss the issues which are of particular concern to the members of this subcommittee.

Included in this year's NSF budget request is a 19.5 percent increase in funding for basic research. This is a significant and necessary increase—and is a recognition that the 23 percent decline in Federal support for basic research which has occurred over the last 7 years must be reversed if we are to maintain our Nation's preeminent position in science. These funds will enable the NSF to carry out its responsibility to push forward the frontiers of scientific knowledge in all disciplines—and includes a 50-percent increase in funding for energy-related basic research.

Not reflected in the budget, however, is the immediate need to strengthen science education programs and to reverse the serious decline in scientific literacy which has taken place in this Nation. A recent survey by the U.S. Office of Education found that less than half of the adults in the United States have the basic scientific and mathematical skills necessary for them to conduct their daily lives.

And since 1963 the math scores of students coming through our school systems and taking college board examinations have dropped from 502 to 472—with an eight point drop occurring in the latest year.

As this decline has occurred, support for science education has dropped from 27 percent of the total NSF budget to less than 9 percent. The administration again this year has deferred science education funds and is proposing no growth in the NSF's science education programs. This subcommittee, many of whose members also serve on the Education Subcommittee, is gravely concerned over this trend and will give particular attention to this aspect of the pending budget and to the recommendation made by the National Science Board to the Office of Management and Budget that these programs should be increased by $19 million.

I also want to recognize that over the last year the Foundation has taken a number of important initial steps to broaden the participation of the public in the formulation of its policies, programs, and priorities. Public hearings have been held by the Foundation on several new programs now being implemented. The Foundation's advisory committee structure is gradually being strengthened by the inclusion on these committees of representatives who can speak for the nonscientist and present a perspective not fully recognized by the Foundation in the past. A 24-member NSF Advisory Council will soon be named to serve at the agency level and to report to the Director—a council which must include nonscientists. The National Science Board also plans to hold a series of regional forums to solicit the views of the public on programs for the advancement of science, for the application of science and technology, and for science education.

I have urged the Foundation to move in this direction and believe that as more effective communication takes place between the Foundation and groups outside its traditional constituency there will be significant benefits—for the NSF, for the scientific and technical community, and for the citizens whose lives are affected by science and technology and whose tax dollars support these programs.

The Foundation has also moved to strengthen its management, and to address the concerns which have been raised over its ability to evaluate, monitor, and direct the research and education programs it supports. The establishment of three directorates to administer basic research programs—three-fourths of the Foundation's budget—is a step which should lead to more effective oversight from within NSF of this primary responsibility. Personnel levels must also be adjusted to reflect the increase in basic research and the proposed 12 percent reduction in applied research. The GAO has completed a study for this subcommittee pointing to the need to strengthen the management of applied research programs. I am pleased to note that the NSF is implementing most of the recommendations made by GAO. Science education programs are also being subjected to intensive review by the Congress, the GAO, NSF's advisory panels, and the National Science Board. These efforts should ultimately improve programs in science education and place them in a stronger

position to seek more adequate funding from the Office of Management and Budget and from the Congress.

These issues are among a number of concerns which the subcommittee will address during these hearings. We also want to examine:

The role of the National Science Board in oversight and policy direction;

The integrity of the peer review systems, and the efforts being made by NSF to strengthen its utilization of this method of evaluating proposed research;

The role of private industry in carrying out federally funded basic research, and the experience thus far with the 7½ percent applied research set-aside provided for small businesses by the Congress last year;

The potential for a continuing role for NSF in support of carefully selected, small scale applied solar energy research;

The Foundation's role in support of research and policy analysis directed to issues of international concern which will enable U.S. science and technology to better serve the needs of the developing world;

The need to place more qualified minority and women scientists and administrators in policy level positions at NSF;

Support available to assist scientists and engineers in upgrading their skills and in working in interdisciplinary fields;

The focus and direction of the science for citizens program;

The guidelines for research supported under the NSF's program to examine the ethical and human value implications of science and technology.

We will examine as many of these areas as possible with the witnesses during their testimony. Those which time may not permit us to raise we will submit in writing for inclusion in the hearing record.

This subcommittee has welcomed the opportunity to participate, not only in the development and oversight of the NSF's programs, but in the larger effort to strengthen the Federal Government's commitment to the effective utilization of science and technology and to the development of sound national policies for science, technology, and engineering. Legislation which will provide the President with a science adviser and which will strengthen national science policy has been approved by both the House and Senate. We expect to have a final version of the bill ready for the President's signature in the next few weeks.

The National Science Foundation will play an important role in providing support to this White House office and the NSF's research and science education programs will continue to be a vital part of our national commitment to the advancement of science and technology. I look forward to the review of these programs which we begin today.

Dr. Stever, please proceed.

STATEMENT OF DR. H. GUYFORD STEVER, DIRECTOR NATIONAL SCIENCE FOUNDATION, ACCOMPANIED BY DR. NORMAN HACKERMAN, PRESIDENT, WILLIAM MARSH RICE UNIVERSITY, AND CHAIRMAN, NATIONAL SCIENCE BOARD; DR. RICHARD C. ATKINSON, DEPUTY DIRECTOR; DR. HARVEY A. AVERCH, ACTING ASSISTANT DIRECTOR FOR SCIENCE EDUCATION; CHARLES F. BROWN, GENERAL COUNSEL; DR. ELOISE E. CLARK, ACTING ASSISTANT DIRECTOR FOR BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES; DR. EDWARD C. CREUTZ, ASSISTANT DIRECTOR FOR MATHEMATICAL AND PHYSICAL SCIENCES, AND ENGINEERING; DR. ALFRED J. EGGERS, ASSISTANT DIRECTOR FOR RESEARCH APPLICATIONS; DR. ROBERT E. HUGHES, ASSISTANT DIRECTOR FOR ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES, AND ACTING ASSISTANT DIRECTOR FOR SCIENTIFIC, TECHNOLOGICAL AND INTERNATIONAL AFFAIRS; DR. JACK T. SANDERSON, ACTING DIRECTOR, OFFICE OF PLANNING AND RESOURCES MANAGEMENT; ELDON D. TAYLOR, ASSISTANT DIRECTOR FOR ADMINISTRATION; AND THEODORE W. WIRTHS, DIRECTOR, OFFICE OF GOVERNMENT AND PUBLIC PROGRAMS, A PANEL

Dr. STEVER. Thank you, Senator Kennedy.

Mr. Chairman, I am very pleased to have an opportunity to highlight the National Science Foundation's program for 1977 and to urge support of the President's budget request. The budget provides a total of $812 million, of which $802 million in new funds and $10 million in proposed fiscal year 1976 deferrals. This represents an increase of $80.4 million in obligational authority, 11 percent above the program level for fiscal year 1976.

The major thrust of the Foundation's program for fiscal year 1977 emphasizes basic research support in the fundamental fields of science. It is part of an overall administration effort to strengthen science and technology. As you know, the total Federal budget for fiscal year 1977 is sharply controlled, held to an increase of about 5 percent. But within the total Federal budget, research and development in the various agencies is increased approximately 11 percent, based on a strong belief that science and technology can help to identify both short- and long-term problems and contribute to their solution.

I would like to show briefly three charts, which I think put what we are going to talk about into perspective.

Senator KENNEDY. These are out of the Science indicators report?

Dr. STEVER. Yes. Science Indicators, 1974.

Senator KENNEDY. We had a chance to review that over the weekend.

Dr. STEVER. We are very proud of it. I am sorry, the National Science Board—of which I am a part—is proud of it.

I think Dr. Hackerman will speak a bit about that.

Senator KENNEDY. Some of these charts go back as far as 1960, but almost all include no data more recent than 1973. For example: "Bachelor's Degrees in Science and Engineering" through 1972; "R. & D. Expenditures by Selected Industry," 1960 through 1972.

Dr. STEVER. Do you want to know why we cannot bring it up to date?

Senator KENNEDY. Yes.

Dr. STEVER. We are trying that.

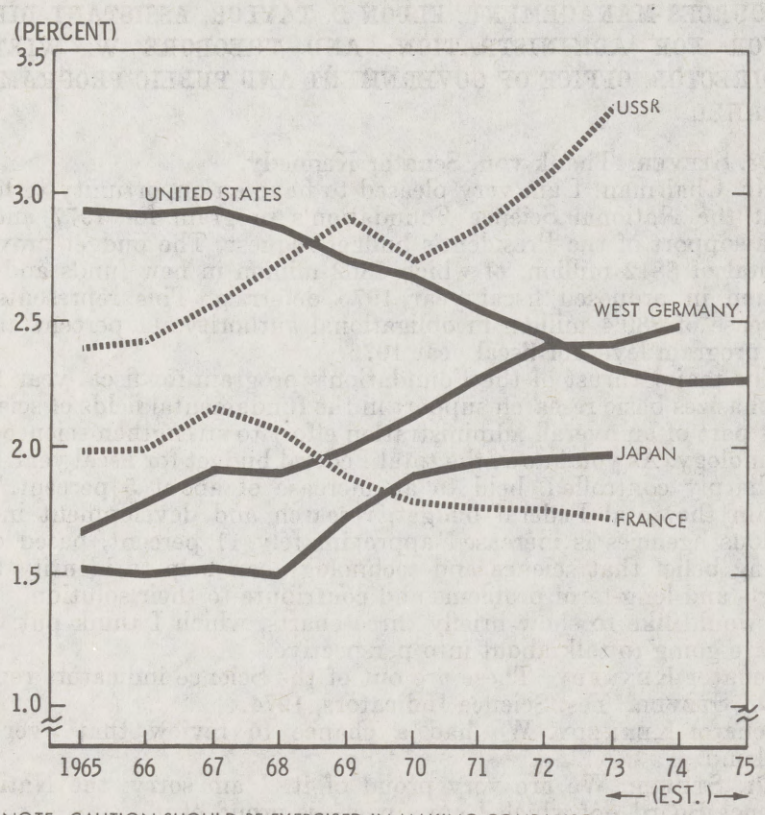
Senator KENNEDY. Particular rates of expenditure or percents of GNP, go up to 1974; some of the charts you have here, as you know, only go to 1973.

Dr. STEVER. That is correct. One of these charts, however, gets up to 1975.

I would say, Mr. Chairman, that we are working hard to get a better capability to keep you more up to date, and I think Dr. Hackerman will speak about that capability.

[The chart referred to follows:]

TRENDS IN R&D/GNP RATIOS BY LEADING INDUSTRIAL COUNTRIES: 1965-75



NOTE: CAUTION SHOULD BE EXERCISED IN MAKING COMPARISONS BETWEEN ESTIMATED DATA FOR THE USSR AND OECD DATA FOR OTHER COUNTRIES BECAUSE OF DIFFERENCES IN DEFINITIONS.

SOURCE: ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT AND DIVISION OF SCIENCE RESOURCES STUDIES/STIA

Senator KENNEDY. All right.

Dr. STEVER. The trends in R. & D., the ratio of research and development to gross national product by leading industrial countries, you can see the United States has dropped from 3 percent in the middle sixties and began dropping about 1967 and dropped pretty steadily to 1974, where it leveled off again. That was accompanied by a growth in West Germany.

By the way, every time I talk with leaders from any other country, Mr. Chairman, they are fascinated with this data. They want to know how they are doing. What is the formula we use? How do we get this through? They can hardly believe that our country, that this chart is really the result of dozens and hundreds of decisions, rather than a single central decision to spend a certain percentage of our gross national product.

I think other countries do centralize that decision much more than we do. Japan has grown. I am not sure what Japan's percentage will be now because I think they have been rather hard hit by recession.

On the other hand, there is no question that the Japanese are beginning to think they had better do more in basic research because they have used up their capability, depending upon other countries in that area. They are realizing they have to lay their own base.

France has leveled off below 2 percent.

U.S.S.R. figures, to the best of our knowledge, continue to grow although their figures are a little harder to obtain.

I think this is the problem we face.

Senator KENNEDY. Before we leave that chart, do you have one which shows expenditure levels for research and development, excluding military and defense related R. & D?

Dr. STEVER. We are going to show basic research on the next chart.

Senator KENNEDY. How would these lines be different if they represented nondefense R. & D?

Dr. STEVER. For nondefense items?

Senator KENNEDY. I have seen some international comparisons in the Science Industries.

Dr. STEVER. Nondefense items as far as Federal budget is concerned, have been growing particularly in the civilian mission agencies. This year I think it is relatively constant, the growth in both nondefense and defense is the same. In the nondefense area there is a big growth in energy, but the defense area grows also across the board, so I think you will discover that here we are presenting 1977 as R. & D. growing in two areas at about the same amount.

Senator KENNEDY. What do you estimate, quickly, in other countries, the U.S.S.R. for example, as to the percentage of R. & D. devoted to defense.

Dr. STEVER. In the Federal budget, ours is about 53 percent of the Federal budget, but I had better check. It must be more than that.

Senator KENNEDY. I would have thought it might be higher.

Dr. STEVER. No. I think you will find a better figure for nondefense.

Here are the numbers proposed for 1977. For the Department of Defense the amount is $11.2 billion out of a total $23.5 billion.

Now, there are some defense investments in ERDA, and that is about it.

Here is another chart, Mr. Chairman, which takes us right up to 1977. It shows you the growth of defense, civilian, space, and total.

Senator KENNEDY. That is good.

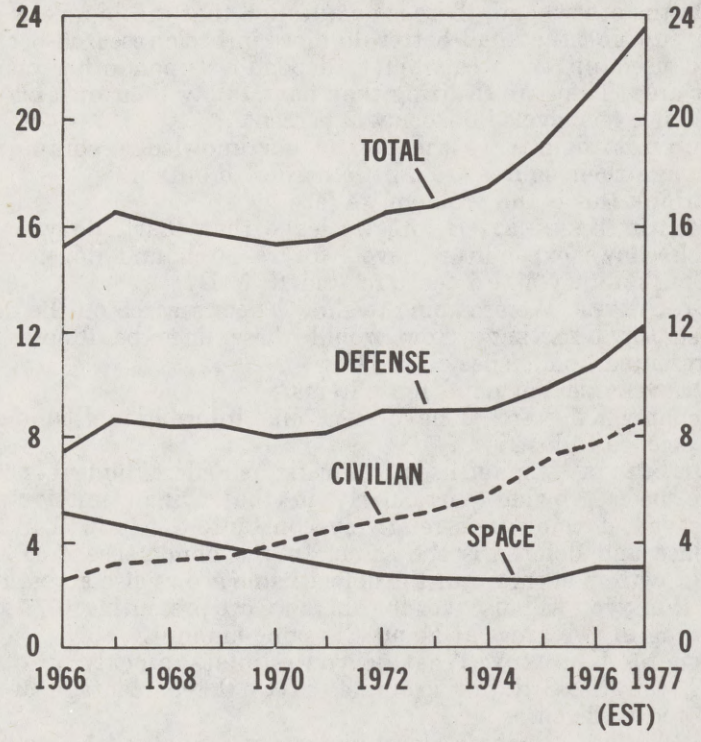
Dr. STEVER. I think it will show you that civilian has grown steadily in billions of dollars over the last decade, about 3 billion to 8 billion. Defense has gone from about 8 to 12. Space had dropped from about 5 to 3.

Could I show you the next chart which pertains a little more closely to the National Science Foundation? Here again we take it to 1975. And it goes, a little beyond what is in the indicators.

[The charts referred to follow:]

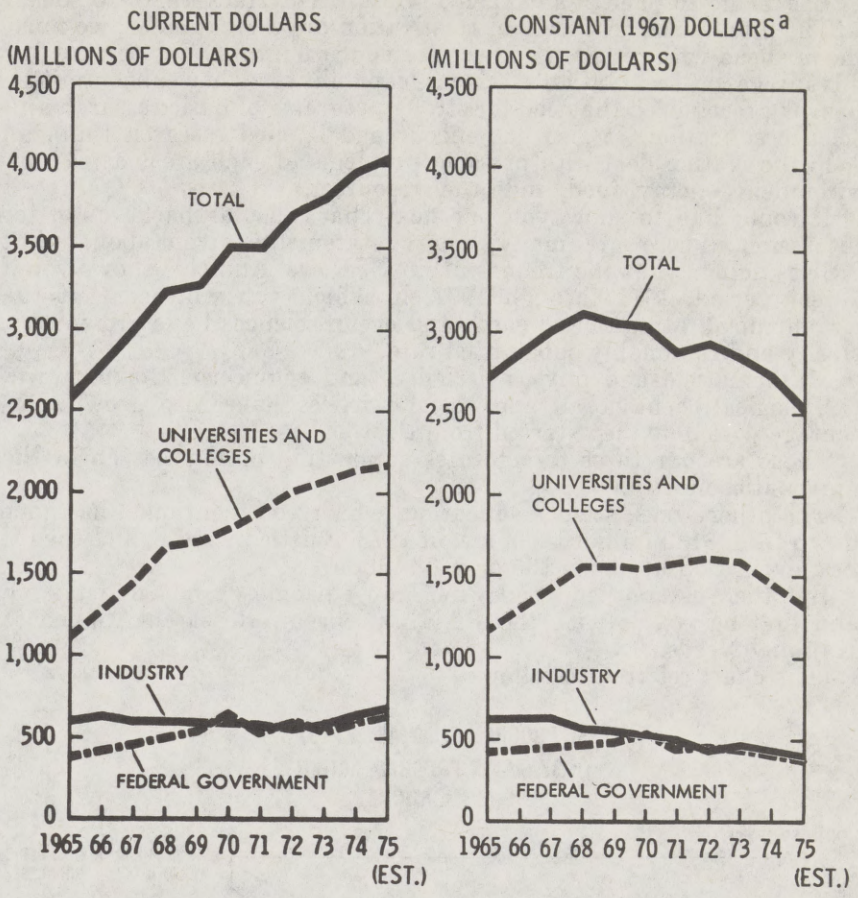
FEDERAL OBLIGATIONS FOR CONDUCT OF R&D BY MAJOR PROGRAM AREA FY 1966-77

BILLIONS OF DOLLARS



SOURCE: SPECIAL ANALYSIS P, 1977 BUDGET

NATIONAL BASIC RESEARCH EXPENDITURES BY PERFORMER: 1965-75



a/BASED ON GNP IMPLICIT PRICE DEFLATOR
SOURCE: DIVISION OF SCIENCE RESOURCES STUDIES/STIA

Dr. STEVER. The current dollars and the constant dollars are both plotted there. You see again that, while the current dollars for universities and colleges has grown for industry and the Federal Government—industry has remained constant and Federal Government has shown a slight growth. When you look at the constant dollars, you will see the total grew to about 1967, and then began to go down. For colleges and universities, it was fairly level, but it is now going down, as is the Federal Government and industry.

That really is the main reason why the National Science Foundation came in with a very strong budget in basic research this year, to counteract the drop of support for research in the universities and colleges.

At the end of the budgeting exercise, Mr. Chairman, this last year, it was my job, this time acting as science adviser, to point out that the

preliminary budget at that stage of the planning was not strong enough in basic research in the universities and colleges. This was particularly apparent when projected outlays were studied. I am very glad that the administration responded to this need to strengthen basic research.

Let me go to page 2, and then I will ask Dr. Hackerman to speak.

The intellectual resources of this Nation are a great asset; we must move ahead with research and science education programs to take full advantage of the Nation's science capabilities. This subcommittee has long recognized the need for strong programs of basic research and science education. It also has encouraged applied research that can help the Nation deal with pressing problems in such areas as the environment, energy, food, and other resources.

I would like to show you our next chart just as background for discussion. There are many, many statements given about what NSF is doing, what the trends within NSF are. And this shows you a 7-year period, 1971 through 1977, in which you will see that the astronomical, atmospheric earth and ocean sciences have grown at a steady and reasonably substantial rate.

Mathematical and physical sciences and engineering have grown.

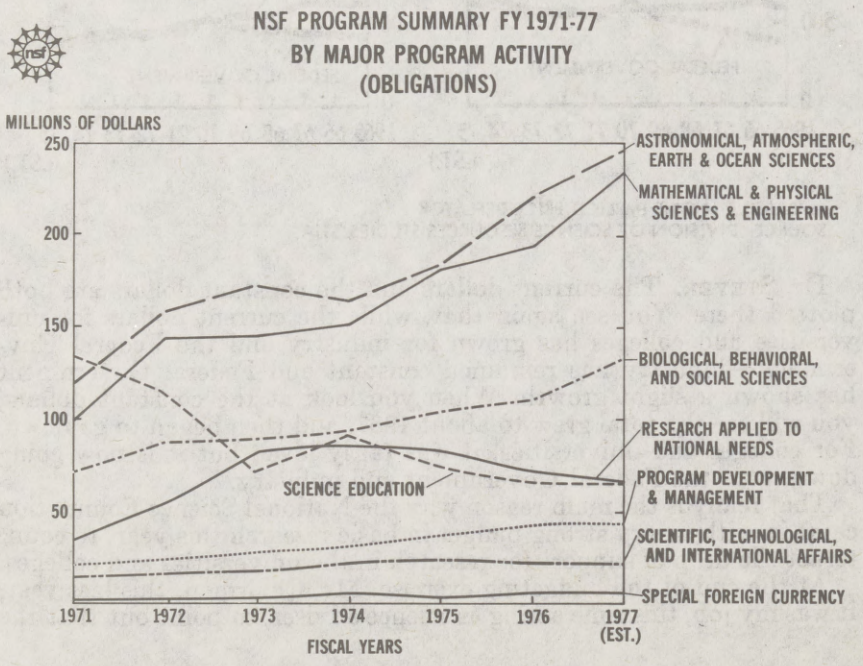
Biological, behavioral, and social sciences have also grown percentage-wise, but they started from a lower base.

Those are our three directorates supporting basic research in the universities mostly.

The other areas, science education, which you mentioned has gone down from $130 million, to a low in 1973, a little increase, and then it has levelled off at about $65 or $70 million.

But there is another trend which most people do not understand, and that has to do with the RANN program, Research Applied to National Needs.

[The chart referred to follows:]



Dr. STEVER. Many people in the science community think that RANN has been growing in an unparallelled way in NSF. Actually it grew to 1973, and it would have grown beyond that had we not had ERDA come along and had a shift in some major programs. We levelled off and we have dropped a little since then.

We are taking up new initiatives and trying to get them on the kind of base that we once had for energy we would expect that other applied research would be spun off. It is important for the people to have proper background with respect to NSF in the applied area.

Let me stress, Mr. Chairman, that the Foundation is a principal source of basic research funding at the Nation's colleges and universities. Without the substantial increase proposed for basic research in the NSF budget——

Senator KENNEDY. Do you have one of these charts to project, say over the next 5 years, what R. & D. expenditures should be? Do you have people in your shop giving some thought as to where we are going?

Dr. STEVER. Yes, sir, we do. NSF does a 5-year budgeting cycle, but I discovered, sir, in the governmental context we always must concentrate on a year-by-year treatment of it.

Senator KENNEDY. I think we understand that. All of us are practical in that sense. It would be of value to all of us to have an idea and understanding of where we are going, what the priorities are, and what your judgments are. We would then have some idea about the future and what we can expect for science policy and Science Foundation directions.

Dr. STEVER. Mr. Chairman, we are on your side. I would like to point out that it is usually at the June meeting when we meet out of Washington and consider long-range thrusts for the National Science Foundation. I think it would be a good objective for us this year, and I think the Board would concur with me on this, that the Foundation formulate some ideas on the longer range issues.

Dr. HACKERMAN. The problem, Senator Kennedy, is that transitions do take place that 5-year plans could not take into account. RANN is a case in point. RANN operates until the point of transfer is reached then it is very important to transfer the activity out of RANN into a mission agency. Therefore RANN operates somewhat on a cyclical basis.

Keeping that in mind, the 5-year plan can be done. Hindsight is still better than foresight.

Senator KENNEDY. I agree with that. I do not think anybody is looking for ways to find out why you have been wrong, by looking backward. I am not particularly concerned about how you are going to try and allocate very specific dollars. But I think it is important for us to have some idea about direction, trends and movement; about priorities at the present time; about research which is interdisciplinary and which affects general Science Foundation priorities. Projections could provide a great deal of important information in their area.

We are all wondering where you are really going with those up curves, and where you are going with the down curves, what is this going to mean? What new areas and priorities are going to arise over a particular period of time? It seems to me with regard to some

of these charts that we need to know where they are going, what the long-range implications are, we need to know this for American industry on our universities, and in the public sector. It would be useful and I think helpful to the Congress as an institution to try to begin to jar and focus our thinking on some of these questions.

Dr. STEVER. I think it is a good question to ask us and we will try to do better.

Senator KENNEDY. Fine.

Dr. STEVER. Let me stress, Mr. Chairman, that the Foundation is a principal source of basic research funding at the Nation's colleges and universities. Without the substantial increase proposed for basic research in the NSF budget, Federal funding in fiscal year 1977 would result in a continuing decline in the level of research effort at the Nation's colleges and universities.

Senator KENNEDY. In the colleges and universities, it is generally assumed now that by the year 2000 enrollment will be down. I know in my own area of Boston new enrollees are going to be down by a third. Our colleges and universities are facing all kinds of financial problems and will have to make difficult adjustments. Does the NSF plan to help alleviate these problems in the short term—particular financial difficulties? Do we expect there will be fewer universities, unless you provide more assistance to the private sector? Those are problems that will be coming up over the next 25 years.

Dr. ATKINSON. Those are matters the Board and Foundation actively have under consideration, particularly how basic research will be supported in the country, particularly given your remarks about reduced student enrollment. The National Science Board has had a number of studies on the subject.

Dr. STEVER. And expect to have another report out on this shortly.

Dr. ATKINSON. We are very actively interested in this.

Dr. STEVER. Mr. Chairman, I think it is more vital than what is being presented here. The strength of the U.S. basic science rests primarily in our universities not solely, but primarily. This is a choice we have made as a society for many years. Other countries do not choose this.

In the Soviet Union the strength of the basic research is in their Government institutions, essentially the institutions making up the Soviet Union Academy of Science.

In Britain it is more our way.

In France it is, I would say, a little more in Government, but a mixed picture. But Germany, well, it is more Russian, not quite, but almost.

The point is we have made a decision, historically, to concentrate our basic science strength in our colleges and universities. We are the leaders. If the kind of trend that you just talked about were to continue and have us lose that leadership in basic research, I think it would be a disasterous thing. A decision made unconsciously, not consciously. I think it is a very important question that you have brought up.

We should report, and I think we will.

I also want to reemphasize NSF's conviction that most Federal agencies need strong programs of basic research to help them achieve their mission objectives over the long term. The Foundation is con-

tinuing its efforts to encourage this policy, and the National Science Board is strongly committed to it. Several areas of basic research included in the Foundation's program for fiscal year 1977 complement, help to underpin, and are coordinated with the research programs of the mission agencies.

As you know, the National Science Board is charged with shaping the Foundation's policies. The Board also plays a major role in developing the NSF budget. I would now like to introduce Dr. Norman Hackerman, Chairman of the Board, who will comment on science in the United States as we move into our third century as a nation.

Dr. HACKERMAN. Before I begin my statement, I would like to return a moment to an earlier conversation. I offer this clarifying statement for the record.

I think one of the important things to keep in mind is that many reports of the kind we are talking about are simply extrapolations. That is not what you are talking about. It is important that we not simply extrapolate. Those are easy to do, but they are very misleading. They have to be thoughtful with regard to what kind of occurrences are apt to appear to divert simple extrapolations.

Also, I would like to point out that the Board report which comes out next does address the university research issue. You might be interested in that.

Further, Science Indicator—1974, literally did use the numbers up to 1973. It occasionally slipped over, but this report, I am sorry to say, is a year late. That is one reason for these numbers.

Senator KENNEDY. Yes, fine.

Dr. HACKERMAN. I want to talk about what appears to me and the Board to be the central mission of the Foundation. That has to do with the basic research activities.

I perceive that there is a certain amount of attack on that area, because it is a costly area and because its product is not so immediately evident. In fact, there is some tendency to cause the problem to be more immediately evident with a constant loss of that somewhat subtler flavor, which stems out of it, what I shall call pure research for the sake of knowing more.

Scientists of today are in important ways like the great explorers of the past. The essential motivation of one of the most exciting explorations in our history, the journey of Lewis and Clark to the Pacific and back, was the acquisition of new knowledge. We still benefit. For example, their botanical specimens exist today, and continue to serve science so well that the National Science Foundation has found it worthwhile to provide funds to assure their preservation and their accessibility to researchers.

This isolated instance makes a large point about the enduring value of new knowledge. The Lewis and Clark collection, some 200 specimens, is at the Academy of Natural Science in Philadelphia. It has been on loan from the American Philosophical Society since 1890.

As an aside, apparently Thomas Jefferson at a speech to the American Philosophical Society talked about the desirability of investigating that area west of the then U.S. boundaries, and that resulted in the Lewis and Clark expedition. I am not a historian, so that is not a firm historical arrangement.

The Lewis and Clark contributions are part of a collection of 20,000 specimens making up what is considered to be the finest historical collection of that nature in the world. The NSF grant is in the interest of the whole.

Lewis and Clark, and all the others in the great tradition of exploration, were moved to penetrate the unknown in the quest for new knowledge with little if any foresight of what they would find and what the effect of the findings would be. Some of today's scientists still search for new knowledge with very little notion of its ultimate usefulness. Others accept different challenges of society embodied in such formidable problems as explosive growth of population, urgent need for greater food production, energy, depletion of mineral resources, environmental pollution, unforeseen consequences of technological development, and the threats of disease and natural hazards. The problems tend to be interdependent, and the solution for one may aggravate another.

I would like to discuss with you today a few examples of the work being done by science explorers supported by NSF within the pattern of policies developed by the National Science Board. The range of these explorations is limited only by the logistics of science, by which I mean that they go as far as available instruments, methods, and intellectual competence can take them. That range is still being extended, as I shall note in a moment. Its ultimate extremes cannot be foreseen, for they will be established only when the scientific curiosity calls itself satisfied, and one doubts that will happen. NSF-supported scientists are penetrating the depths of the oceans, the polar regions, and the far reaches of the universe. They are pushing into unknown territories for knowledge about the nature and behavior of matter in all its forms, about man and his behavior in society, and the mysterious processes within all living things.

Some of the results will have a readily apparent value to the well-being of the Nation. Others will have discernible potential benefits. The worth of others will be seen in retrospect only after a very long time span. Lewis and Clark sent back one plant they had been told was good for rattlesnake bite—an immediate benefit, if it worked. Along with it they shipped others which are still being studied in the museum at Philadelphia some 175 years after being collected, because under study they may yield new knowledge. Thus we are reminded again that all the yields of science, whether immediate or long delayed, have their roots in knowledge.

A moment ago I noted that the range of exploration is still being extended. There have in fact occurred during the past year, discoveries carrying our knowledge of the deep reaches of the universe farther than ever before. Scientists at the University of California at Berkeley, using the Lick Observatory's 120-inch telescope and instrumentation developed at the University of California at Santa Cruz, have disdiscovered the most distant galaxy observed to date. The distance of this galaxy from Earth is estimated to 8 billion light years. That means we are observing events which were going on something like twice as long ago as this Earth is believe to have come into being. This new reach means that the part of the universe now accessible to observations from Earth has quadrupled. Further research on this object may give us clues to the pattern of evolution followed by stars

and galaxies. I deliberately avoid any speculation as to the results of this new knowledge, except to say confidently that it will lead to further new knowledge. I may note, however, that we looked for thermonuclear energy because of knowledge learned from the stars.

Now let me turn from the reaches of the universe to the laboratory. First, I would like to present to you certain examples of research being conducted in various parts of the country with NSF support. These were chosen because they represent research which I might describe as free standing because its target is new knowledge.

Dr. Arthur T. Hubbard, of the University of Hawaii, has completed experiments on single crystals of platinum in which he has shown that water causes surface rearrangements in the crystal structure. This may be somewhat involved scientifically, Senator Kennedy, but, in fact, this happens to be an area in which I am personally interested, and so it was chosen.

Acids such as hydrochloric acid and perchloric acid displace the water and the ultimate extension of these experiments will be to the deposition of metal ions and the corresponding measurement of precise positions of surface metal atoms resulting from electrolysis. These experiments will have great significance in our understanding of numerous electrochemical processes.

At the University of Georgia, Dr. Allen D. King is conducting research on interfacial tension of systems containing an aqueous phase in equilibrium with a dense gas. This research program divides into two parts. The first involves measuring pressure-induced changes in surface tension of water and various aqueous solutions which are in direct contact with a dense gas. The purpose is to utilize measured surface tensions to determine adsorption isotherms of various low molecular weight gaseous species absorbed at the aqueous surface; such measurements can be a sensitive probe for studying the nature of the gas-water interface. The second part of the research involves similar measurements on three-phase systems consisting of immiscible organic and aqueous phases, including the effects of dissolved gases on the interfacial tension at the oil-water interface.

Dr. William C. Lineberger, at the University of Colorado, is conducting laser studies of molecular structure and energy transfer processes. The highly reactive methylene molecule (CH_2) is known to exist in two forms, a diamagnetic ("singlet") form and a paramagnetic ("triplet") form. The difference in energy between the forms was not accurately known. The energy difference cannot be measured directly by absorption of light because triplet to singlet transitions are forbidden. The theoretical calculation of this small difference is accurate to only 50 percent. However, recent laser photoelectron spectroscopy has determined this difference to better than 3 percent. In their experiments, the CH_2 ion absorbed light to form $CH_2 + e^-$, where the CH_2 could be produced in either form by changing the energy of the light. This yielded the desired energy difference between the two forms.

Now, let me introduce an example of basic research which has proceeded to a stage at which promise of potential uses can be discerned. Scientists supported by NSF are addressing themselves to methods of producing synthetic prostaglandins, which promise to furnish therapeutic agents for many medical problems. They are

synthesized in the body, but only small quantities of the natural product can be obtained. Hence the effort to produce them by other means. Prostaglandins first engaged the attention of scientists over 30 years ago, and new knowledge about them has come from the efforts of many scientists in many other countries as well as the United States. In 1966 a Harvard chemist, E. J. Corey, in research supported by the Foundation, discovered ways to synthesize prostaglandins in the laboratory. Since that time the research of other scientists, including numerous Foundation grantees, in addition to continuing progress in Corey's laboratory, has contributed to a rapid advance in our knowledge of these compounds. Here again, I am focusing on the exploratory aspect of research and its yield in new knowledge.

Physicists at the University of Washington and at the Joint Institute for Laboratory Astrophysics at the University of Colorado are using a magnetic bottle corked with static electricity as a test-tube for charged-particle chemistry. They have discovered that carefully shaped configurations of static electricity and magnetic fields can be used to store electrically charged molecules for many hours and, indeed, can store electrons for months in a small highly evacuated volume. By introducing carefully controlled reagents into the "bottle," scientists can study reactions of a new breed; previously inaccessible reactions which nevertheless may determine the behavior of a laser-excited plasma, a fusion plasma, or some other aspect of our proliferating high-temperature technology, where chemical species readily exist in an electrically charged state.

In the area of the behavioral sciences, significant studies have been conducted on the impact of crowding on humans. Social psychologist Jonathan Freedman of Columbia University, in research supported by NSF, has found that crowding is not consistently harmful to people. In the background of this research there lay a substantial body of knowledge about various negative effects of population density on animals other than humans. However, until recently, there has been very little scientific study of the impact of crowding upon humans. Studies by Freedman and his colleagues led to findings confirmed in controlled experiments that, in situations of relatively short-term crowding, people showed no overall ill effects of high density. Their analyses showed that crowding has complex effects which depend on the particular circumstances and persons involved. Among other things, a hypothesis was tested and confirmed that crowding intensifies typical reactions to a situation. That is, if people tend to be pleasant, warm, cooperative, or generally positive toward each other they will be more positive under high density. If they are unpleasant, aloof, hostile, or generally negative, they will be more negative under high density. It is perhaps permissible to draw from such work the suggestion that scientific exploration not only can lead to new knowledge but can challenge firmly held beliefs based only on intuition, and thus provide a sounder basis for social judgments. That is another way of saying that truth changes in the light of new understanding.

I have discussed only a few of the thousands of projects being carried on with NSF support. Scientific exploration always offers the hope that new knowledge will start a chain reaction of understanding, a hope based on a sufficient number of instances in which just that result

has occurred. The process can sometimes be seen to occur as a system which man can seek to reproduce, and to occur sometimes at random, with unpredictable but conceivably high yields of knowledge and understanding. The National Science Board in carrying out its policymaking duty has the task of attempting to arrive at a pattern of endeavor by the National Science Foundation to provide stimulus for this process, taking advantage of the best opportunities and the best promise of adding to scientific knowledge.

Mr. Chairman and members of the subcommittee, thank you.

[The prepared statement and biography of Dr. Hackerman follows:]

STATEMENT BY DR. NORMAN HACKERMAN
CHAIRMAN, NATIONAL SCIENCE BOARD
BEFORE THE
SPECIAL SUBCOMMITTEE ON THE NATIONAL SCIENCE FOUNDATION
COMMITTEE ON LABOR AND PUBLIC WELFARE
U.S. SENATE
MARCH 1, 1976

MR. CHAIRMAN, I APPRECIATE THE OPPORTUNITY TO TESTIFY BEFORE THIS COMMITTEE IN SUPPORT OF THE NATIONAL SCIENCE FOUNDATION (NSF) PROGRAM FOR FISCAL YEAR 1977.

THE EXERCISE OF THE NATIONAL SCIENCE BOARD'S STATUTORY MANDATE TO "...ESTABLISH THE POLICIES OF THE FOUNDATION" IS SUBJECT TO THE AUTHORITY OF THE CONGRESS. THE POLICIES REFLECTED IN THE NSF PROGRAM YOU ARE CONSIDERING PROVIDE, WE HOPE, A BASIS FOR A READY MEETING OF MINDS WITH THIS SUBCOMMITTEE. IT IS IN THAT SPIRIT THAT I OFFER MY REMARKS AND AWAIT YOUR QUESTIONS.

DR. STEVER WILL BE DISCUSSING WITH YOU THE HIGHLIGHTS OF THE PROGRAM ITSELF.

SCIENTISTS OF TODAY ARE IN IMPORTANT WAYS LIKE THE GREAT EXPLORERS OF THE PAST. THE ESSENTIAL MOTIVATION OF ONE OF THE MOST EXCITING EXPLORATIONS IN OUR HISTORY, THE JOURNEY OF LEWIS AND CLARK TO THE PACIFIC AND BACK, WAS THE ACQUISITION OF NEW KNOWLEDGE. WE STILL BENEFIT. FOR EXAMPLE, THEIR BOTANICAL SPECIMENS EXIST TODAY, AND CONTINUE TO SERVE SCIENCE SO WELL THAT THE NATIONAL SCIENCE FOUNDATION HAS FOUND IT WORTHWHILE TO PROVIDE FUNDS TO ASSURE THEIR PRESERVATION AND THEIR ACCESSIBILITY TO RESEARCHERS.

THIS ISOLATED INSTANCE MAKES A LARGE POINT ABOUT THE ENDURING VALUE OF NEW KNOWLEDGE. THE LEWIS AND CLARK COLLECTION, SOME 200 SPECIMENS, IS AT THE ACADEMY OF NATURAL SCIENCE IN PHILADELPHIA. IT HAS BEEN ON LOAN FROM THE AMERICAN PHILOSOPHICAL SOCIETY SINCE 1890. THE LEWIS AND CLARK CONTRIBUTIONS ARE PART OF A COLLECTION OF 20,000 SPECIMENS MAKING UP WHAT IS CONSIDERED TO BE THE FINEST HISTORICAL COLLECTION OF THAT NATURE IN THE WORLD--THE NSF GRANT IS IN THE INTEREST OF THE WHOLE. THE EXAMPLE OF THIS COLLECTION CARRIES ITS OWN SUGGESTION THAT NEW KNOWLEDGE NEVER REALLY GROWS OLD, AND THAT KNOWLEDGE FROM HOWEVER FAR BACK MAY STILL YIELD ADDITIONAL NEW KNOWLEDGE.

LEWIS AND CLARK, AND ALL THE OTHERS IN THE GREAT TRADITION OF EXPLORATION, WERE MOVED TO PENETRATE THE UNKNOWN IN THE QUEST FOR NEW KNOWLEDGE WITH LITTLE IF ANY FORESIGHT OF WHAT THEY WOULD FIND AND WHAT THE EFFECT OF THE FINDING WOULD BE. SOME OF TODAY'S SCIENTISTS STILL SEARCH FOR NEW KNOWLEDGE WITH VERY LITTLE NOTION OF ITS ULTIMATE USEFULNESS. OTHERS ACCEPT DIFFERENT CHALLENGES OF SOCIETY EMBODIED IN SUCH FORMIDABLE PROBLEMS AS EXPLOSIVE GROWTH OF POPULATION, URGENT NEED FOR GREATER FOOD PRODUCTION, ENERGY, DEPLETION OF MINERAL RESOURCES, ENVIRONMENTAL POLLUTION, UNFORESEEN CONSEQUENCES OF TECHNOLOGICAL DEVELOPMENT, AND THE THREATS OF DISEASE AND NATURAL HAZARDS. THE PROBLEMS TEND TO BE INTERDEPENDENT, AND THE SOLUTION FOR ONE MAY AGGRAVATE ANOTHER.

I WOULD LIKE TO DISCUSS WITH YOU TODAY A FEW EXAMPLES OF THE WORK BEING DONE BY SCIENCE EXPLORERS SUPPORTED BY NSF WITHIN THE PATTERN OF POLICIES DEVELOPED BY THE NATIONAL SCIENCE BOARD. THE RANGE OF THESE EXPLORATIONS IS LIMITED ONLY BY THE LOGISTICS OF SCIENCE, BY WHICH I MEAN THAT THEY GO AS FAR AS AVAILABLE INSTRUMENTS, METHODS, AND INTELLECTUAL COMPETENCE CAN TAKE THEM. THAT RANGE IS STILL BEING EXTENDED, AS I SHALL NOTE IN A MOMENT. ITS ULTIMATE EXTREMES CANNOT BE FORESEEN, FOR THEY WILL BE ESTABLISHED ONLY WHEN THE SCIENTIFIC CURIOSITY CALLS ITSELF SATISFIED, AND ONE DOUBTS THAT CAN HAPPEN. NSF-SUPPORTED SCIENTISTS ARE PENETRATING THE DEPTHS OF THE OCEANS, THE POLAR REGIONS, AND THE FAR REACHES OF THE UNIVERSE. THEY ARE PUSHING INTO UNKNOWN TERRITORIES FOR KNOWLEDGE ABOUT THE NATURE AND BEHAVIOR OF MATTER IN ALL ITS FORMS, ABOUT MAN AND HIS BEHAVIOR IN SOCIETY, AND THE MYSTERIOUS PROCESSES WITHIN ALL LIVING THINGS.

SOME OF THE RESULTS WILL HAVE A READILY APPARENT VALUE TO THE WELL-BEING OF THE NATION. OTHERS WILL HAVE DISCERNIBLE POTENTIAL BENEFITS. THE WORTH OF OTHERS WILL BE SEEN IN RETROSPECT ONLY AFTER A VERY LONG TIME SPAN. LEWIS AND CLARK SENT BACK ONE PLANT THEY HAD BEEN TOLD WAS GOOD FOR RATTLESNAKE BITE--AN IMMEDIATE BENEFIT, IF IT WORKED. ALONG WITH IT THEY SHIPPED OTHERS WHICH ARE STILL BEING STUDIED IN THE MUSEUM AT PHILADELPHIA SOME 175 YEARS AFTER BEING COLLECTED, BECAUSE UNDER STUDY THEY MAY YIELD NEW KNOWLEDGE. THUS WE ARE REMINDED

AGAIN THAT ALL THE YIELDS OF SCIENCE, WHETHER IMMEDIATE OR LONG DELAYED, HAVE THEIR ROOTS IN KNOWLEDGE.

A MOMENT AGO I NOTED THAT THE RANGE OF EXPLORATION IS STILL BEING EXTENDED. THERE HAVE IN FACT OCCURRED DURING THE PAST YEAR DISCOVERIES CARRYING OUR KNOWLEDGE OF THE DEEP REACHES OF THE UNIVERSE FARTHER THAN EVER BEFORE. SCIENTISTS AT THE UNIVERSITY OF CALIFORNIA AT BERKELEY, USING THE LICK OBSERVATORY'S 120-INCH TELESCOPE AND INSTRUMENTATION DEVELOPED AT THE UNIVERSITY OF CALIFORNIA AT SANTA CRUZ, HAVE DISCOVERED THE MOST DISTANT GALAXY OBSERVED TO DATE. THE DISTANCE OF THIS GALAXY FROM EARTH IS ESTIMATED TO BE EIGHT BILLION LIGHT YEARS. THAT MEANS WE ARE OBSERVING EVENTS WHICH WERE GOING ON SOMETHING LIKE TWICE AS LONG AGO AS THIS EARTH IS BELIEVED TO HAVE COME INTO BEING. THIS NEW REACH MEANS THAT THE PART OF THE UNIVERSE NOW ACCESSIBLE TO OBSERVATIONS FROM EARTH HAS QUADRUPLED. FURTHER RESEARCH ON THIS OBJECT MAY GIVE US CLUES TO THE PATTERN OF EVOLUTION FOLLOWED BY STARS AND GALAXIES. I DELIBERATELY AVOID ANY SPECULATION AS TO THE RESULTS OF THIS NEW KNOWLEDGE, EXCEPT TO SAY CONFIDENTLY THAT IT WILL LEAD TO FURTHER NEW KNOWLEDGE. I MAY NOTE, HOWEVER, THAT WE LOOKED FOR THERMONUCLEAR ENERGY BECAUSE OF KNOWLEDGE LEARNED FROM THE STARS.

NOW LET ME TURN FROM THE REACHES OF THE UNIVERSE TO THE LABORATORY. FIRST I WOULD LIKE TO PRESENT TO YOU CERTAIN EXAMPLES OF RESEARCH BEING CONDUCTED IN VARIOUS PARTS OF THE

COUNTRY WITH NSF SUPPORT. THESE I HAVE CHOSEN BECAUSE THEY REPRESENT RESEARCH WHICH I MIGHT DESCRIBE AS FREE-STANDING BECAUSE ITS TARGET IS NEW KNOWLEDGE.

DR. ARTHUR T. HUBBARD, OF THE UNIVERSITY OF HAWAII, HAS COMPLETED EXPERIMENTS ON SINGLE CRYSTALS OF PLATINUM IN WHICH HE HAS SHOWN THAT WATER CAUSES SURFACE REARRANGEMENTS IN THE CRYSTAL STRUCTURE. ACIDS SUCH AS HYDROCHLORIC ACID AND PERCHLORIC ACID DISPLACE THE WATER AND THE ULTIMATE EXTENSION OF THESE EXPERIMENTS WILL BE TO THE DEPOSITION OF METAL IONS AND THE CORRESPONDING MEASUREMENT OF PRECISE POSITIONS OF SURFACE METAL ATOMS RESULTING FROM ELECTROLYSIS. THESE EXPERIMENTS WILL HAVE GREAT SIGNIFICANCE IN OUR UNDERSTANDING OF NUMEROUS ELECTROCHEMICAL PROCESSES.

AT THE UNIVERSITY OF GEORGIA, DR. ALLEN D. KING IS CONDUCTING RESEARCH ON INTERFACIAL TENSION OF SYSTEMS CONTAINING AN AQUEOUS PHASE IN EQUILIBRIUM WITH A DENSE GAS. THIS RESEARCH PROGRAM DIVIDES INTO TWO PARTS. THE FIRST INVOLVES MEASURING PRESSURE-INDUCED CHANGES IN SURFACE TENSIONS OF WATER AND VARIOUS AQUEOUS SOLUTIONS WHICH ARE IN DIRECT CONTACT WITH A DENSE GAS. THE PURPOSE IS TO UTILIZE MEASURED SURFACE TENSIONS TO DETERMINE ADSORPTION ISOTHERMS OF VARIOUS LOW MOLECULAR WEIGHT GASEOUS SPECIES ADSORBED AT THE AQUEOUS SURFACE; SUCH MEASUREMENTS CAN BE A SENSITIVE PROBE FOR STUDYING THE NATURE OF THE GAS-WATER INTERFACE. THE SECOND PART OF THE RESEARCH INVOLVES SIMILAR MEASUREMENTS

ON THREEPHASE SYSTEMS CONSISTING OF IMMISCIBLE ORGANIC AND AQUEOUS PHASES, INCLUDING THE EFFECTS OF DISSOLVED GASES ON THE INTERFACIAL TENSION AT THE OIL-WATER INTERFACE.

DR. WILLIAM C. LINEBERGER, AT THE UNIVERSITY OF COLORADO, IS CONDUCTING LASER STUDIES OF MOLECULAR STRUCTURE AND ENERGY TRANSFER PROCESSES. THE HIGHLY REACTIVE METHYLENE MOLECULE (CH_2) IS KNOWN TO EXIST IN TWO FORMS, A DIAMAGNETIC ("SINGLET") FORM AND A PARAMAGNETIC ("TRIPLET") FORM. THE DIFFERENCE IN ENERGY BETWEEN THE FORMS WAS NOT ACCURATELY KNOWN. THE ENERGY DIFFERENCE CANNOT BE MEASURED DIRECTLY BY ABSORPTION OF LIGHT BECAUSE TRIPLET TO SINGLET TRANSITIONS ARE FORBIDDEN. THE THEORETICAL CALCULATION OF THIS SMALL DIFFERENCE IS ACCURATE TO ONLY 50 PERCENT. HOWEVER, RECENT LASER PHOTOELECTRON SPECTROSCOPY HAS DETERMINED THIS DIFFERENCE TO BETTER THAN 3 PERCENT. IN THEIR EXPERIMENTS, THE CH_2^- ION ABSORBED LIGHT TO FORM $CH_2 + e^-$, WHERE THE CH_2 COULD BE PRODUCED IN EITHER FORM BY CHANGING THE ENERGY OF THE LIGHT. THIS YIELDED THE DESIRED ENERGY DIFFERENCE BETWEEN THE TWO FORMS.

NOW, LET ME INTRODUCE AN EXAMPLE OF BASIC RESEARCH WHICH HAS PROCEEDED TO A STAGE AT WHICH PROMISE OF POTENTIAL USES CAN BE DISCERNED. SCIENTISTS SUPPORTED BY NSF ARE ADDRESSING THEMSELVES TO METHODS OF PRODUCING SYNTHETIC PROSTAGLANDINS, WHICH PROMISE TO FURNISH THERAPEUTIC AGENTS FOR MANY MEDICAL PROBLEMS. THEY ARE SYNTHESIZED IN THE BODY, BUT ONLY SMALL QUANTITIES OF THE NATURAL PRODUCT CAN BE OBTAINED. HENCE THE

EFFORT TO PRODUCE THEM BY OTHER MEANS. PROSTAGLANDINS FIRST ENGAGED THE ATTENTION OF SCIENTISTS OVER 30 YEARS AGO, AND NEW KNOWLEDGE ABOUT THEM HAS COME FROM THE EFFORTS OF MANY SCIENTISTS IN MANY OTHER COUNTRIES AS WELL AS THE UNITED STATES. IN 1966, A HARVARD CHEMIST, E. J. COREY, IN RESEARCH SUPPORTED BY THE FOUNDATION, DISCOVERED WAYS TO SYNTHESIZE PROSTAGLANDINS IN THE LABORATORY. SINCE THAT TIME THE RESEARCH OF OTHER SCIENTISTS, INCLUDING NUMEROUS FOUNDATION GRANTEES, IN ADDITION TO CONTINUING PROGRESS IN COREY'S LABORATORY, HAS CONTRIBUTED TO A RAPID ADVANCE IN OUR KNOWLEDGE OF THESE COMPOUNDS. HERE AGAIN, I MAY SAY, I AM FOCUSING ON THE EXPLORATORY ASPECT OF RESEARCH AND ITS YIELD IN NEW KNOWLEDGE.

PHYSICISTS AT THE UNIVERSITY OF WASHINGTON AND AT THE JOINT INSTITUTE FOR LABORATORY ASTROPHYSICS AT THE UNIVERSITY OF COLORADO ARE USING A MAGNETIC BOTTLE CORKED WITH STATIC ELECTRICITY AS A TEST-TUBE FOR CHARGED-PARTICLE CHEMISTRY. THEY HAVE DISCOVERED THAT CAREFULLY SHAPED CONFIGURATIONS OF STATIC ELECTRICITY AND MAGNETIC FIELDS CAN BE USED TO STORE ELECTRICALLY CHARGED MOLECULES (IONS) FOR MANY HOURS AND, INDEED, CAN STORE ELECTRONS FOR MONTHS IN A SMALL HIGHLY EVACUATED VOLUME. BY INTRODUCING CAREFULLY CONTROLLED REAGENTS INTO THE "BOTTLE" SCIENTISTS CAN STUDY REACTIONS OF A NEW BREED; PREVIOUSLY INACCESSIBLE REACTIONS WHICH NEVERTHELESS MAY DETERMINE THE BEHAVIOR OF A LASER-EXCITED PLASMA, A FUSION PLASMA, OR SOME OTHER ASPECT OF OUR PROLIFERATING HIGH-TEMPERATURE

TECHNOLOGY, WHERE CHEMICAL SPECIES READILY EXIST IN AN ELECTRICALLY CHARGED STATE.

IN THE AREA OF THE BEHAVIORAL SCIENCES, SIGNIFICANT STUDIES HAVE BEEN CONDUCTED ON THE IMPACT OF CROWDING ON HUMANS. SOCIAL PSYCHOLOGIST JONATHAN FREEDMAN OF COLUMBIA UNIVERSITY, IN RESEARCH SUPPORTED BY NSF, HAS FOUND THAT CROWDING IS NOT CONSISTENTLY HARMFUL TO PEOPLE. IN THE BACKGROUND OF THIS RESEARCH THERE LAY A SUBSTANTIAL BODY OF KNOWLEDGE ABOUT VARIOUS NEGATIVE EFFECTS OF POPULATION DENSITY ON ANIMALS OTHER THAN HUMANS. HOWEVER, UNTIL RECENTLY, THERE HAS BEEN VERY LITTLE SCIENTIFIC STUDY OF THE IMPACT OF CROWDING UPON HUMANS. STUDIES BY FREEDMAN AND HIS COLLEAGUES LED TO FINDINGS CONFIRMED IN CONTROLLED EXPERIMENTS THAT, IN SITUATIONS OF RELATIVELY SHORT-TERM CROWDING, PEOPLE SHOWED NO OVERALL ILL EFFECTS OF HIGH DENSITY. THEIR ANALYSES SHOWED THAT CROWDING HAS COMPLEX EFFECTS WHICH DEPEND ON THE PARTICULAR CIRCUMSTANCES AND PERSONS INVOLVED. AMONG OTHER THINGS, A HYPOTHESIS WAS TESTED AND CONFIRMED THAT CROWDING INTENSIFIES TYPICAL REACTIONS TO A SITUATION. THAT IS, IF PEOPLE TEND TO BE PLEASANT, WARM, COOPERATIVE OR GENERALLY POSITIVE TOWARD EACH OTHER THEY WILL BE MORE POSITIVE UNDER HIGH DENSITY. IF THEY ARE UNPLEASANT, ALOOF, HOSTILE, OR GENERALLY NEGATIVE, THEY WILL BE MORE NEGATIVE UNDER HIGH DENSITY. IT IS PERHAPS PERMISSIBLE TO DRAW FROM SUCH WORK THE SUGGESTION THAT SCIENTIFIC EXPLORATION NOT ONLY CAN LEAD TO NEW KNOWLEDGE BUT CAN CHALLENGE

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FIRMLY HELD BELIEFS BASED ONLY ON INTUITION, AND THUS PROVIDE A SOUNDER BASIS FOR SOCIAL JUDGMENTS.

I HAVE DISCUSSED ONLY A FEW OF THE THOUSANDS OF PROJECTS BEING CARRIED ON WITH NSF SUPPORT. SCIENTIFIC EXPLORATION ALWAYS OFFERS THE HOPE THAT NEW KNOWLEDGE WILL START A CHAIN REACTION OF UNDERSTANDING, A HOPE BASED ON A SUFFICIENT NUMBER OF INSTANCES IN WHICH JUST THAT RESULT HAS OCCURRED. THE PROCESS CAN SOMETIMES TO SEEN TO OCCUR AS A SYSTEM WHICH MAN CAN SEEK TO REPRODUCE, AND TO OCCUR SOMETIMES AT RANDOM, WITH UNPREDICTABLE BUT CONCEIVABLY HIGH YIELDS OF KNOWLEDGE AND UNDERSTANDING. THE NATIONAL SCIENCE BOARD IN CARRYING OUT ITS POLICY-MAKING DUTY HAS THE TASK OF ATTEMPTING TO ARRIVE AT A PATTERN OF ENDEAVOR BY THE NATIONAL SCIENCE FOUNDATION TO PROVIDE STIMULUS FOR THIS PROCESS, TAKING ADVANTAGE OF THE BEST OPPORTUNITIES AND THE BEST PROMISE OF ADDING TO SCIENTIFIC KNOWLEDGE.

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE, THANK YOU.

NATIONAL SCIENCE FOUNDATION

WASHINGTON, D.C. 20550

Dr. Norman Hackerman
Chairman
National Science Board

Dr. Norman Hackerman, President of Rice University, Houston, Texas, was appointed to the National Science Board by President Johnson in 1968 and was reappointed by President Nixon in 1974. He was elected as Chairman by the Board in 1974.

A chemist whose special research interest is in corrosion, Dr. Hackerman was born in Baltimore, Maryland, March 2, 1912. He received the A.B. from the Johns Hopkins University in 1932 and the Ph.D. in 1935.

Early in his career, Dr. Hackerman was an assistant professor at Loyola College, Baltimore, a research chemist with the Colloid Corporation, and a chemist with the U.S. Coast Guard. Dr. Hackerman became an assistant professor at the Virginia Polytechnic Institute at Blacksburg, and later a research chemist with the Kellex Corporation.

In 1945, Dr. Hackerman began a long and distinguished career at the University of Texas, beginning as an assistant professor of chemistry and holding positions successively as an associate professor, professor, department chairman, director of the corrosion research laboratory, dean for research and sponsored programs, vice president and provost, vice chancellor for academic affairs, and president (1967-1970). In 1970 he became professor of chemistry and president at Rice University.

Dr. Hackerman's professional society memberships include the National Academy of Sciences, the New York Academy of Sciences, American Philosophical Society, Texas Philosophical Society, American Association for the Advancement of Science, American Chemical Society, Electrochemical Society, Faraday Society, National Association of Corrosion Engineers, and Sigma Xi. He is editor of the Journal of the Electrochemical Society, member of the editorial board of Catalysis Reviews, and has served in an editorial advisory capacity with Electrochemical Technology and Corrosion Science.

He is a director of the Gordon Research Conferences and Chairman and Director of the Independent Colleges and Universities of Texas. He was Palladium Medalist of the Electrochemical Society, 1965; was Joseph J. Mattiello Memorial Lecturer, Federation of Societies of Paint Technology, 1964; and recipient of the Whitney award, National Association of Corrosion Engineers, 1956.

Dr. Hackerman was married in 1940 and has four children.

Dr. STEVER. Mr. Chairman, would you like for me to proceed?

Senator KENNEDY. Yes. Do you have anything additional?

Dr. STEVER. On page 4 of my prepared statement there is an interesting grant which I should bring up because I am quite sure it will be known as the Horseradish Grant.

It says:

> Recently, Foundation-supported scientists discovered a method for using a unique enzyme—known as horse-radish peroxidase—which can be absorbed by brain cells. The great significance of the technique is that the enzyme can be traced. This makes it possible to track the enzyme through the brain and to identify specific nerve pathways and any "short circuits" in those pathways because the enzyme will not jump gaps in the nerve cable. This pioneering work with an enzyme produced by a rather ordinary vegetable has profound implications for medical science. Most recently, it has also led to the discovery of other techniques for tracing nerve pathways through the brain.

Mr. Chairman, I know that this subcommittee has been keenly interested in efforts to improve the environment. There is, of course, a great range of efforts to improve environmental quality, from those dealing with air and water pollution to others dealing with the more perplexing problems of solid waste. I would like to cite briefly one project in this area being supported by NSF.

There is an urgent need to find ways to remove most of the organic and inorganic matter from sewage in primary systems. It now appears that removal will have to be done through secondary and tertiary treatment of sewage—at great cost—unless we find some novel ways to accomplish the job. However, scientists at Woods Hole Oceanographic Institution, working with funds provided by NSF, have advanced to the pilot stage a method for removing inorganic matter from sewage. The method uses such matter to grow algae to feed oysters. The water resulting from this process is reported to be as clean as the sea itself. Using this method, it may be possible to obtain clean water and at the same time realize a substantial economic benefit in the process itself.

There are many areas where improvements in productivity can be of great benefit to the economy. In some of these areas there is not sufficient incentive for industry to make the necessary research investments to explore totally new concepts in techniques. NSF, through its RANN program, provides support for research in such areas on a highly selective basis. An example is in excavation technology. Excavation techniques are in a relatively primitive state. They have not progressed significantly in the past few decades, even though demands have increased sharply for excavation and tunneling for transportation, power transmission, public utilities, mining, energy resources, industrial facilities and underground storage projects.

Under an NSF grant, researchers have incorporated high pressure water jets with a conventional tunnel boring machine. The machine has been tested under field conditions in granite. This was a joint venture of the Colorado School of Mines, the Robbins Co., and Flow Research. Penetration rates 400 percent greater were achievable. Significantly reduced cutter wear was realized and overall systems costs reduced.

In our budget request this year, we have listed more than 150 major research questions that are driving research in the various fields of science. There is much to be learned and used by the Nation

over the next 100 years. We have barely scratched the surface in understanding the natural laws and phenomena which govern and regulate our lives and the behavior of the universe.

The Foundation's program for fiscal year 1977 is summarized in a series of tables attached to the text of my statement. Now, very briefly, I would like to highlight the major features of our program for fiscal year 1977:

Basic research support is increased from $523.1 million to $624.9 million—nearly 19.5 percent above the fiscal year 1976 level. Almost all of these funds go to support research at the Nation's universities and colleges. Included in this increase are higher funding levels for mathematical and physical sciences and engineering; astronomical, atmospheric, earth and ocean sciences; and biological, behavioral and social sciences.

Research application efforts in the Research Applied to National Needs program are continued at an effective level. The focus is on resources, the environment, productivity.

The budget continues science education at a level designed to help assure the strength of the Nation's science manpower and the availability of high quality science education to the public.

Finally, the budget provides for continued U.S. research in the Antarctic, and increases support of national objectives through expanded international cooperative science activities.

One area of the NSF budget which has been changed substantially since last year involves funding of the Antarctic research program As you may recall, the procurement of two LC–130R aircraft in fiscal year 1976 accounted for a one-time increase of $18 million in that year. The Antarctic budget proposed for fiscal year 1977 decreases not by $18 million but by about $4 million because of increased charges to the NSF for operational support, the major cost of mounting a research program in this remote area.

Let me expand a bit on that point. The fiscal year 1977 request for operational support is $39.9 million, compared to $26.6 million for fiscal year 1976, an increase of $13.3 million. On this increase, $6.9 million is for continued support of functions previously funded by the Department of Transportation. The support of these functions is not in the fiscal year 1976 base figure of $26.6 million. NSF, DOD, and DOT have agreed that NSF will request funding for future support costs. It will also support the Ross Ice Shelf Project which was deferred in fiscal year 1976 for lack of aircraft support, and will support an improved vehicle and equipment maintenance and replacement program.

Funds also are included for increased costs of operating the research ship, *Islas Orcadas;* the construction of a new Siple Station, and the relocation of the Williams Field landing strip away from the receding edge of the Ross Ice Shelf. There also are increases for military personnel, intercontinental airlift and sea lift, fuel costs and aircraft overhaul which must be absorbed.

The Sacramento Peak solar observatory is another example of adjustment which must be made in the NSF budget. As you may know, the Air Force is dropping its support of the observatory. Two months ago, NSF reviewed the observatory's research program—in line with our responsibilities for the health of the Nation's basic research.

The conclusions of the ad hoc advisory committee convened by NSF were that there does not appear to be any gross imbalance between funds for solar astronomy compared to all other astronomy; that Sacramento Peak plays an essential role in solar research and should be maintained at a productive level; and that the National Science Foundation should assume responsibility for the support of the observatory with help of other agencies interested in solar astronomy, particularly the Air Force and ERDA. Negotiations with the Air Force have begun for implementing transfer of the observatory facilities to NSF, effective in fiscal year 1977. The costs of something over $1.0 million will be an additional requirement to be covered within the total fiscal year 1977 budget. This is another reason why the entire $812 million is needed.

With respect to the Ocean Sediment Coring program we are pleased to report the willingness of foreign governments to contribute to this important program. The present status of agreements is that the NSF has signed memorandums of understanding with four countries: the U.S.S.R., Japan, United Kingdom, and France; a fifth signing is pending with the German Federal Republic. These agreements grant each country certain privileges in the coring program in exchange for an annual $1 million contribution. This represents potential $5 million contribution in fiscal year 1977 against the budgeted figure of $3 million. The $3 million figure is considered to be a conservative estimate based on the following possible occurrences: (1) the West Germans may decide not to come in; (2) the agreements with U.S.S.R., United Kingdom and France have termination clauses with advanced notice by either party of at least 6 months; for Japan this is 2 months; (3) the foreign countries have various fiscal year periods; (4) a delay in the appropriation of a foreign government may delay an expected fiscal year 1977 payment into fiscal year 1978.

I would like to comment on four specific areas that have been of special interest to this subcommittee:

The Foundation is keenly aware of the need to achieve more public involvement in its program formulation, and we have undertaken a series of meetings with interested citizens' groups and individual members of the public to foster a better interchange of their views with scientists. These are pioneering efforts which require close consultation with the public. Our efforts are designed only to make science more readily available for use. As we see it, science is a tool that must serve society.

Good progress has been made in upgrading the academic research fleet over the past several years, and this subcommittee has played a key role in these efforts. I am happy to report that since 1970—when the academic fleet consisted of 32 vessels, 18 of which were seriously outdated and extremely expensive to operate and maintain—14 of the outdated vessels, have been retired or replaced. The fleet now consists of 31 vessels, only 4 of which are seriously overage. So progress has been made.

Senator KENNEDY. How much time did they spend at sea last year? I believe the program ran $2 million deficit.

Dr. STEVER. That is one of the serious problems.

Senator KENNEDY. Give us the whole story.

Dr. STEVER. The cost of operating is going the other way. That is mainly the cost of oil, and it is a serious, serious problem.

Mr. Chairman, you listed a whole series of questions that perhaps you would rather have us shift to the focal point.

Senator KENNEDY. I think that would be helpful.

Dr. STEVER. I can say on the second of your questions, which is, "the integrity of the peer review systems, and the efforts being made by the NSE to strengthen its utilization of this method of evaluating proposed research." I have summarized in a letter which has been dispatched to you hopefully this morning. We recognize that while we at NSF have discussed these matters with Congressman Symington's committee, at great length, we wanted to bring you up to date on that. I have in the mail to you a summary of the steps we have taken over the past year, that is, both the Foundation staff and the Board itself.

Senator KENNEDY. These are going to be maintained on a continuing basis, is that right?

Dr. STEVER. Pardon me?

Senator KENNEDY. The policy guidelines, the list of reviewers, the procedures being established will be the ones to be used from now on?

Dr. ATKINSON. That is a continuing aspect of our study. We are conducting a number of surveys with the scientific community with regard to their views on various aspects of the peer review process. We have a National Academy of Science study underway. Although we have made a number of changes in the peer review process, it would be a continuing study, and I would assume that it will be another year of fairly active investigation and possibly change in various aspects of the peer review process. That is something that got started in June, and I would suspect it would take another year before we have some degree of levelling off of our interest there.

Senator KENNEDY. Senator Helms had a bill establishing a legislatively mandated peer review process, which includes a number of different requirements. It lists a number of requirements, criteria. It provides for the establishment of peer review office in NSF, central listing of peer reviewers, access to verbatim reviews, access by applicants to names of peer reviewers, a fixed number of peer reviewers for each project, appeals procedures professional staff for the Board and Board review of all grants over $250,000.

It gets into some detail.

Dr. STEVER. Mr. Chairman, we are aware of it. We agree with some points of it and disagree with other points, as you might expect.

The surveys that we have made which have been mentioned by Dr. Atkinson show that there is a strong preference for having, as the Board has decided, the verbatim peer reviews supplied to the principal investigator, but not the name and the institution that specifically identify the peer reviewer. They believe that withholding this will continue to give us much stronger criticism, which is needed in this case. On the other hand, Senator Helm's bill mentions an appeals process, and we have instituted such a process.

I would say that we agree with part of what he has said and do not agree with some of the other.

Senator KENNEDY. The present procedures are going to be maintained in place through this year, at least that is your present plan,

unless you get additional scientific information or advice which merits further adjustments?

Dr. ATKINSON. We have initiated a number of major changes starting in June 1975 and as recently as 3 weeks ago, as Dr. Stever stated, we set up a formal reconsideration procedure, which we now have in place.

In the survey which I referred to we found that 80 percent of the scientific community supported the change in the Foundation of moving to release verbatim reviews, that is providing investigators with verbatim accounts of the review. But about 80 percent of the community also opposed any effort by the Foundation to make the names of the reviewers available. Those changes are subtle, and we do have to go slowly to be sure the scientific community is totally behind us.

I think everyone agrees that the peer review process has been a real strength in American science. To change it drastically as some of the suggestions in that bill would do, I think the consequences are too difficult to speculate about.

Senator KENNEDY. We will be interested in the development of these procedures. We will appreciate being kept informed of the changes.

Let me ask, Dr. Hackerman, about the provision in the NSF Act that gives the Board the authority to appoint special study commissions, consisting of six scientists and five nonscientists. Did the Board consider using this mechanism for any other curriculum programs rather than in house team?

Dr. HACKERMAN. No, not to my knowledge. We have always used Board members. Occasionally we have talked to advisory committees and consultants.

Senator KENNEDY. You are aware of that authority, are you not?

Dr. HACKERMAN. No, I was not.

Dr. STEVER. The appointment of commissions, by the Chairman's authority, was used because the first contact I have had by the science board was being appointed by Dr. Philip Handler on a social science study.

Senator KENNEDY. Well, do you see the value of this kind of authority, and do you feel that it is relevant in evaluating the performance of the Foundation.

Dr. HACKERMAN. It is certainly worth looking into very seriously.

Dr. ATKINSON. We have undergone a number of major changes in our management practices over the last 9 months, and at this time we have considered the possibility of setting up commissions. If we did recommend such commissions in the future, they would of course depend on the Board's review and approval. For example, in reviewing the management changes implemented by NSF, the use of a management consulting firm has been suggested. Whether we use commissions or outside organizations we recognize that in some cases NSF should use mechanisms with a degree of neutrality that can only be achieved through outside bodies.

Senator KENNEDY. What about looking at the appropriate role for the public in NSF programs? What steps are you undertaking now to examine that role?

Dr. HACKERMAN. The Board will be considering at its meeting this month, the question of regional forums in which both the lay and scientific public would be involved. That discussion will take place on March 18–19. From the Board's point of view, there is that involvement.

We also have been involved as Board members in planning the Science for Citizens program.

Senator KENNEDY. Are these panels to consider the question of the role of the public in NSF programs? Is that what they will attemp?

Dr. HACKERMAN. Yes, the panels were considering the role of the public, the question of whether the programs are moving in the proper direction, whether they are serving their proper purpose, how involved one should get in the areas peripheral to basic research and peripheral to science.

Senator KENNEDY. Are they going to make some recommendations to NSF?

Dr. HACKERMAN. I presume recommendations would come forth.

Dr. ATKINSON. Based on regional forums we have used in conjunction with the Science for Citizens program, we have a number of ideas as to how these forums might be handled. The idea would be that they would be on a continuing basis, possibly two or three such forums each year, in different regions of the country, where individuals from that region of the country, scientists, university-related people, and others in public interest groups would help define the nature of that forum in that particular region. NSF representatives, staff, Board members and the like would be present to review the sort of issues that are raised at the forum. It would be continuing activity of the Foundation.

Senator KENNEDY. We will be interested as you move along in finding out what your reactions are as to the responses which come in to those forums, where you feel that there is a legitimate role for the public, and where you have some concerns about the public involvement in NSF programs and the reasons for those concerns.

We will continue to have an interest in that area.

I firmly believe that one of the ways to strengthen the whole program at the NSF is through the public's involvement and interest and basic support.

Let me ask: What was the role of the Board itself in the preparation and review of the Hughes report on precollege science curriculum programs?

Dr. HACKERMAN. Two members of the Board were appointed to follow the activity.

Senator KENNEDY. What was the extent of their involvement in it?

How active were they in overseeing the preparation and review of it?

Dr. HACKERMAN. Not quite as involved as that.

Dr. HUGHES. I can speak to that. Both Dr. Shields and Dr. Murray attended a number of the meetings of the review team. Their role was one of broad general oversight. They concerned themselves only with broad policy issues that were developed.

I had occasion to discuss with them the procedural and policy recommendations that I made as a result of the study. But they were not involved in any way in dealing with the detailed issues or the detailed papers.

Senator KENNEDY. What could you tell us, Dr. Hughes about the report itself, about the basic and fundamental integrity of the conclusions?

Dr. HUGHES. I can tell you about my own opinion of that.

Senator KENNEDY. That is what I am asking for.

Dr. HUGHES. I regarded my own role as one of receiving information developed by the review team and trying to develop from that, and from conversations with members of the Board and other members of the staff, major procedural recommendations and general policy recommendations, relating to the conduct of science curriculum activities at NSF. In a very limited time from the review covered 15 or 18 years of science curriculum development activity at the National Science Foundation. I have recently had occasion to look back at the recommendations that were developed and, I must add that they were cited in the report as my personal recommendations. I feel strongly that they were responsive, that they represent a rather serious indictment of the practices, policies and procedures that had been used in the past, in terms of their applicability to present day needs.

I feel that the recent developments within the science education directorate, the restructuring, reorganization have indeed followed very closely the pattern of the procedural recommendations.

I think the policy recommendations still stand as a basis for continued consideration of the deeper issues that underlie these questions.

As far as integrity of the report is concerned, I find it more difficult to speak to that. I understand that there are elements in the appendix that have been questioned. I have no reason to doubt that there are at least a few serious errors in the appendix. It happens that I did not play a significant role in the development of that appendix. I was given some rather serious assignments around that time and did not particularly follow the details of it.

By the same token, during the course of the actual review itself I was unable to do much more than follow the general procedural and policy issues that were being developed.

Dr. STEVER. Mr. Chairman, may I add something to that?

I think Dr. Hughes' summary is correct, that we began to operate on many of the recommendations quite quickly and have been operating to implement them. There is no concealing the fact that the Foundation did a very bad job on the second part of the report, the appendix. There are a number of errors in it. We have discovered a number of the errors.

GAO discovered a number of errors. We are in the process of working on them.

Senator KENNEDY. Well, as you know, these have been points that have been raised and are familiar to all of you. I think we have to complete the record here because we are going to be asked about it, I am sure, in the committee, on the floor and elsewhere.

Let me ask this: There were a number of members of the team and there has been only one change in personnel, the executive secretary. Is he really the only one who knew about this particular problem? There have been those saying that he has been made the scapegoat. How do you respond to that?

Dr. STEVER. First of all, the executive secretary who in his main duties headed by planning and budgetary activities, requested reassignment. In his letter to me he said that he felt, as Dr. Hughes believed, that the recommendations, the structure that we got out of the report was what we were after—to find out what was wrong, and to correct the practices. There was no question that in the drafting of the appendix to the report, a lot of mistakes entered.

The executive secretary said that he felt he could not continue to serve in the important role that he was at the time. As far as others are concerned in the Foundation, we have new administration in science education—and, by the way, almost all the entire top people there have been replaced, as you know, in science education. Dr. Averch who is here, is now Acting Assistant Director for Education and can describe that. One of our recent objectives has been to go back to the beginning, to find out where we made mistakes in the appendix of this review that Dr. Hughes was chairman of, and to see if they warranted personnel action.

There are some further project review cases referred to counsel for study, and instead of taking them one by one, we felt we would like to see the totality of these, and we have an internal group looking at the kind of personnel action we will have to take. We have discovered loose, poor administrative practices in the preparation of the document. We have not discovered that people made intentional errors. One error, for example, was on a program called ISIS. The original staff evaluation—the original recommendation—was a very strongly worded one, and a lot of the recommendations of that strong memo on Project ISIS in fact got in the report. However, in the drafting of the appendix somehow some mistakes entered and this was a terribly unfortunate thing. We are still trying to sort out the source of these errors. However, I think we have met the original objective of finding out what was wrong in our science education directorate and curriculum development. We have found out where we were making mistakes, and some of them were serious mistakes.

Let me tell you the kind of mistakes that were made. Some of the mistakes, I believe, were pure policy. Matters that probably should have gone not on a project-to-project basis to the Board but in a policy way, never got to the Board and policies changed over time. I think this is a serious problem which the Board and Foundation have to address. This is one of the most serious jobs in front of us as far as the administration is concerned.

Another kind of problem that has emerged is what I would call an administrative system which might have been good at the beginning of NSF, but is not now adequate to the additional demands for accountability being placed on the Foundation.

We get a lot of requests for grants, and we have depended very heavily on the individuals in NSF, and most of them have a high degree of integrity.

But if one of them just does not do a good job, or strongly advocates or favors a project as it is presented to the National Science Board by picking only favorable reviews, then in our old system that such a decision could go through too easily. I discovered by talking to people in the system that often they—the person at the lowest level—would

say, well, we were supposed to be advocates. You know, we like advocates, but we like them to be fair and thorough. That is one of the reasons we have changed our administrative procedures.

I think there is still another kind of problem and that is, as the years went by, there was great enthusiasm for curriculum development. This enthusiasm was in the science education community, in NSF, in the Congress where we got support and encouragement and that led us from one position to another.

For example, in the matter of implementing curriculums, if you develop these expensive curriculums, do you not think that we had better get them out in the field?

So we tried methods of doing it. I am quite sure that we did not look hard enough at those methods.

Senator KENNEDY. That program has been rather dramatically reduced?

Dr. STEVER. Yes, it has. But, on the other hand, I would like to point out a couple of other things. Congress, particularly the House and the Foundation—the Board and the staff—agreed, that we conduct a de novo review of all of our active curriculum projects and the Board and the Foundation staff acted. In other words, we did not try to sift back through who made what mistakes and why, and who is to blame for this policy slipping in, but we looked at the projects anew, and this de novo review has been completed and we are now advising the Congress. We have approved continuing some of the projects and we will cut back and slow down some others. We will actually decide to stop supporting still others and put some material in the public record.

I think we have done pretty well in that area looking it over.

On the other hand, Mr. Chairman, we are still haunted by the mistakes we have made. That is an indictment of us.

Senator KENNEDY. Could we talk just a little bit about the Advisory Council you propose in your report to the Congress on public participation? You have a 24 member Advisory Council to be named soon.

Can you tell us about how many nonscientists you plan to have on that?

Dr. STEVER. I am delighted to have the Deputy Director on board.

Dr. ATKINSON. I am sorry to inform you that we have not made decisions yet about the structure of that Advisory Council. We had planned to hold our first meeting of the Advisory Council in April, and if things had gone according to schedule, the last meeting of the National Science Board would have been devoted to selecting the roster of individuals for that Advisory Council. But the last Board meeting we spent mainly in reviewing aspects of our management practices and the like, and so we have actually deferred plans for that first meeting until October 1.

So I cannot tell you at this time what the structure of the Advisory Council will be like.

Senator KENNEDY. Well, you can tell us a little bit about your current thinking of the makeup of it. Do you expect you are going to have nonscientists on it, and to what extent?

Dr. ATKINSON. Frankly, our thinking has been to have broad representation of the scientific community in terms of distribution across the country, age, and the like, but we had not thought of that particular committee as relating to this issue of public involvement.

Senator KENNEDY. Why not?

Dr. ATKINSON. We did not feel that was the appropriate committee for that type of involvement. There are very technical issues that are brought before that committee.

Senator KENNEDY. I thought this was to be an Advisory Council, is it not?

Dr. STEVER. For the Director.

Dr. ATKINSON. Right.

Dr. STEVER. I think the question is well taken, because you have been jabbing at us, which may not be the right word——

Senator KENNEDY. Encouraging.

Dr. STEVER. You have been encouraging us to do better on the input from the public in many different ways, and I do think we have responded but perhaps not yet as well as we should have.

I would like to see some response.

Senator KENNEDY. I want to welcome Senator Stafford to the committee this morning.

I would hope that we could find a role for the public. It seems to me this is terribly important to the particular functions of an Advisory Council. You already have a Board made up of scientists, representatives of the scientific community. It is supposed to be broad-based in terms of interest, background, experience, geography, et cetera. It seems to me that in the role of the Advisory Council there should be public involvement and awareness. I think that is something that is important. It is constantly, really constantly, suggested to us here that on these various advisory groups, it should always be left up to the experts. Yet when we find that they are broad-based, and particularly in the health area, whether it is neighborhood health centers, community mental health centers, you do not need just great experts, perhaps in psychiatry or psychology, but you need public participation. And in administration and performance public participation and quality have been first rate.

There are important policy-decisions to be looked at. It is like Henry Ford says: He can open up the front of his car and not be be able to make a determination of how the car works. But, he can make the broad decisions about companies, competition and the implications. These types of questions require public participation.

I know it is difficult to select the members. All of us are aware of that.

But I make the point and we will be glad to work with you in that area. I hope that you will give some thought to this conclusion.

Could we talk a little bit about the role of private industry in basic research and one of the things which you touched on a little bit in an earlier comment. Many of the youngest, most gifted, creative and talented people coming out of universities are not able to find positions in the universities and colleges, and this situation can be expected to continue based on long range projections. These scientists and engineers of necessity are going into the private sector.

As you point out, a wealth of talent that exists in universities. But in many instances the younger and creative and dedicated people there are moving into the private sector. Should we not be giving some thought at least to moving from the fraction of 1 percent of basic research funds going to the private sector to involvement or trying a

pilot program to see how it works. There you could come back to us and give us an opportunity to see what could be done?

Does it make any sense or does it not? In fact, you talked a little bit about this. I would be interested in the development of that issue.

Dr. STEVER. I think you are touching on a very important long term trend. The industries of the country have kind of dropped off their support of basic research because many of them have felt they have so many pressures for applied research and development of products, that is for their capital, that they have to go that way. Basic research does not yield results for them alone. That is, they discover something in basic research and it is available for everybody, but the trends that you are talking about have seemed to have impacted in two ways.

For one thing the universities now are trying to motivate and teach their students, not to do just basic research now, but to do the kinds of things that industry is doing. But I think you are right there should be a larger proportion of people doing basic research in industry. I would like to see those parts of our economy that do give support for basic research, provide support in industry, and some do, of course. NSF's role has been over the years heavily oriented toward the universities. RANN, of course, does more with industry. We do a little basic research there. If we were to try with the budget we have now, to cover the industries that would be interested in doing basic research, I think it would be counterproductive in part because we would then have injured the universities.

So I think this is an additive role, a role that might better be carried by institutions like NASA and NOAA, and ERDA, but is it very important for the total Government support in this country to help industries.

Senator KENNEDY. I suppose the question is, just to press on a bit in this area: Is not the test really the issue of competency, whether it is going to be in university or in the private sector? And if you find a high level of competency in the private area, even in basic research although in some areas the distinction between basic and applied is difficult to make——

Dr. STEVER. It is hard.

Senator KENNEDY. Do you see yourself as a continuing kind of funnel into universities, or should we be looking into the areas of basic and applied research, trying to find out how we can be sure this research is conducted in the best possible place by the most competent scientists.

Dr. STEVER. Dr. Creutz.

Dr. CREUTZ. Certainly there is first class basic research carried out in industry. In some cases, however, it is not very common to find research that competes with that in universities.

There is a problem to stay alive. Industry must make use of its manpower, for its major problems. You seldom find a person in industry who thinks of himself just as a basic researcher in the way a university professor will. He looks on himself as a scientist who is trying to help that industry reach some of its goals, such as new and better products. It is quite difficult for such a person to really separate himself off as he can in the university and say I am looking just for knowledge for whoever wants to use it. This is almost to say I am not looking for dollars that will help my company. That is difficult.

There are some very important examples of first class basic research that has been carried out in industry. The discovery of the transistor is an example. It is quite difficult to have the same person who is concerned with his company's future by having better products than his competitors to be completely isolated and work in basic research, which will help anybody that comes along—it can be done and has been done, but in very few instances.

Dr. STEVER. On the other hand, I do not think that completely answers your question, Senator Kennedy, because you did point out that more of our young people in the science field are going to be in industry.

Senator KENNEDY. Suppose you talk about that, Dr. Creutz. The extent to which there can be basic research in an area which might be directed toward a particular future problem, and still be sufficiently basic in nature and important enough that its value would be generally recognized. I see these trends in industry and universities. Should we not be giving some thought on that development?

Dr. STEVER. Of course, you know the RANN program does have a fairly high percentage of industry participation. What is the percentage?

Dr. EGGERS. The percentage in RANN has run for several years now, and this is separating out the large energy transfer to ERDA, about 60 percent universities and 30 percent industry, and that is both profit and nonprofit, and the remaining 10 percent roughly equally divided among State and local government and national laboratories.

As you know, Senator, RANN policy has always been a best performer policy. We have always encouraged teaming between universities and industry. I would agree that most of the time when those teams have formed, and we have many good examples in all parts of the country of excellent teams, basic research will tend to be the component of the RANN program emphasized by the university element, and applied research will be emphasized by the industry component. However, it is not 100 percent on each side by any stretch of the imagination.

As a matter of fact, as I was listening to this discussion, I recalled a case of teaming in solar energy between Minneapolis Honeywell Corp. and the University of Minnesota on solar thermal systems. Actually, most of the basic research in that instance was done by Minneapolis Honeywell and a somewhat larger percentage of applied research was done by the University of Minnesota. So you see. it varies.

In our business, the RANN business, we fund the most competitive, the best, and let the chips fall where they may.

Dr. HUGHES. Mr. Chairman, I think the important issue here is the one you raised earlier when you spoke to the need for projecting into the future, the changing national patterns of research, both in the university community and industry. I think the National Science Foundation is very much interested in doing this in STIA, the Directorate for Scientific, Technological and International Affairs.

In the Policy Research and Analysis Division of that directorate, a number of long-term working groups have been set up to look at the aspects of this problem. For example, one working group is concerned with the analysis of a emerging science and technology.

They will deal with the national science and technology posture, with questions related to the health of basic research, where it is performed, how it is performed.

Another working group will be concerned with the process of innovation and its management within industry, large industry and small industry; another to the effects of public policy on both R. & D., including regulation, taxation, and government procurement, for example. I think that the background material developed there will help to lay the framework for future policy decisions in this arena.

Senator KENNEDY. Well, we will continue.

I know what RANN is doing. You are less than 10 percent of the total NSF budget, and 60 percent of your funds still go to universities. So business and industry participation is still pretty small, but it is interesting.

Dr. HACKERMAN. Mr. Chairman, in the 1960's a number of industrial laboratories in this country did undertake to do basic research on a substantial scale. You can tell from the publication that a lot has been done. But toward the end of the decade there was a period of asking whether this research was sufficiently oriented toward the company's mission. There was a move to divert the people doing that kind of work into more mission-oriented research activities.

Once that point is reached, there is less tendency to publish the research results, except long after the fact. If, indeed, the National Science Foundation were to support "basic research" in industry, there would be a problem. I think industrial laboratories would ask the question: "Why should we take this on if we do not get a monetary advantage, from whatever might come out of it?" Therefore, the question of free publication would become a serious problem. That does not change the proposition you make; the fact of the matter is that good new people are going into industrial laboratories and into Government laboratories. Therefore, their talent for this particular kind of activity is being diverted to other purposes, albeit good ones. The problem of supporting with Foundation funds the pure basic research in industrial laboratories becomes a rather difficult one, primarily because of this question of direct benefit to the company.

Senator KENNEDY. All right on the small business set asides, we are up to 7½ percent, I believe?

Dr. STEVER. On the small business?

Senator KENNEDY. Yes. You are doing pretty well, as I understand it.

Dr. EGGERS. We are 7.7 percent, Mr. Chairman, of the part of the program that is committed; in other words, we are running percentagewise a little bit ahead of the law, and we want to beat that significantly, and we think we will.

Dr. STEVER. That is not a very good expression; "We are only a little bit ahead of the law."

Senator KENNEDY. There is something that could be for that.

Now, how about it, can you get it up higher. Is 10 percent a realistic target?

Can you reach that, based on your projections, over the next fiscal year?

Dr. EGGERS. I am not sure we will be that successful this fiscal year.

We would like to achieve that next fiscal year. We put a target for next fiscal year at 8.3 percent, which is an increase. We feel that you are operating in an area of uncertainty, and there is no point in setting targets that would turn out to be unrealistic as we gain more experience. I would like to say again with regard to our encouragement for teaming industries and universities, we feel particularly strongly that that kind of teaming in the case of small business with universities offers great potential. As you know, in our recent conference we encouraged that very strongly because the opportunities for the limited resources of small businesses teamed with universities to put together a top-notch team, I think, are tremendous.

Senator KENNEDY. All right. Let me say, Dr. Stever, that you are maintaining the ethics research program at the $1 million level to which we increased it last year. We are very, very interested in that program. I am just wondering if you could talk about it for a moment, and I am wondering whether you think there is any problem in providing the necessary emphasis in biological sciences.

Dr. STEVER. I turn to Dr. Averch and Dr. Clark, who are education and science respectively.

Dr. AVERCH. Senator Kennedy, I think there are two questions: One, are biomedical-ethical questions eligible in the current program? I think they are.

What we are proposing to do to make that clear is to call attention to them out specifically in the next set of guidelines. In fact, of the 100 proposals that we are currently looking at, about one-third are in the biological and biomedical ethics, and if that ratio holds, then that area will have a third of the awards.

The second question has to do with relations to between NIH and NSF in the ethical and human values area. The only restriction that we put on our program is that health care professionals by themselves would not be eligible; that is, if a group of doctors wants to address an ethical question in the biomedical field, we would feel that is NIH's responsibility, and, in fact, that is given to NIH by law. If health care professionals, doctors—want to engage in interdisciplinary kinds of activities in the biomedical field, they would be eligible under the EHVIST program. What we propose to do is to make these things clearer in the next set of guidelines.

Senator KENNEDY. That is very helpful. I think we obviously intended in the legislation to include these efforts in the program. We are concerned that in the early promulgation of the regulations the biological series were not mentioned, I think that it will be very important to have those clarifications.

You are aware of our interest in the continued coordination of the international research and policy programs, I think particularly in the area of nutrition and food and health and trying to bring those together with AID. We will work with Senator Humphrey and the other related committees to try to get a comprehensive coordinated program. I think it is an important area and its implications for humanity are enormous. It is mind-boggling.

70-027 O - 76 - 6

I think we have had a very narrow definition of our national interest as defined in the Public Health Service Act. It has been very narrowly defined, and I think this has been a hinderance to getting a full view of various agencies, particularly in these areas of food, nutrition and health, of what we should be doing. We will work with you, and we want to flag that and call it to your attention today.

Concerning the direction of the science for citizens program, I think you mentioned this.

Is there anything you want to say further on that?

Dr. STEVER. I think I would like to turn to Dr. Averch, who conducted that, for a brief statement.

Senator KENNEDY. All right.

Dr. AVERCH. Senator Kennedy, we submitted the draft copy to the Congress for response, reaction, and comment. We did not define the program options. We went out to get the public's ideas of what would be appropriate. First we are suggesting that we conduct some experiments with national registries, giving public interest groups and other interested people access to scientists who want to do pro bono work. Hopefully, these registries would be designed so that people can access them quickly and find the kind of science or scientific assistance that they want.

The second set of experiments that is proposed has to do with the use of the public media. These programs would be analogous to the NOVA series, which is produced in the Boston area, but would engage in public information on public policy issues concerned with science and technology. We would have to have some kind of requirement for balanced presentation of views as we go forward in Science for Citizens, because that is one of the major concerns about such programs. You will find such concern in our report.

The third set of experiments that we are proposing are scientific information centers at the regional level. They would provide access to research, to studies, to positions by various parties to a public policy question, and would provide an information retrieval service.

As we looked at all the data and at all the evidence, we concluded that we did not have a lot of hard experience in doing these kinds of things, so in fiscal year 1977 we are proposing to design the experiments, set them up, then set up some kind of evaluation system for them. We propose to go at Science for Citizens in a prototype fashion rather than invest very large sums without too much information.

Senator KENNEDY. That makes some sense.

Dr. Stever, could you talk a little bit about the minorities and women and their participation in careers in science and science policy. What progress you are making in that?

Dr. STEVER. Dr. Averch seems to have the floor.

Senator KENNEDY. He has all the hard ones here.

Dr. STEVER. That is right, including getting a whole new Science Education directorate going.

Dr. AVERCH. Let me take them separately.

In December, the science board approved our moving from a study program to active programs to operate in the field. We are putting out a program announcement right now that will do three things: one, get practicing women scientists either in the universities or industry out to the high schools to explain to both male and female students how scientists work and what the rewards are.

The second activity will be concerned with upgrading the career counseling available to women at the undergraduate level, and a third activity is concerned with what in the educational field are called reentry opportunities. The latter are for women who were in science but have been out for some time. Institutions would give courses designed for women who have been out and, hopefully, at times when women can get to them.

I should say that these programs will not solve all the problems connected with women in science, and we are thinking further about them. Within the current guidelines that we have and the current legal restraints, we have gone about as far as we can. We can always expand these current kinds of activities.

With respect to minorities, we have a program solicitation for the minority institution science improvement program. In fact, we are requesting a $200,000 increase for 1977. We also plan to continue research studies of minority problems. One of the things we do want to do is to look at the problems of minority students not in minority institutions. We are also proposing to take another cohort of students into the minority institutions graduate traineeship program.

The last time we did that was in fiscal year 1974. It appears to be reasonably successful in inducing minority students to choose careers in science, but we only had 30 people back in 1974, so we want to again get another 40 or 50 in and get them going.

Senator KENNEDY. We are very much interested in that. Part of the need is to provide institutional support and to upgrade science education programs. There is really a great deal that has to be done in reaching out into those communities and schools and groups to attract that interest and to make science and technology understandable. I think it is an effort that is well worth the time and money involved.

Dr. STEVER. Dr. Cobb, a member of the National Science Board, I think is going to testify Wednesday of this week. She has been very closely associated with that.

Senator KENNEDY. All right. We have some other questions, but we will submit those to you in writing.

I want to thank you very, very much for coming.

I think we will look forward to seeing you this afternoon at 3:45.

Thank you very much.

[The prepared statement of Dr. Stever along with his biography and a statement of NSF 1977 budget, and questions submitted by Senator Kennedy and Senator Pell along with answers supplied follows:]

STATEMENT BY DR. H. GUYFORD STEVER
DIRECTOR, NATIONAL SCIENCE FOUNDATION
BEFORE THE
SPECIAL SUBCOMMITTEE ON NATIONAL SCIENCE FOUNDATION
COMMITTEE ON LABOR AND PUBLIC WELFARE
UNITED STATES SENATE
MARCH 1, 1976

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I APPRECIATE VERY MUCH THIS OPPORTUNITY TO HIGHLIGHT THE NATIONAL SCIENCE FOUNDATION'S PROPOSED PROGRAM FOR FY 1977 AND TO URGE SUPPORT OF THE PRESIDENT'S BUDGET REQUEST.

THE BUDGET PROVIDES A TOTAL OF $812 MILLION--$802 MILLION IN NEW FUNDS AND $10 MILLION IN PROPOSED FY 1976 DEFERRALS. THIS REPRESENTS AN INCREASE OF $80.4 MILLION IN OBLIGATIONAL AUTHORITY, 11 PERCENT ABOVE THE PROGRAM LEVEL FOR FY 1976.

THE MAJOR THRUST OF THE FOUNDATION'S PROGRAM FOR FY 1977 EMPHASIZES BASIC RESEARCH SUPPORT IN THE FUNDAMENTAL FIELDS OF SCIENCE. IT IS PART OF AN OVERALL ADMINISTRATION EFFORT TO STRENGTHEN SCIENCE AND TECHNOLOGY. AS YOU KNOW, THE TOTAL FEDERAL BUDGET FOR FY 1977 IS SHARPLY CONTROLLED, HELD TO AN INCREASE OF ABOUT 5 PERCENT. BUT WITHIN THE TOTAL FEDERAL BUDGET, RESEARCH AND DEVELOPMENT IN THE VARIOUS AGENCIES IS INCREASED APPROXIMATELY 11 PERCENT, BASED ON A STRONG BELIEF THAT SCIENCE AND TECHNOLOGY CAN HELP TO IDENTIFY BOTH SHORT AND LONG TERM PROBLEMS AND CONTRIBUTE TO THEIR SOLUTION.

THE INTELLECTUAL RESOURCES OF THIS NATION ARE A GREAT ASSET; WE MUST MOVE AHEAD WITH RESEARCH AND SCIENCE EDUCATION PROGRAMS TO TAKE FULL ADVANTAGE OF THE NATION'S SCIENCE CAPABILITIES. THIS SUBCOMMITTEE HAS LONG RECOGNIZED THE NEED FOR STRONG PROGRAMS OF BASIC RESEARCH AND SCIENCE EDUCATION. IT ALSO HAS ENCOURAGED APPLIED RESEARCH THAT CAN HELP THE NATION DEAL WITH PRESSING PROBLEMS IN SUCH AREAS AS THE ENVIRONMENT, ENERGY, FOOD AND OTHER RESOURCES. MANY OF THESE CONCERNS ARE ADDRESSED BY THE FOUNDATION'S PROGRAM FOR FY 1977.

LET ME STRESS, MR. CHAIRMAN, THAT THE FOUNDATION IS A PRINCIPAL SOURCE OF BASIC RESEARCH FUNDING AT THE NATION'S COLLEGES AND UNIVERSITIES. WITHOUT THE SUBSTANTIAL INCREASE PROPOSED FOR BASIC RESEARCH IN THE NSF BUDGET, FEDERAL FUNDING IN FY 1977 WOULD RESULT IN A CONTINUING DECLINE IN THE LEVEL OF RESEARCH EFFORT AT THE NATION'S COLLEGES AND UNIVERSITIES.

I ALSO WANT TO REEMPHASIZE NSF'S CONVICTION THAT MOST FEDERAL AGENCIES NEED STRONG PROGRAMS OF BASIC RESEARCH TO HELP THEM ACHIEVE THEIR MISSION OBJECTIVES OVER THE LONG TERM. THE FOUNDATION IS CONTINUING ITS EFFORTS TO ENCOURAGE THIS POLICY, AND THE NATIONAL SCIENCE BOARD IS STRONGLY COMMITTED TO IT. SEVERAL AREAS OF BASIC RESEARCH INCLUDED IN THE FOUNDATION'S PROGRAM FOR FY 1977 COMPLEMENT, HELP TO UNDERPIN, AND ARE COORDINATED WITH THE RESEARCH PROGRAMS OF THE MISSION AGENCIES.

AS YOU KNOW, THE NATIONAL SCIENCE BOARD IS CHARGED WITH SHAPING THE FOUNDATION'S POLICIES. THE BOARD ALSO PLAYS A MAJOR ROLE IN DEVELOPING THE NSF BUDGET. I WOULD NOW LIKE TO INTRODUCE DR. NORMAN HACKERMAN, CHAIRMAN OF THE BOARD, WHO WILL COMMENT ON SCIENCE IN THE UNITED STATES AS WE MOVE INTO OUR THIRD CENTURY AS A NATION.

(STATEMENT BY DR. HACKERMAN)

MR. CHAIRMAN, SOME OF THE MOST INTERESTING AND SIGNIFICANT RESEARCH BEING UNDERTAKEN TODAY IS AIMED AT GAINING A BETTER UNDERSTANDING OF BASIC SUBSTANCES THAT OCCUR IN NATURE AND THAT ARE SOMETIMES TAKEN FOR GRANTED.

WATER, FOR EXAMPLE, IS A VERY COMMON SUBSTANCE AND PROBABLY THE MOST IMPORTANT FOR LIFE ON EARTH. IT HAS MANY UNIQUE PROPERTIES AND ALTHOUGH IT HAS BEEN STUDIED INTENSIVELY, THE REASONS FOR ITS SPECIAL PROPERTIES ARE NOT WELL UNDERSTOOD.

AS FAR BACK AS 1935 SCIENTISTS DISCOVERED THE EXISTENCE OF A NON-CRYSTALLINE FORM OF SOLID WATER--NOT CRYSTALLINE ICE--BUT TRULY A SOLIDIFIED LIQUID. RECENTLY, AN NSF GRANTEE AT THE UNIVERSITY OF CHICAGO AND HIS CO-WORKERS HYPOTHESIZED THAT THIS UNIQUE FORM OF SOLIDIFIED WATER SHOULD BE SIMILAR IN ITS STRUCTURAL ARRANGEMENT TO LIQUID WATER. THE MOLECULAR ARRANGEMENTS IN LIQUID WATER ARE CONSTANTLY AND RAPIDLY SHIFTING WHICH MAKE IT EXTREMELY DIFFICULT TO ANALYZE. THE STRUCTURAL ARRANGEMENT OF THIS UNIQUE SOLIDIFIED WATER IS STATIC. IT IS VERY MUCH LIKE HAVING A "STILL FRAME" PICTURE OF A PARTICULAR BASKETBALL OR FOOTBALL PLAY EXCERTED FROM A MOVIE FILM. THIS PROVIDES A MAJOR OPPORTUNITY FOR CHEMISTS TO STUDY THE STRUCTURAL ARRANGEMENT OF LIQUID WATER.

MAJOR TECHNICAL DIFFICULTIES HAD TO BE OVERCOME IN OBTAINING SAMPLES OF THE SOLIDIFIED LIQUID. THIS REQUIRED THE USE OF THE MOST SOPHISTICATED AND ADVANCED SCIENTIFIC INSTRUMENTATION INCLUDING FACILITIES AT THE OAK RIDGE NATIONAL LABORATORY AND THE ATOMIC ENERGY LABORATORY IN DENMARK.

WE HAVE HIGH HOPES THAT THIS RESEARCH WILL PROVIDE TOTALLY NEW INSIGHTS INTO THE SPECIAL CHEMICAL PROPERTIES OF WATER. RESULTS IN THIS AREA HAVE POTENTIAL APPLICATION TO CONCERNS RANGING FROM ENERGY PRODUCTION TO HUMAN BIOLOGY AND FROM CLIMATOLOGY TO INDUSTRIAL CHEMISTRY.

IN THE AREA OF NEURAL BIOLOGY, SIGNIFICANT PROGRESS IS BEING MADE IN THE UNDERSTANDING OF FUNCTIONAL RECOVERY AFTER BRAIN DAMAGE. UNTIL RECENTLY, THERE WAS NO SIMPLE OR SURE WAY TO IDENTIFY WHAT WAS TAKING PLACE IN INDIVIDUAL NERVE CELLS OF THE BRAIN. TECHNIQUES FOR STUDYING BRAIN CELL DEGENERATION WERE ANALOGOUS TO TRYING TO FIND A SHORT CIRCUIT IN A TELEPHONE LINE BY CUTTING THROUGH THE MAIN CABLE AND THEN TRYING TO TRACK BACK THROUGH A MYRIAD OF WIRES TO THE SOURCE OF THE PROBLEM.

RECENTLY, FOUNDATION-SUPPORTED SCIENTISTS DISCOVERED A METHOD FOR USING A UNIQUE ENZYME--KNOWN AS HORSE-RADISH PEROXIDASE--WHICH CAN BE ABSORBED BY BRAIN CELLS. THE GREAT SIGNIFICANCE OF THE TECHNIQUE IS THAT THE ENZYME CAN BE TRACED. THIS MAKES IT POSSIBLE TO TRACK THE ENZYME THROUGH THE BRAIN AND TO IDENTIFY SPECIFIC NERVE PATHWAYS AND ANY "SHORT CIRCUITS" IN THOSE PATHWAYS BECAUSE THE ENZYME WILL NOT JUMP GAPS IN THE NERVE CABLE. THIS PIONEERING WORK WITH AN ENZYME PRODUCED BY A RATHER ORDINARY VEGETABLE HAS PROFOUND IMPLICATIONS FOR MEDICAL SCIENCE. MOST RECENTLY, IT HAS ALSO LED TO THE DISCOVERY OF OTHER TECHNIQUES FOR TRACING NERVE PATHWAYS THROUGH THE BRAIN.

MR. CHAIRMAN, I KNOW THAT THIS SUBCOMMITTEE HAS BEEN KEENLY INTERESTED IN EFFORTS TO IMPROVE THE ENVIRONMENT. THERE IS, OF COURSE, A GREAT RANGE OF EFFORTS TO IMPROVE ENVIRONMENTAL QUALITY, FROM THOSE DEALING WITH AIR AND WATER POLLUTION TO OTHERS DEALING WITH THE MORE

PERPLEXING PROBLEMS OF SOLID WASTE. I WOULD LIKE TO CITE BRIEFLY ONE PROJECT IN THIS AREA BEING SUPPORTED BY NSF.

THERE IS AN URGENT NEED TO FIND WAYS TO REMOVE MOST OF THE ORGANIC AND INORGANIC MATTER FROM SEWAGE IN PRIMARY SYSTEMS. IT NOW APPEARS THAT REMOVAL WILL HAVE TO BE DONE THROUGH SECONDARY AND TERTIARY TREATMENT OF SEWAGE—AT GREAT COST--UNLESS WE FIND SOME NOVEL WAYS TO ACCOMPLISH THE JOB. HOWEVER, SCIENTISTS AT WOODS HOLE OCEANOGRAPHIC INSTITUTION, WORKING WITH FUNDS PROVIDED BY NSF, HAVE ADVANCED TO THE PILOT STAGE A METHOD FOR REMOVING INORGANIC MATTER FROM SEWAGE. THE METHOD USES SUCH MATTER TO GROW ALGAE TO FEED OYSTERS. THE WATER RESULTING FROM THIS PROCESS IS REPORTED TO BE AS CLEAN AS THE SEA ITSELF. USING THIS METHOD, IT MAY BE POSSIBLE TO OBTAIN CLEAN WATER AND AT THE SAME TIME REALIZE A SUBSTANTIAL ECONOMIC BENEFIT IN THE PROCESS ITSELF.

THERE ARE MANY AREAS WHERE IMPROVEMENTS IN PRODUCTIVITY CAN BE OF GREAT BENEFIT TO THE ECONOMY. IN SOME OF THESE AREAS THERE IS NOT SUFFICIENT INCENTIVE FOR INDUSTRY TO MAKE THE NECESSARY RESEARCH INVESTMENTS TO EXPLORE TOTALLY NEW CONCEPTS IN TECHNIQUES. NSF, THROUGH ITS RANN PROGRAM, PROVIDES SUPPORT FOR RESEARCH IN SUCH AREAS ON A HIGHLY SELECTIVE BASIS. AN EXAMPLE IS IN EXCAVATION TECHNOLOGY. EXCAVATION TECHNIQUES ARE IN A RELATIVELY PRIMITIVE STATE. THEY HAVE NOT PROGRESSED SIGNIFICANTLY IN THE PAST FEW DECADES, EVEN THOUGH DEMANDS HAVE INCREASED SHARPLY FOR EXCAVATION AND TUNNELING FOR TRANSPORTATION, POWER TRANSMISSION, PUBLIC UTILITIES, MINING, ENERGY RESOURCES, INDUSTRIAL FACILITIES AND UNDERGROUND STORAGE PROJECTS.

UNDER AN NSF GRANT RESEARCHERS HAVE INCORPORATED HIGH PRESSURE WATER JETS WITH A CONVENTIONAL TUNNEL BORING MACHINE. THE MACHINE HAS BEEN TESTED UNDER FIELD CONDITIONS IN GRANITE. THIS WAS A JOINT VENTURE OF THE COLORADO SCHOOL OF MINES, THE ROBBINS COMPANY, AND FLOW RESEARCH. PENETRATION RATES 400 PERCENT GREATER WERE ACHIEVABLE. SIGNIFICANTLY REDUCED CUTTER WEAR WAS REALIZED AND OVERALL SYSTEMS COSTS REDUCED.

IN OUR BUDGET REQUEST THIS YEAR, WE HAVE LISTED MORE THAN 150 MAJOR RESEARCH QUESTIONS THAT ARE DRIVING RESEARCH IN THE VARIOUS FIELDS OF SCIENCE. THERE IS MUCH TO BE LEARNED AND USED BY THE NATION OVER THE NEXT 100 YEARS. WE HAVE BARELY SCRATCHED THE SURFACE IN UNDERSTANDING THE NATURAL LAWS AND PHENOMENA WHICH GOVERN AND REGULATE OUR LIVES AND THE BEHAVIOR OF THE UNIVERSE.

THE FOUNDATION'S PROGRAM FOR FY 1977 IS SUMMARIZED IN A SERIES OF TABLES ATTACHED TO THE TEXT OF MY STATEMENT. NOW, VERY BRIEFLY, I WOULD LIKE TO HIGHLIGHT THE MAJOR FEATURES OF OUR PROGRAM FOR FY 1977:

BASIC RESEARCH SUPPORT IS INCREASED FROM $523.1 MILLION TO $624.9 MILLION--NEARLY 19.5% ABOVE THE FY 1976 LEVEL. ALMOST ALL OF THESE FUNDS GO TO SUPPORT RESEARCH AT THE NATION'S UNIVERSITIES AND COLLEGES. INCLUDED IN THIS INCREASE ARE HIGHER FUNDING LEVELS FOR MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING; ASTRONOMICAL, ATMOSPHERIC, EARTH AND OCEAN SCIENCES; AND BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES.

RESEARCH APPLICATION EFFORTS IN THE RESEARCH APPLIED TO NATIONAL NEEDS PROGRAM ARE CONTINUED AT AN EFFECTIVE LEVEL. THE FOCUS IS ON RESOURCES, THE ENVIRONMENT, PRODUCTIVITY.

THE BUDGET CONTINUES SCIENCE EDUCATION AT A LEVEL DESIGNED TO HELP ASSURE THE STRENGTH OF THE NATION'S SCIENCE MANPOWER AND THE AVAILABILITY OF HIGH-QUALITY SCIENCE EDUCATION TO THE PUBLIC.

FINALLY, THE BUDGET PROVIDES FOR CONTINUED U.S. RESEARCH IN THE ANTARCTIC, AND INCREASES SUPPORT OF NATIONAL OBJECTIVES THROUGH EXPANDED INTERNATIONAL COOPERATIVE SCIENCE ACTIVITIES.

ONE AREA OF THE NSF BUDGET WHICH HAS BEEN CHANGED SUBSTANTIALLY SINCE LAST YEAR INVOLVES FUNDING OF THE ANTARCTIC RESEARCH PROGRAM. AS YOU MAY RECALL, THE PROCUREMENT OF TWO LC-130R AIRCRAFT IN FY 1976 ACCOUNTED FOR A ONE-TIME INCREASE OF $18 MILLION IN THAT YEAR. THE ANTARCTIC BUDGET PROPOSED FOR FY 1977 DECREASES NOT BY $18 MILLION BUT BY ABOUT $4 MILLION BECAUSE OF INCREASED CHARGES TO THE NSF FOR OPERATIONAL SUPPORT, THE MAJOR COST OF MOUNTING A RESEARCH PROGRAM IN THIS REMOTE AREA.

LET ME EXPAND A BIT ON THAT POINT. THE FY 1977 REQUEST FOR OPERATIONAL SUPPORT IS $39.9 MILLION, COMPARED TO $26.6 MILLION FOR FY 1976, AN INCREASE OF $13.3 MILLION. OF THIS INCREASE, $6.9 MILLION IS FOR CONTINUED SUPPORT OF FUNCTIONS PREVIOUSLY FUNDED BY THE DEPARTMENT OF TRANPORTATION. THE SUPPORT OF THESE FUNCTIONS IS NOT IN THE FY 1976 BASE FIGURE OF $26.6 MILLION. NSF, DOD, AND DOT HAVE AGREED THAT NSF WILL REQUEST FUNDING FOR FUTURE SUPPORT COSTS.

IT WILL ALSO SUPPORT THE ROSS ICE SHELF PROJECT WHICH WAS DEFERRED IN FY 1976 FOR LACK OF AIRCRAFT SUPPORT, AND WILL SUPPORT AN IMPROVED VEHICLE AND EQUIPMENT MAINTENANCE AND REPLACEMENT PROGRAM.

FUNDS ALSO ARE INCLUDED FOR INCREASED COSTS OF OPERATING THE RESEARCH SHIP, ISLAS ORCADAS; THE CONSTRUCTION OF A NEW SIPLE STATION, AND THE RELOCATION OF THE WILLIAMS FIELD LANDING STRIP AWAY FROM THE RECEDING EDGE OF THE ROSS ICE SHELF. THERE ALSO ARE INCREASES FOR MILITARY PERSONNEL, INTERCONTINENTAL AIRLIFT AND SEA LIFT, FUEL COSTS AND AIRCRAFT OVERHAUL WHICH MUST BE ABSORBED.

THE SACRAMENTO PEAK SOLAR OBSERVATORY IS ANOTHER EXAMPLE OF ADJUSTMENT WHICH MUST BE MADE IN THE NSF BUDGET. AS YOU MAY KNOW, THE AIR FORCE IS DROPPING ITS SUPPORT OF THE OBSERVATORY. TWO MONTHS AGO, NSF REVIEWED THE OBSERVATORY'S RESEARCH PROGRAM--IN LINE WITH OUR RESPONSIBILITIES FOR THE HEALTH OF THE NATION'S BASIC RESEARCH.

THE CONCLUSIONS OF THE AD HOC ADVISORY COMMITTEE CONVENED BY NSF WERE THAT THERE DOES NOT APPEAR TO BE ANY GROSS IMBALANCE BETWEEN FUNDS FOR SOLAR ASTRONOMY COMPARED TO ALL OTHER ASTRONOMY; THAT SACRAMENTO PEAK PLAYS AN ESSENTIAL ROLE IN SOLAR RESEARCH AND SHOULD BE MAINTAINED AT A PRODUCTIVE LEVEL; AND THAT THE NATIONAL SCIENCE FOUNDATION SHOULD ASSUME RESPONSIBILITY FOR THE SUPPORT OF THE OBSERVATORY WITH HELP OF OTHER AGENCIES INTERESTED IN SOLAR ASTRONOMY, PARTICULARLY THE AIR FORCE AND ERDA. NEGOTIATIONS WITH THE AIR FORCE HAVE BEGUN FOR IMPLEMENTING TRANSFER OF THE OBSERVATORY FACILITIES TO NSF, EFFECTIVE IN FY 1977. THE COSTS OF SOMETHING OVER $1.0 MILLION WILL BE AN ADDITIONAL REQUIREMENT

TO BE COVERED WITHIN THE TOTAL FY 1977 BUDGET. THIS IS ANOTHER REASON WHY THE ENTIRE $812 MILLION IS NEEDED.

WITH RESPECT TO THE OCEAN SEDIMENT CORING PROGRAM WE ARE PLEASED TO REPORT THE WILLINGNESS OF FOREIGN GOVERNMENTS TO CONTRIBUTE TO THIS IMPORTANT PROGRAM. THE PRESENT STATUS OF AGREEMENTS IS THAT THE NSF HAS SIGNED MEMORANDA OF UNDERSTANDING WITH FOUR COUNTRIES: THE USSR, JAPAN, UNITED KINGDOM, AND FRANCE; A FIFTH SIGNING IS PENDING WITH GERMAN FEDERAL REPUBLIC. THESE AGREEMENTS GRANT EACH COUNTRY CERTAIN PRIVILEGES IN THE CORING PROGRAM IN EXCHANGE FOR AN ANNUAL $1 MILLION CONTRIBUTION. THIS REPRESENTS A POTENTIAL $5 MILLION CONTRIBUTION IN FY 1977 AGAINST THE BUDGETED FIGURE OF $3 MILLION. THE $3 MILLION FIGURE IS CONSIDERED TO BE A CONSERVATIVE ESTIMATE BASED ON THE FOLLOWING POSSIBLE OCCURRENCES: (1) THE WEST GERMANS MAY DECIDE NOT TO COME IN; (2) THE AGREEMENTS WITH USSR, UNITED KINGDOM AND FRANCE HAVE TERMINATION CLAUSES WITH ADVANCED NOTICE BY EITHER PARTY OF AT LEAST SIX MONTHS; FOR JAPAN THIS IS TWO MONTHS; (3) THE FOREIGN COUNTRIES HAVE VARIOUS FISCAL YEAR PERIODS; (5) A DELAY IN THE APPROPRIATION OF A FOREIGN GOVERNMENT MAY DELAY AN EXPECTED FY 1977 PAYMENT INTO FY 1978.

I WOULD LIKE TO COMMENT ON FOUR SPECIFIC AREAS THAT HAVE BEEN OF SPECIAL INTEREST TO THIS SUBCOMMITTEE:

--THE FOUNDATION IS KEENLY AWARE OF THE NEED TO ACHIEVE MORE PUBLIC INVOLVEMENT IN ITS PROGRAM FORMULATION, AND WE HAVE UNDERTAKEN A SERIES OF MEETINGS WITH INTERESTED CITIZENS' GROUPS AND INDIVIDUAL MEMBERS OF THE PUBLIC TO FOSTER A BETTER INTERCHANGE OF THEIR VIEWS WITH SCIENTISTS. THESE ARE PIONEERING EFFORTS WHICH REQUIRE CLOSE CONSULTATION WITH THE

WITH THE PUBLIC. OUR EFFORTS ARE DESIGNED ONLY TO MAKE SCIENCE MORE READILY AVAILABLE FOR USE. AS WE SEE IT, SCIENCE IS A TOOL THAT MUST SERVE SOCIETY.

--GOOD PROGRESS HAS BEEN MADE IN UPGRADING THE ACADEMIC RESEARCH FLEET OVER THE PAST SEVERAL YEARS, AND THIS SUBCOMMITTEE HAS PLAYED A KEY ROLE IN THESE EFFORTS. I AM HAPPY TO REPORT THAT SINCE 1970--WHEN THE ACADEMIC FLEET CONSISTED OF 32 VESSELS, 18 OF WHICH WERE SERIOUSLY OUTDATED AND EXTREMELY EXPENSIVE TO OPERATE AND MAINTAIN--14 OF THE OUTDATED VESSELS, HAVE BEEN RETIRED OR REPLACED. THE FLEET NOW CONSISTS OF 31 VESSELS, ONLY FOUR OF WHICH ARE SERIOUSLY OVERAGE.

--THE FOUNDATION IS CONTINUING TO PROVIDE STRONG SUPPORT FOR EARTHQUAKE ENGINEERING AND FOR A RANGE OF RESEARCH ON NATURAL HAZARDS. WE ARE ALSO BEEFING UP RESEARCH IN THE AREA OF EARTHQUAKE PREDICTIONS.

MR. CHAIRMAN, THE FOUNDATION'S PROGRAM FOR FY 1977 IS WELL-BALANCED WITHIN THE CONTEXT OF TOTAL FEDERAL SUPPORT FOR BASIC RESEARCH. I BELIEVE IT IS ESSENTIAL TO CONTINUE TO MAKE STRONG INVESTMENTS IN THE RESEARCH ENTERPRISE OF THIS NATION. SUCH INVESTMENTS HOLD THE KEY TO FUTURE ECONOMIC AND SOCIAL PROGRESS. I AM CONFIDENT THAT THE SCIENCE PROGRAMS AT THE NATION'S COLLEGES AND UNIVERSITIES WILL CONTINUE TO CONTRIBUTE TO THE ATTAINMENT OF THE NATION'S ECONOMIC AND SOCIAL GOALS, AND I URGE YOUR SUPPORT FOR THE AUTHORIZATION REQUEST AS PRESENTED.

NATIONAL SCIENCE FOUNDATION
ROLE AND PURPOSE

- SUPPORT A SOLID BASE OF SCIENTIFIC RESEARCH AND EDUCATION WHICH SERVES THE LONG RANGE NEEDS OF THE NATION THROUGH:
  - UNDERSTANDING THE STRUCTURE OF MATTER
  - UNDERSTANDING THE NATURE OF THE ENVIRONMENT
  - UNDERSTANDING THE PROCESSES OF LIFE
  - UNDERSTANDING THE BEHAVIOR OF HUMAN SOCIETY
- POLICIES SET BY NATIONAL SCIENCE BOARD
- PROJECTS CARRIED OUT PRIMARILY IN UNIVERSITIES AND COLLEGES THROUGHOUT THE NATION
- SOME PROJECTS SUPPORTED IN INDUSTRY, NON-PROFIT LABORATORIES AND IN MISSION AGENCY LABORATORIES

O/D 76-1376
1-20-76

Chart 1

TOTAL DOLLAR SUMMARY
FY 1975-FY 1977
(OBLIGATIONS IN MILLIONS OF DOLLARS)

	FY 1975 ACTUAL	FY 1976 BUDGET REQUEST TO CONGRESS	FY 1976 PLAN BASED ON ACTUAL LEGISLATION & APPORTIONMENT	FY 1977 BUDGET REQUEST TO CONGRESS	FY 1977 REQUEST/ FY 1976 PLAN
NEW OBLIGATIONAL AUTHORITY	768.2	755.4	715.4 2/	802.0	86.6
TRANSFERS, DEFERRALS, CARRYOVER, LAPSES, AND ADJUSTMENTS	-75.0 1/	20.0	16.2	10.0	-6.2
TOTAL	693.2	775.4	731.6	812.0	80.4

1/ REFLECTS SHIFT OF RESPONSIBILITY FOR MORE THAN $50 MILLION OF ENERGY RESEARCH PROGRAMS TO ERDA AND DEFERRAL ACTIONS

2/ INCLUDES $1.4 MILLION PROPOSED SUPPLEMENTAL APPROPRIATION FOR FY 1976 PAY RAISE COSTS

Chart 2

O/D 76-1377
1-20-76

BUDGET PROGRAM COMPARISONS FY 1975-1977
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING	180.9	193.4	233.3
ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES	184.1	219.3	245.0
BIOLOGICAL, BEHAVIORAL, & SOCIAL SCIENCES	104.2	110.4	132.3
SCIENCE EDUCATION PROGRAMS	74.0	64.8	65.0
RESEARCH APPLIED TO NATIONAL NEEDS	83.6	73.6	64.9
SCIENTIFIC, TECHNOLOGICAL & INTERNATIONAL AFFAIRS	24.9	22.2	22.0
PROGRAM DEVELOPMENT AND MANAGEMENT	37.9	42.6	43.5
SPECIAL FOREIGN CURRENCY PROGRAM	3.6	5.3	6.0
TOTAL	693.2	731.6	812.0

Chart 3

O/D 76-1378
1-20-76

70-027 O - 76 - 7

SUMMARY OF FY 1977 PROGRAM CHANGES
(MILLIONS OF DOLLARS)
MAJOR PROGRAM INCREASES

MATHEMATICAL AND PHYSICAL SCIENCES & ENGINEERING	39.9
ASTRONOMICAL, ATMOSPHERIC, EARTH, & OCEAN SCIENCES	25.7
BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES	21.9

Chart 4

O/D 76-1379
1-20-76

SUMMARY OF FY 1977 PROGRAM CHANGES
(MILLIONS OF DOLLARS)
PROGRAM DECREASES AND MINOR CHANGES

RESEARCH APPLIED TO NATIONAL NEEDS	— 8.7
SCIENTIFIC, TECHNOLOGICAL & INTERNATIONAL AFFAIRS	— .2
SCIENCE EDUCATION	+ .2

Chart 5

O/D 76-1380
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
MATHEMATICAL SCIENCES	16.4	17.5	20.9
COMPUTER RESEARCH	11.8	12.6	15.8
PHYSICS	42.2	44.8	55.5
CHEMISTRY	32.7	35.4	42.3
ENGINEERING	34.3	36.3	44.7
MATERIALS RESEARCH	43.5	46.8	54.1
TOTAL	180.9	193.4	233.3

Chart 6

O/D 76-1381
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
ASTRONOMICAL, ATMOSPHERIC, EARTH AND OCEAN SCIENCES			
ASTRONOMICAL SCIENCES			
ASTRONOMY PROJECT SUPPORT	10.9	11.3	16.2
NATIONAL ASTRONOMY & IONOSPHERIC CENTER	3.2	3.8	4.0
KITT PEAK NATIONAL OBSERVATORY	7.7	8.4	8.9
CERRO TOLOLO INTER-AMERICAN OBSERVATORY	3.0	3.5	3.6
NATIONAL RADIO ASTRONOMY OBSERVATORY	19.3	21.6	22.0
SOLAR ECLIPSE	-0-	.2	-0-
SUBTOTAL	44.1	48.8	54.7
ATMOSPHERIC SCIENCES			
ATMOSPHERIC SCIENCES PROJECT SUPPORT	13.8	14.4	18.7
GLOBAL ATMOSPHERIC RESEARCH PROGRAM	4.0	4.0	4.8
CLIMATE DYNAMICS PROGRAM	1.0	2.0	4.9
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH	17.5	23.8	23.0
SUBTOTAL	36.3	44.2	51.4

Chart 7

O/D 76-1382
1-20-76

BUDGET ALLOCATIONS --(CONTINUED)
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
EARTH SCIENCES			
EARTH SCIENCES PROJECT SUPPORT	13.0	13.6	18.8
OCEAN SEDIMENT CORING PROGRAM	10.5	12.0	13.4
SUBTOTAL	23.5	25.6	32.2
OCEAN SCIENCES			
OCEANOGRAPHY PROJECT SUPPORT	15.3	15.5	18.8
INTERNATIONAL DECADE OF OCEAN EXPLORATION	14.8	15.8	18.4
OCEANOGRAPHIC FACILITIES AND SUPPORT	20.6	16.5	19.2
SUBTOTAL	50.7	47.8	56.4
U.S. ANTARCTIC RESEARCH PROGRAM	25.9	48.9	45.0
(LC 130 AIRCRAFT PROCUREMENT)	(-0-)	(18.0)	(-0-)
ARCTIC RESEARCH PROGRAM	3.6	4.0	5.3
TOTAL	184.1	219.3	245.0

Chart 8

O/D 76-1383
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES			
PHYSIOLOGY, CELLULAR AND MOLECULAR BIOLOGY	41.9	44.6	54.2
BEHAVIORAL AND NEURAL SCIENCES	18.5	19.7	24.4
ENVIRONMENTAL BIOLOGY	26.1	28.1	32.5
SOCIAL SCIENCES	17.7	18.0	21.2
TOTAL	104.2	110.4	132.3

Chart 9

O/D 76-1384
1-2076

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
SCIENCE EDUCATION PROGRAMS			
SCIENCE MANPOWER IMPROVEMENT	20.9	22.8	23.0
SCIENCE EDUCATION RESOURCE IMPROVEMENT	28.4	25.6	26.9
SCIENCE EDUCATION DEVELOPMENT & RESEARCH	23.0	13.4	11.7
SCIENCE AND SOCIETY	1.7	3.0	3.4
TOTAL	74.0	64.8	65.0

Chart 10

O/D 76-1387
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
RESEARCH APPLIED TO NATIONAL NEEDS			
RESOURCES	38.9	16.1	10.0
ENVIRONMENT	23.8	27.0	24.5
PRODUCTIVITY	16.9	24.5	24.4
INTERGOVERNMENTAL SCIENCE & R&D INCENTIVES	2.8	4.6	4.6
EXPLORATORY RESEARCH & TECHNOLOGY ASSESSMENT	1.2	1.4	1.4
TOTAL	83.6	73.6	64.9

Chart 11

O/D 76-1385
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

SCIENTIFIC, TECHNOLOGICAL AND INTERNATIONAL AFFAIRS	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES	7.9	7.0	8.7
SCIENCE INFORMATION ACTIVITIES	5.4	6.0	6.0
SCIENCE ASSESSMENT, POLICY & PLANNING	11.6	9.2	7.3
TOTAL	24.9	22.2	22.0

Chart 12

O/D 76-1386
1-20-76

NSF PROGRAM SUMMARY FY 1971-77
BY MAJOR PROGRAM ACTIVITY
(OBLIGATIONS)

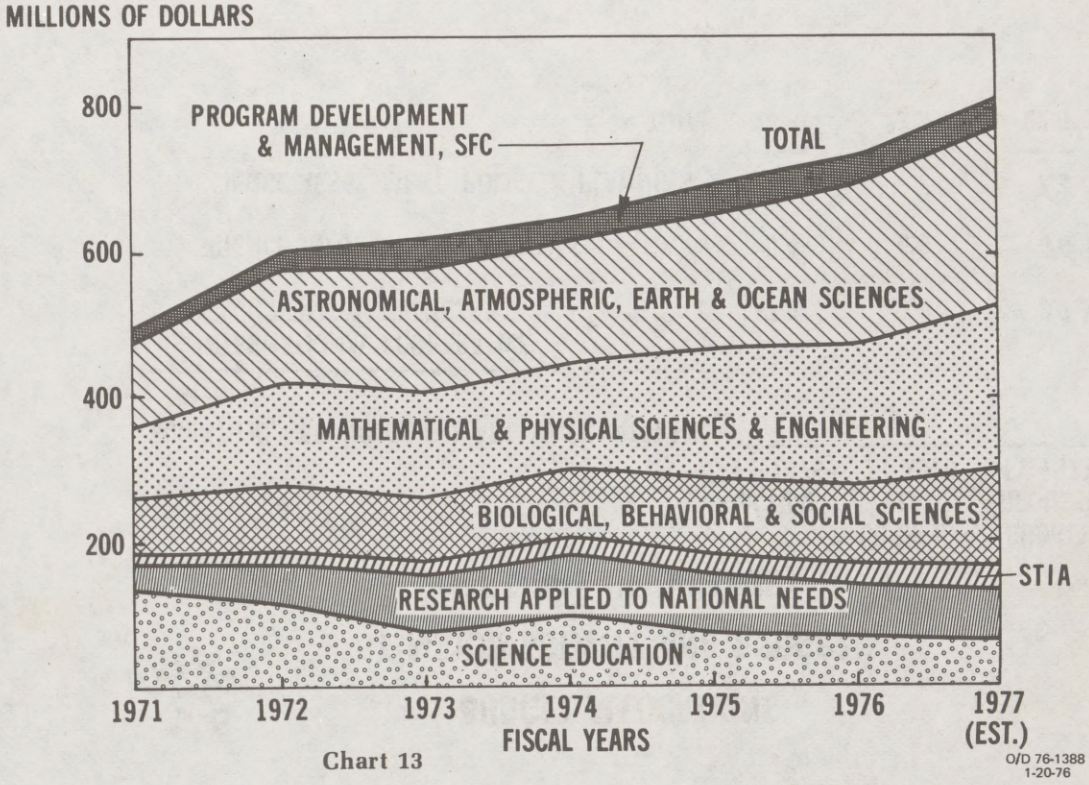

Chart 13

O/D 76-1388
1-20-76

NSF PROGRAM SUMMARY FY 1971-77
BY MAJOR PROGRAM ACTIVITY
(OBLIGATIONS)

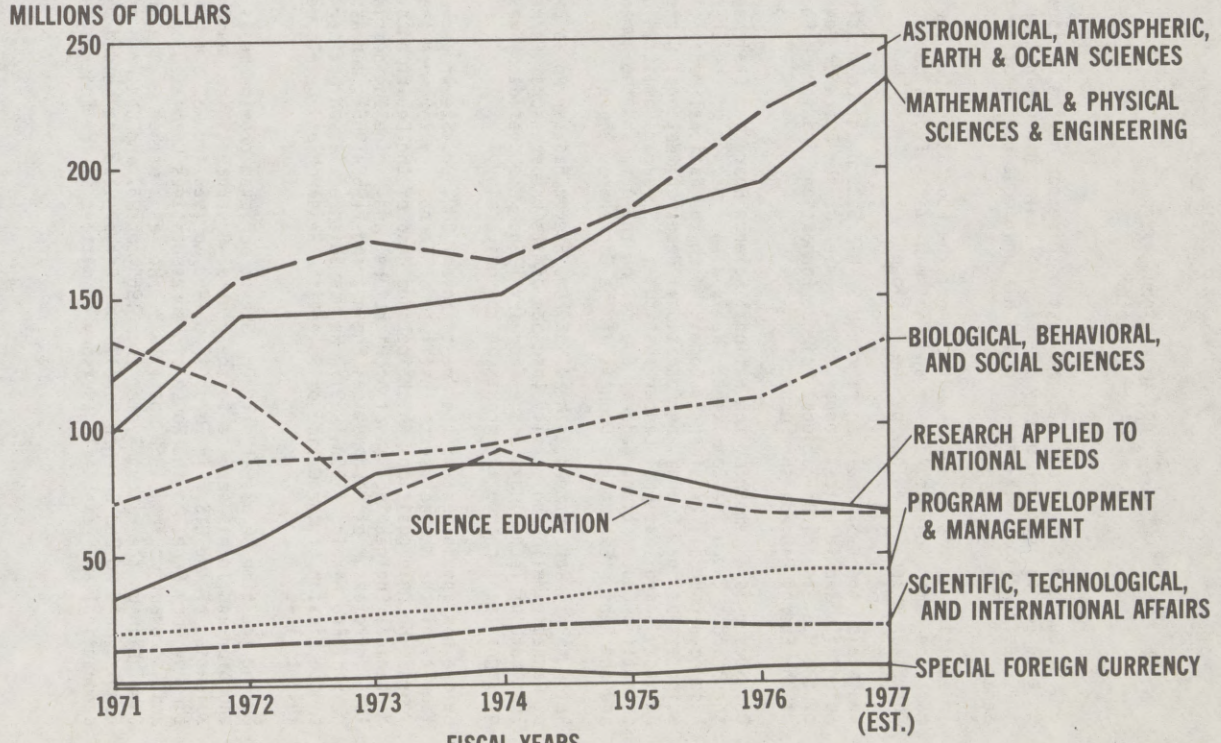

Chart 14

O/D 76-1389
1-20-76

NATIONAL SCIENCE FOUNDATION

WASHINGTON, D.C. 20550

DR. H. GUYFORD STEVER
Director

Dr. H. Guyford Stever assumed the post of Director of the National Science Foundation on February 1, 1972, following his nomination by the President to a six-year term and his unanimous confirmation by the Senate.

In addition to his duties as Director of the Foundation, Dr. Stever has been named Science Adviser and Chairman of the Federal Council for Science and Technology by the President.

He is also the U.S. Chairman of the U.S.-U.S.S.R. Joint Commission on Scientific and Technical Cooperation; member of the Board of Governors of the U.S.-Israel Bi-national Science Foundation; and former Chairman of the Energy R&D Advisory Council.

Dr. Stever is a member of the National Science Board and Chairman of the Board's Executive Committee. He is also a member of the Energy Resources Council; President's Committee on the National Medal of Science; National Council on Educational Research; National Cancer Advisory Board; National Cancer Institute; U.S.-Japan Committee on Scientific Cooperation; Federal Council on the Arts and the Humanities; and the Senior Executives Council of The Conference Board.

Prior to his appointment to head NSF, Dr. Stever had served as President of Carnegie-Mellon University (and one of its predecessors, Carnegie Institute of Technology) since February 1965. His presidency was marked by significant change and growth in the university.

Before his appointment to the Presidency of CMU, Dr. Stever served on the faculty of the Massachusetts Institute of Technology for more than 20 years. He held positions which included Head of the Departments of Mechanical Engineering, Naval Architecture, and Marine Engineering (1961-1965); Professor of Aeronautical Engineering (1956-1965); and Associate Dean of Engineering (1956-1959). He was Science Liaison Officer at the London Mission of the Office of Scientific Research and Development from 1942 to 1945.

During the time he was at MIT, Dr. Stever achieved prominence as an educator and in his service to the Federal Government. He was Chief Scientist of the U.S. Air Force from 1955 to 1956 and was a member of the Advisory Panel to the House of Representatives Committee on Science and Astronautics from 1959 until 1972. He was a member of the President's Commission on the Patent System from 1965 to 1967 and Chairman of the Commission's Ad Hoc Science Panel. Dr. Stever also has headed many other aeronautical and scientific advisory committees at the Federal level.

Professionally, Dr. Stever has specialized in aeronautical, missile, and spacecraft engineering, design, and performance, particularly aerodynamics; radiation physics; scientific and engineering education; university administration; and science policy, with principal contributions in the fields of high speed flows of compressible fluids and control and guidance of flight vehicles. He is best known for his work on condensation phenomena in high speed flows and the growth of the boundary layer behind a shockwave. He has pioneered in missile guidance, and increased our understanding of the stability and control of transonic aircraft.

As an internationally-known expert on aeronautical engineering and space technology, Dr. Stever has often been honored for his work in both fields and for his service to the Government. He is a member of the National Academy of Sciences, National Academy of Engineering (Chairman, Aeronautical and Space Engineering Board, 1967-1969), Institute of Aeronautical Sciences (Vice-President, 1958-1959; President, 1960-1962), American Physical Society, American Institute of Aeronautics and Astronautics (Fellow), American Academy of Arts and Science, Royal Aeronautical Association, American Association for the Advancement of Science, Phi Beta Kappa, and other organizations.

Dr. Stever received his A.B. from Colgate University in 1938 and his Ph.D. degree in physics from California Institute of Technology in 1941. He has received 15 honorary degrees and other honors, including the President's Certificate of Merit, 1948; Exceptional Civilian Service Award, U.S. Air Force, 1956; Scott Gold Medal, American Ordnance Association, 1960; Distinguished Public Service Medal, Department of Defense, 1968. He was named Pittsburgh's "Man of the Year" by the Junior Chamber of Commerce in 1966 and was appointed an Honorary Councilor of the Superior of the Superior Council for Scientific Research of Spain in 1975.

He is the author of more than 45 published articles, papers, or chapters on scientific, technical, educational, and science policy matters.

Dr. Stever, who was born in Corning, New York, in 1916, is married to the former Louise Risley Floyd. They have two daughters, Sarah Newell and Margarette Risley, and two sons, Horton Guyford, Jr. and Roy Risley.

January 1976

Jack Renirie
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FOR RELEASE:

STRICTLY EMBARGOED
NOT FOR RELEASE BEFORE
10:00 A.M. EST, JAN. 21, 1976
NSF PR76-6

STATEMENT OF FY 1977 BUDGET

A total of $812 million, $802 in new funds and $10 million in proposed FY 1976 deferrals, is included for the National Science Foundation (NSF) in the Budget of the United States for Fiscal Year 1977.

The $80.4 million increase in overall budget authority, 11 percent above the program level for FY 1976, is aimed primarily at strengthening Federal support of basic research in all major fields of science.

Dr. H. Guyford Stever, Director of the NSF, said, "The National Science Foundation's proposed program for FY 1977 represents a major effort on the part of the Administration to bolster science and to ensure for the United States a strong basic research program in all major fields of science and engineering. A specific aim of this program is to counteract the gradual decrease of Federal support for basic research which has declined about 23 percent in terms of constant dollars since 1968. Other Federal agencies are also increasing their commitment to basic research, where the research is tightly coupled to the agency's mission objective.

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"Since much of the basic research of the nation is conducted in colleges and universities, where about 87 percent of the NSF program is performed, NSF support is a key to the effectiveness of the college and university system in expanding the frontiers of knowledge. This new knowledge is expected to strongly underpin the activities of some other Federal agencies. In this sense, the NSF research program will serve to balance the total Federal R&D effort."

In FY 1977, the NSF program will contribute significantly to the Nation's scientific strength by:

- Increasing support for basic research in FY 77 to $624.9 million -- nearly 19.5% over the FY 76 level. Included in this increase are higher funding levels for Mathematical and Physical Sciences and Engineering; Astronomical, Atmospheric, Earth and Ocean Sciences, and Biological, Behavioral and Social Sciences.

- Continuing at an effective level Foundation programs -- primarily Research Applied to National Needs -- focusing U.S. scientific and technical resources on selected problems of national importance for the purpose of contributing to their timely, practical solution.

- Providing education programs designed to help assure the quality of the Nation's science manpower and the availability of quality science education to the public.

- Increasing support of foreign policy objectives through expanded international cooperative science activities.

For FY 1977 the NSF program will include:

- An increase of $39.9 million for Mathematical and Physical Sciences and Engineering to a total of $233.2 million. Sub-activity totals for FY 1977 are: mathematical sciences, $20.9 million; computer research, $15.8 million; physics, $55.45 million; chemistry, $42.35 million; engineering, $44.65 million; and materials research, $54.1 million.

  Expanded computer sciences research will explore technical aspects of privacy and security, techniques for improving the quality and reliability of computer software, the best steps towards solving complex problems with ordinary and micro-computers, and other areas.

Increases in physics support will permit greater use of nuclear accelerators in studies of newly discovered particles, and a more concentrated effort in the investigation of plasmas -- a state in which most of the matter of the universe exists but many of whose properties are unknown.

Increased engineering research on two-phase fluid systems, such as solid and gaseous components in combustion by flames, will be supported to help solve problems involving energy and the environment. Additional research related to extremely small optical and electronic devices is expected to lead to small lasers and computers and open the way for optical communication and other information processing systems.

° Astronomical, Atmospheric, Earth and Ocean Sciences will increase from $219.3 million to $245 million with the following area support: astronomical sciences, $54.7 million; atmospheric sciences, $51.4 million; earth sciences, $32.2 million; and ocean sciences, $56.4 million; U.S. Antarctic Research Program, $45 million; Arctic research program, $5.3 million.

New emphasis in astronomy will be placed on observational and theoretical research related to the unusual processes occurring at the centers of galaxies that can generate energy at the rate of ten billion billion times that of the sun, on research related to pulsars, quasars, black holes, and on a search for stars with planetary systems.

Construction, installation, and testing of additional components of the Very Large Array will continue. The four-meter optical telescope at the Cerro Tololo Inter-American Observatory, in Chile, placed in operation January 12, will be in full-time use.

Expanded atmospheric sciences studies will continue to focus on investigations of the basic chemistry of the upper atmosphere, on large and small-scale motions of the atmosphere and stratosphere, as well as on major international cooperative projects.

The Climate Dynamics Program, increased to $4.9 million, is an increasingly concentrated effort to improve our understanding of global climate as a basis for predicting climate variations and assessing their impact on matters important to man.

The increased support for earth sciences will be used to initiate or emphasize selected research in support of the U.S. Program for the International Geodynamics project. In addition, new emphasis will be placed on earthquake research as part of the national effort in earthquake prediction and hazard reduction.

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The highly productive Ocean Sediment Coring Program continues with its international phase during FY 1977.

The International Decade of Ocean Exploration will continue in FY 1977 with large international projects focused on the role of the oceans in climate, food production, pollution, energy, and natural resources.

° An increase in support of Biological, Behavioral and Social Sciences from $110.4 million to $132.3 million. Area support totals are: physiology, cellular and molecular biology, $54.2 million; behavioral and neural sciences, $24.4 million; environmental biology, $32.5 million; and social sciences, $21.2 million.

Research in the plant sciences, particularly in photosynthesis and nitrogen fixation, will be expanded as will investigations in genetics and differentiation where new cell culture capabilities have opened opportunities.

Studies of key aspects of behavior and the nervous system during early development, and research on brain structure and its function in cognitive processes will be increased in FY 1977. Increased emphasis will be placed on studies of social psychology in real life settings.

Research in environmental biology will be expanded to increase our understanding of population biology, physiological ecology, aquatic ecosystems and other areas.

Provisions will be made for increased study of economic theory and advanced measurement techniques to analyze inflation, energy, resources, productivity, and international economic problems.

Fundamental research will be continued to increase our understanding of how human beings and man-made organizations and institutions function.

° Support for Science Education will provide $65 million, including $10 million in funds proposed for deferral from FY 1976, for programs aimed at providing training for scientists and engineers, including the increased entry into science of women and minorities historically under-represented in those fields. A strong effort in three new programs started by the Congress -- Comprehensive Assistance to Undergraduate Science Education (CAUSE), Research Initiation and Support (RIAS) and Science for Citizens -- will be continued. Programs aimed at

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70-027 O - 76 - 8

strengthening science education and research training capabilities of schools, colleges and universities will be continued with a small increase in funding to $26.9 million.

Support of efforts to identify and develop technologies, methods, and course materials to increase the effectiveness of science instruction at all levels will continue at the same level as in FY 1976. A program to increase the amount and quality of communication between the scientific community and the public and the use of science by the public will continue with an increase from $3 million to $3.4 million.

° Research Applied to National Needs (RANN) efforts will continue to be applied to selected problems of national concern in five major program areas: resources, environment, productivity, intergovernmental science and R&D incentives, and exploratory research and problem assessment. The level of RANN support is reduced from $73.6 million in FY 1976 to $64.9 million in FY 1977, reflecting phase down and shift of responsibility of energy resources and environmental effects of energy to the Energy Research and Development Administration and phase down and transfer of fire research to the Department of Commerce.

RANN resources research will apply $10 million to research designed to lead to improvement of the Nation's management of its natural resources through the development of alternative solutions to emerging scarcity problems before a crisis stage is reached.

Special emphasis in the $24.5 million RANN environmental program is placed on chemical threats to the environment and man, regional environmental management, earthquake engineering, weather modification and societal response to natural hazards. $24.4 million will support policy research and experiments with new technologies to help improve productivity of public and private sectors of the economy.

° In Scientific, Technological, and International Affairs an increase of $1.69 million will provide for regionally oriented international cooperative programs as well as increased support for 21 ongoing cooperative programs. A reduction of $1.9 million in science assessment, policy, and planning is made in anticipation of the establishment of the White House Office of Science and Technology.

-END-

NATIONAL SCIENCE FOUNDATION

FY 1977 PROGRAM SUMMARY

The Foundation's FY 1977 budget request totals $812 million, including $802 million in New Obligational Authority and $10 million in proposed FY 1976 deferrals. The total program requested is more than $80 million, or 11 percent above the FY 1976 level. Specifically, the program strengthens basic research in all major fields of science. Additionally, the program gives emphasis to areas where research results are closely coupled to improvements in technology and economic productivity; it continues research in the polar regions and at five major research centers sponsored by the NSF; it strengthens major international cooperative research efforts in oceanography and the atmospheric and earth sciences; it provides support capabilities in science policy research and analysis; and it provides for continued international scientific and technological activities.

Science and technology alone cannot solve many of the major perplexing problems confronting the Nation, such as unemployment, inflation, energy, transportation, stagnating productivity, and the increasing cost of government at all levels. But these and other problems have a significant science and technology component, and it is essential that U.S. scientific resources be applied to national efforts to help resolve them. The ability to make significant progress is increasingly dependent upon a broadening base of scientific understanding that can be provided only through a stronger national basic research effort. The NSF program for FY 1977 was developed with this central goal.

The National Science Foundation's proposed program for FY 1977 represents a major effort on the part of the Administration to bolster science and to ensure for the United States a strong basic research program in all major fields of science and engineering. A specific aim of this program is to counteract the gradual decrease of Federal support for basic research which has declined about 23 percent in terms of constant dollars since 1968. Other Federal agencies are also increasing their commitment to basic research, where the research is tightly coupled to the agency's mission objective. The National Science Foundation is a key element in strengthening Federal support for fundamental science. NSF's budget for FY 1977 provides $624.9 million for basic research or an increase of nearly 19.5 percent over the FY 1976 level of $523.1 million. Since much of the basic research of the Nation is performed in colleges and universities, the Foundation's program is central to this effort; about 87 percent of the NSF program is performed by colleges and universities.

Basic research programs are important national investments, not only because they frequently lead to improved new technologies, but also because they:

- provide an expanding knowledge base which improves man's understanding of basic laws, processes, and phenomena, which opens new avenues of investigation and study.

- improve the methods of detection and measurement which enable the Nation to recognize incipient changes or threats at earlier stages in their development—before they become unmanageable; and
- prepare the Nation to meet emerging new problems.

NSF is a major factor in Federal support for basic research at colleges and universities in all parts of the country, accounting for 40-50 percent of Federal funds for basic research in a number of major science fields. For example, NSF accounts for 43 percent of Federal support for basic research in engineering at colleges and universities, 65 percent in the environmental sciences, more than 56 percent in mathematical sciences, 42 percent in the physical sciences, and 46 percent in the social sciences. NSF support is a major determinant of the overall U.S. basic research effort and is the key to the effectiveness of the college and university system in expanding the frontiers of knowledge.

Research projects supported by NSF are selected on the basis of scientific merit and potential contribution to the body of scientific knowledge and understanding. Results of research may be useable by the same or by other areas of science, or they may require applied research and then development in order to have a social or economic benefit. In some cases, the results may have to be combined with many other research findings before they can be applied and their value realized. Research results may have a continuing payoff. Obtaining the full economic value from research ultimately depends on the willingness of the private sector to provide the capital needed to finance the conversion of knowledge into specific products and services.

Science Education is an important responsibility of the National Science Foundation. The Foundation's programs in this area are designed to improve the quality of science manpower, to strengthen the science education and research training capabilities of colleges and universities, to improve science instruction at all educational levels and to increase public understanding of science and technology.

About 16 percent of the Foundation's total research budget for FY 1977 will fund applied research, compared with 19 percent in FY 1975, and 17 percent in FY 1976. The Foundation's applied research support is concentrated in the program of Research Applied to National Needs (RANN).

Another major feature of the Foundation's program is Scientific, Technological and International Affairs. Included here are a range of international cooperative science efforts with more than twenty nations, science information activities and a variety of science resources policy studies and assessment and planning activities.

The National Science Foundation program for FY 1977 is designed to make progress towards the accomplishment of the agency's Presidential level objectives. These are:

- Increase scientific contributions to help meet national needs and maintain a national competitive capability in all fields of science.
- Increase support of foreign policy objectives through international cooperative science programs.
- Improve integration of scientific and technical advice into national decision-making process.

- Develop energy-related knowledge in a broad range of scientific disciplines and exploit unique research opportunities for application

Taken together the Foundation's programs for FY 1977 represent a strong and well balanced set of science support activities that will make significant contributions to the national effort to maintain U.S. scientific strength.

The budget includes several items where the funding cuts across several major activities and they are noted here because of their particular significance.

NSF plans to continue Scientific Research Initiation Grants at minority institutions. This program was formerly a part of Scientific Research Project Support and under the recent reorganization will continue to be funded in the major science disciplines as appropriate. Since FY 1971, the program has provided about $1.0 million per year for research by faculty members of colleges which historically have provided educational opportunties to predominantly disadvantaged ethnic minorities and which have themselves been disadvantaged in the financial support of their science education programs. The grants totalling about $16,000 each support research in all fields of science and have provided a significant opportunity for research by faculty members of these institutions.

The budget includes $4 million for cooperative research supported under the US/USSR agreement in Science and Technology. This is the same level as in FY 1975 and FY 1976.

Advanced instrumentation and equipment requirements have been highlighted in previous Foundation budgets. The program for FY 1977 continues to place emphasis on these requirements. However, no special program thrust for major equipment items is planned for FY 1977.

MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING

Program Highlights

In FY 1977 the Mathematical and Physical Sciences and Engineering (MPE) activity provides $233.3 million for fundamental research projects in mathematics, computer science, physics, chemistry, engineering, and materials research. This is an increase of $39.9 million over the current FY 1976 plan. In each area, activities will continue to focus on fundamental research on natural phenomena from which may arise new opportunities for technological accomplishments and increased options for improving the quality of life.

Specific highlights of the various MPE subactivities are as follows:

Mathematical Sciences—Support for mathematical sciences is increased from $17.5 million in FY 1976 to $20.9 million in FY 1977. Continued research support will be provided for all areas of mathematics, including classical analysis and geometry, topology, foundations, applied mathematics, statistics, modern analysis, probability, and algebra. Research efforts will also continue to be supported which involve the development of mathematical techniques for application to the solution of problems in the biological and social sciences, as well as the physical sciences. Emphasis will be given to the mathematics of nonlinear waves which is essential to work with high temperature plasmas, optical systems, and descriptions of atmospheric and oceanic phenomena. Global analysis, which enables one to describe the properties of extended objects from a set of measured quantities, and new work in mathematical statistics will also receive increased support.

Computer Sciences—The expanded support for fundamental research in computer science totals $15.8 million for FY 1977, an increase of $3.3 million over the FY 1976 level of $12.5 million. Support will continue to be provided for studies involving techniques for increasing the quality and reliability of computer software, the technical aspects of privacy and security, and computer system fault tolerance. Increasing knowledge of solid state physics and materials properties can provide continuously smaller electronic devices for processing data. Such micro-computers could be used to optimize the total energy useage in a large building. Increased support will be given to computer scientists who are attempting to determine the best practical algorithms, that is, steps toward solving complex problems with both ordinary and micro-computers. Sets of instructions for computers, called software, can be very complex and are subject to errors or may give different results on different computers. Increased emphasis will be placed on research that can lead to improvements in the quality and reliability of such software. Support will also be provided for a new research effort on the structure and management of very large data banks.

Physics—Physics research support increases by $10.7 million from $44.8 million in FY 1976 to $54.5 million in FY 1977. Physics research support will continue in elementary particle physics; intermediate energy physics; nuclear physics; atomic, molecular, and plasma physics; theoretical physics; and gravitational physics. Recent discovery of new particles produced with accelerators have given us new insights into the nature of matter. Many phenomena at the nuclear and subnuclear level can only be examined experimentally with accelerators, which provide tremendous concen-

trations of energy in very small volumes. Because of increasing costs of electrical energy, the use of existing accelerators has been severely curtailed. Additional funding will be provided in FY 1977 to increase this useage more nearly to the available capacity.

Plasmas, or gases in which electrons have been removed from their original positions in the atoms and move freely about, are a basic ingredient of systems considered for producing controlled thermonuclear energy. Although all stars and, in fact, most of the matter in the universe exists in the plasma state, many of its properties are unknown, an increased support for further research on plasmas is required.

Because of the complexity of physical theory, specialists tend to become isolated and its is therefore important to facilitate the interaction of these specialists. The Foundation proposes to establish an institute on a trial basis for a set period of time to increase the interaction of expert theoretical physicists.

Chemistry—The FY 1977 program includes $42.3 million for fundamental research in chemistry, or $6.9 million more than the FY 1976 level of $35.4 million. Continued support will be provided for research in all areas of chemistry to increase our understanding of the laws and principles that govern the chemical transformation of matter. This research provides new knowledge on how molecules form, why they assume a particular geometry or structure, and how interatomic and intermolecular forces influence the speed and direction of a chemical reaction. The Foundation's program covers the entire range of fundamental research in chemistry including such areas as chemical thermodynamics, quantum chemistry, synthetic inorganic chemistry, and synthetic organic and natural products chemistry, among others. Although much of chemistry is carried out in liquids, our knowledge of the structure and behavior of this state is inferior to that of the gaseous and solid state. Expanded support for research on the liquid state is included in the FY 1977 request. Catalysis holds great promise for decreasing the energy required to carry out important chemical reactions. Increased support in this area will provide the new experimental tools which make possible more detailed analysis of the atomic and electronic structure of surfaces with catalytic activity. Increased emphasis will also be given to laser induced chemical reactions of high efficiency. Additional support will also be provided in FY 1977 for improved syntheses for the prostaglandins which regulate many life processes and which may be important to future advances in human health care.

Engineering—The support for research in engineering is increased in FY 1977 by $8.3 million to a total of $44.7 million as compared with $36.3 million in FY 1976. Continued support will be given to research on engineering concepts which will enable industry to conserve energy through reduced consumption and elimination of energy-intensive steps. The Foundation's engineering research covers all of the engineering fields and includes major efforts in electrical sciences and analysis, engineering chemistry and energetics, and engineering mechanics. Many fluid phenomena occur with more than one phase present; for example, the solid and liquid components present in coal slurries, the solid and gaseous components in combustion by flames, and fly ash in air pollutants, all represent two-phase systems. Increased research on their structure and behavior is required to solve some of the major problems involving

energy and the environment. Pattern recognition is proving to be an invaluable tool in studying the weather, the distribution of natural resources, diseases of agricultural crops, and automation in industry. Expanded support is requested for this type of research.

By using beams of electrons or X-rays to etch surfaces with high precision, it is becoming possible to develop extremely small optical and electronic devices. Increased research on these techniques may lead to small lasers and computers and open the way for optical communication and other information processing systems.

Enhanced research on turbulent mixing of fluids will be undertaken to better forecast the properties of jets of pollutants entering bodies of water, or plumes of gases entering the atmosphere from a stack, and to gain further understanding of the interaction between winds and ocean waves.

Materials Research—Support for this subactivity is increased by $7.3 million in FY 1977 to $54.1 million compared with the FY 1976 level of $46.8 million. Support will continue for studies of the fundamental properties of materials to increase understanding of the behavior of materials in complex environments of technological importance, as well as for studies on materials-limited technologies. A serious limitation on many types of materials is their brittleness. What causes this and how it can be controlled is the subject of important research that will be supported by the increased funding. Metallic glasses are a relatively new type of material in which the metal atoms are not arranged in a crystalline structure, but as an amorphous solid. Research on such materials with unique properties of corrosion resistance, strength, and ductility will be expanded. Superconductivity, the ability of some materials to conduct electricity with no use of energy whatsoever, is not well understood and research in this area will receive increased support. Many important phenomena occur at surfaces. Such properties as catalytic activity, corrosion, and crack formation which occur at surfaces will be studied in FY 1977, using new techniques which have become available only recently.

ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES

Program Highlights

The Astronomical, Atmospheric, Earth, and Ocean Sciences Activity supports primarily basic research in several disciplines to increase our knowledge of the physical environment, both on earth and in space.

The research is pursued through the programs and projects of the Subactivities, listed in the above table, which have the following objectives: to generate new knowledge in astronomy and the atmospheric sciences over the entire spectrum of physical phenomena; to arrive at a better understanding of the physical and chemical makeup of the earth and its geologic history; and to increase our insight into the oceans—their composition, structure, behavior, and resources.

The total planned program for FY 1977 is $245.0 million, which is $25.8 million above the Current Plan for FY 1976 of $219.2 million.

Thrusts and changes in the individual subactivities are as follows:

Astronomical Sciences—This subactivity consists of Astronomy Project Support and four National Research Centers in Astronomy. It includes research on the solar system, stars and stellar systems and motions, galactic and extragalactic astronomy, as well as development and operation of astronomical facilities and instrumentation. An increase of $5.9 million (FY 1976, $48.8 million; FY 1977, $54.7 million) will provide for expanded research in astronomy by university scientists, new instrumentation, upgrading of existing instrumentation, data processing, and initial operation of the Very Large Array Radio Astronomy facility.

Atmospheric Sciences—Programs concerned with the earth's atmosphere are Atmospheric Sciences Project Support, Global Atmospheric Research Program, Climate Dynamics Program and the National Center for Atmospheric Research. Atmospheric sciences is a discipline in which knowledge of physics, chemistry, and biology is used and combined in different ways to improve our understanding of the atmosphere, and provide a basis for dealing with atmospheric problems. The $7.2 million increase (FY 1976, $44.2 million; FY 1977, $51.4 million) will be used for research project support for the International Magnetospheric Study, for studies of the atmosphere and atmospheric pollution, and to prepare for the solar maximum period; planning for the First GARP Global Experiment and certain regional experiments; data analysis; acceleration of the Climate Dynamics Program; and construction of a staging building for launching balloon flights at the National Scientific Balloon Facility.

Earth Sciences—Studies of the solid earth and the ocean floor are pursued by the Earth Sciences Project Support and the Ocean Sediment Coring Program. Research is supported to obtain basic information on the nature, origin, history, and behavior of rock formations and the oceans' basins. Such information will help in understanding the forces that affect the earth's interior and modify its surface. An increase of $6.6 million (FY 1976, $25.6 million; FY 1977, $32.2 million) will be needed to initiate new projects to support the U.S. Program for the International Geodynamics Project with emphasis on testing of a plate tectonics model of the earth, geochemical studies of deep melting within the earth, and earthquake research to support the national effort in earthquake prediction and hazard reduction. The Ocean Sediment Coring Program will enter its second year of drilling under the International Phase of Ocean Drilling.

Ocean Sciences—Studies of the ocean are jointly planned for the Oceanography Project Support, the International Decade of Ocean Exploration, and Oceanographic Facilities and Support. The overall goal of the Ocean Sciences Program is improved understanding of the nature of the ocean and its influence on Man's activities and Man's impact on the marine environment. An increase of $8.7 million (FY 1976, $47.8 million; FY 1977, $56.5 million) will provide support for the joint U.S.-U.S.S.R. POLYMODE experiment, studies of pollutants in the marine environment and the chemical reactions which change them into harmful or harmless compounds, continental shelf research, and increased operating costs of oceanographic research ships.

U.S. Antarctic Research Program—This program includes environmental research, and research related to mineral and marine resources. It is carried out within the context of the Antarctic Treaty and continues U.S. presence in that area. The net decrease of $3.9 million (FY 1976, $48.9 million; FY 1977, $45.0 million) is a combination of several factors: nonrecurring costs of $18.0 million for two LC-130R aircraft which were authorized in FY 1976; the restoration of research efforts to the planned FY 1976 level; and increases of $13.3 million in operations support mainly due to the transfer of funding responsibility for DOD and DOT antarctic operation support functions to NSF.

Arctic Research Program—This program extends research in the Arctic while strengthening and broadening U.S. arctic research capabilities. Work is supported in the areas of environmental research, resource related research, and socioeconomic research. The increase of $1.3 million (FY 1976, $4.0 million; FY 1977, $5.3 million) provides for increased efforts in glaciology, atmospheric sciences, polar biology, earth sciences research, and for a Bering Sea ecosystems program.

BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES

Program Highlights

The four budget subactivities of the Biological, Behavioral and Social Sciences activity are a key element of the Nation's scientific research effort on biological and social phenomena. Programs supported under this activity are expected to provide new knowledge and insure future scientific capability which ultimately will be applicable to individual and societal needs and goals. It will provide an effective and broad base for the Nation to prepare for emerging problems of the future, and to insure that U.S. science maintains its position at the frontier of world research.

The Foundation's FY 1977 Budget request for Biological, Behavioral and Social Sciences totals $132.35 million, $21.9 million more than the FY 1976 level. The increase of 19.9 percent will provide for new research opportunities in fundamental areas and continued emphases in areas related to energy, the environment, food, resources, productivity, inflation and employment.

Fundamental research support amounting to $54.2 million in Physiology, Cellular and Molecular Biology will increase $9.6 million over FY 1976 and provide for: increased biochemical and physiological research in plant-related sciences, in particular photosynthesis and nitrogen fixation; molecular biological methodologies which lead to increased sensitivity of measurement and extend the range of parameters; exploitation of opportunities for research in genetics and differentiation now available through new cell culture capabilities; and increased understanding of hormone action and the interactions between different kinds of macromolecules.

The FY 1977 request for the Behavioral and Neural Sciences amounts to $24.4 million, an increase of $4.7 million over the FY 1976 total and will support: studies of key aspects of behavior and the nervous system during early development; research on brain structure, and its function in cognitive processes; increased support for

anthropological research including studies of the impact of technology on change in nonwestern cultures; and an increased emphasis on social psychology in real life settings.

The support for fundamental research provided by Environmental Biology will increase $4.4 million to a total of $32.55 million in FY 1977 for studies to advance understanding of population biology and physiological ecology, tropical biology, aquatic ecosystems, space-time patterns in ecosystems and ecosystem modelling.

Fundamental and methodological research in the Social Sciences will be supported at $21.2 million an increase of $3.2 million over the FY 1976 total of $18.0 million. Funding for this program has been approximately level for the past two years. Support will continue for fundamental research to increase our understanding of how human beings interact and how man-made organizations and institutions function. Provision is be made for: increased study of economic theory and advanced measurement techniques to analyze inflation, energy, resources, productivity, and international economic problems; and increased support for new studies on the changing structure of political systems.

SCIENCE EDUCATION PROGRAMS ACTIVITY

Program Highlights

The goal of the Science Education Program Activity is to "initiate and support. . .programs to strengthen. . .science education programs at all levels. . ." as directed in PL 81-507, as amended, Section 3. (a)(1).

To accomplish this goal the Foundation provides, on a competitive basis, support for institutions to improve their capabilities for teaching science and engineering; for needed innovations in curricula, materials, and technologies for teaching science and engineering. Support is given to able individuals to enable them to pursue careers in the sciences and engineering. The overall program structure in which existing programs are located has been revised so that program results can more easily be identified and their effectiveness evaluated. Accomplishing program objectives in more effective fashion is the major thrust for FY 1977, and one which is being initiated this year.

FY 1976 funds in the amount of $10.0 million will be requested to be deferred into FY 1977 to allow for the evaluation of certain programs and assessment of future directions and to assist in meeting the President's outlay reduction objectives for FY 1977. The descriptions below reflect program highlights and changes for FY 1977.

- **Science Manpower Improvement**—(FY 1976, $22.9 million; FY 1977, $23.0 million) Encourage highest quality standards in students and institutions by providing support for fellowships, traineeships, and other student-oriented

activities; and by increasing the entry into science of women and minorities historically underrepresented in these fields. The program remains essentially level from FY 1976 to FY 1977.

- **Science Education Resources Improvement**—(FY 1976, $25.6 million; FY 1977, $26.9 million) This program helps strengthen the science education and research training capabilities of schools, colleges, and universities, and stimulates the incorporation of validated knowledge and instructional strategies in science teaching. The net increase of $1,400,000 consists primarily of $1.5 million planned for a redesigned program of Improvement of Pre-College Instruction. This is offset by a decrease of .$100,000 in other programs.
- **Science Education Development and Research**—(FY 1976, $13.4 million; FY 1977, $11.7 million) This program helps identify and develop technologies methods and course materials to increase the effectiveness of science instruction at all educational levels. The total decrease of $1.7 million is in Special Studies and Experimentation which will be terminated as a separate program in FY 1976. Future activity in these areas will be integrated into the other program elements.
- **Science and Society**—(FY 1976, $3.0 million; FY 1977, $3.4 million) This program aims at increasing public understanding of science and technology and the role of science and technology in meeting national needs. It is designed to increase both the amount and quality of communication between the scientific community and the public, and to increase the use of science by the public. Most of the $400,000 increase is in the new Science for Citizens Program.

RESEARCH APPLIED TO NATIONAL NEEDS

Program Highlights

The Foundation's program of Research Applied to National Needs (RANN) focuses U.S. scientific and technical resources on selected problems of national importance for the purpose of contributing to their timely, practical solution. RANN serves as a bridge between the Foundation's basic research programs and the development, demonstration, and operational programs of Federal mission agencies, State and local governments, and industry. RANN is coordinated from the program to the project level with the related efforts of these institutions.

An amount of $64.9 million is included in the FY 1977 budget for the RANN program to support problem-focused research in five major program areas: Resources; Environment; Productivity; Intergovernmental Science and R&D Incentives; and Exploratory Research and Technology Assessment.

The reduction of $8.7 million in this program for FY 1977 reflects the further phasedown and shift to other government agencies of research in the areas of energy resources, environmental effects of energy, and fire research.

- **Resources**—Research supported under the RANN Resources program is directed toward improving the Nation's management of its natural resources by developing alternative solutions to emerging scarcity problems before the crisis stage is reached as it was with petroleum. Resources Systems, Renewable Resources, and Nonrenewable Resources are addressed. Special emphasis in these areas is placed on comprehensive analyses of mineral market behavior and laternative renewable and nonrewable resources; on research to develop new technologies to increase the yield and reduce the energy intensiveness of resource extraction; and on research to reduce waste in resource utilization. The reduction in funding of this program ($6.1 million) in FY 1977 reflects the further phase down and shift of responsibility for energy resources research to the Energy Research and Development Administration (ERDA).

- **Environment**—Research supported under the RANN Environment program is directed toward enhancing the Nation's capability to mitigate environmental hazards, whether natural or man caused. This research addresses two major problem areas: Managing the Natural Environment, and Disasters and Natural Hazards. Special emphasis in these areas is placed on chemical threats to the environment and man, regional environmental management, earthquake engineering, weather modfication, and societal response to natural hazards. The reduction in funding of the RANN Environment program ($2.5 million) in FY 1977 reflects the phase down and shift of responsibility for fire research to the Department of Commerce in accordance with P.L. 93-498, and for research on the environmental effects of energy to ERDA.

- **Productivity**—The basic objective of the RANN Productivity program is to support policy research and experiments with new technologies to help improve the productivity of the public and private sectors of the economy.

  Research on public sector productivity focuses on the most cost effective use of technology, capital, and human resources in service delivery, including especially health care, emergency and welfare services. Research on private sector productivity problems emphasizes Advanced Industrial Processes and Regional Productivity Research. This effort brings to bear unique combinations of research capabilities of universities and industry, including small businesses, with special emphasis on the development and application of advanced technologies and systems analysis to production processes that are industrially fragmented or regionally separated.

  Underlying these efforts is policy research to improve the measurement of public and private sector productivity, to analyze the distributional and equity issues involved in the allocation of the benefits of productivity gains, to analyze the effects of government regulations on national productivity, and to determine the effects on productivity of institutional relationships between labor, management, and government.

- **Intergovernmental Science and R&D Incentives**—The basic objectives of this RANN program are to ensure that science and technology are effectively integrated into the policy planning, program planning, and program execution

activities in State and local governments, and to test and evaluate selected incentives which the Federal Government may properly and effectively use to increase R&D investment in the private sector where new technology is needed in the national interest.

The Intergovernmental Program element places emphasis on increasing the awareness of public officials of science and technology issues, experimenting with improved science and technology delivery systems, facilitating the replication of successful experiments, mobilizing additional science and technology resources in the public and private sectors to work on State and local government problems, and increasing the communication and information exchange between and across various levels of government. The Industrial program element places special emphasis on incentives for innovations by small businesses and on incentives to accelerate the introduction of new technologies and systems in the mining and public works industries.

- **Exploratory Research and Technology Assessment**—This program supports research and assessment efforts to provide greater visibility on the longer range social, environmental and economic impacts of new technology applications, and to identify and analyze emerging national problems which may be avoided or ameliorated by effective applications of science and technology. Special emphasis is placed on research and assessment studies of important issues posed by the continuing trends toward a resource-scarce and environment-limited economy. These issues include the socioeconomic and environmental impacts of large scale application of new technologies for low grade ore extraction. More generally, the economy tends to become "closed cycle" because of increasing requirements for reuse and renewal of resources and the environment, and such an economy places a new level of demand on understanding the opportunities and consequences of using science and technology for its effective operation.

SCIENTIFIC, TECHNOLOGICAL, AND INTERNATIONAL AFFAIRS

Program Highlights

The Scientific, Technological, and International Affairs activity (STIA) collects data, supports research, conducts studies, administers international science activities, and undertakes science and technology policy analysis, providing advice on how science and technology can better meet national and international economic and social objectives. This activity includes International Cooperative Scientific Activities, Science Information Activities and a new program group—Science Assessment, Policy and Planning—which contains Science Resources Studies, Policy Research and Analysis, and NSF Planning and Evaluation.

The budget provides an overall decrease of $0.2 million for STIA programs in FY 1977. Although there is an increase in the International program, this will be offset by a significant decrease in the policy research and analysis program of the Science Assessment, Policy and Planning subactivity.

International Cooperative Scientific Activities—(FY 1976, $7.0 million; FY 1977, $8.7 million). The main emphasis of this subactivity is to foster international cooperation between U.S. scientists and their foreign colleagues through its support of U.S. participation in joint research and exchange activities. The requested increase will provide for new regionally oriented joint programs as well as increased support of the 21 cooperative programs for which the Foundation is responsible and the growing scientific and technological activities of the Joint Commissions for Economic Cooperation ($870,000). In addition, increased support is requested to cover rising costs of participation in international organizations ($700,000) and expanded dollar support for Special Foreign Currency projects ($125,000).

Science Information Activities—(FY 1976, $6.0 million; FY 1977, $6.0 million) This subactivity stimulates and supports efforts to improve accessibility and use of scientific and technical information. Although no increase in total funding is sought, $200,000 will be reallocated from the program's applied research support to stimulate increased basic research on the process of information transfer.

Science Assessment, Policy, and Planning—(FY 1976, $9.2 million; FY 1977, $7.3 million). The objective of the Science Resources Studies (SRS) program is the development and maintenance of a current factual and analytical basis for planning and policy formulation in the area of science and technology resources. An increase of $400,000 is requested to better enable SRS to fulfill its statutory responsibility in the area of manpower studies. The Policy Research and Analysis program examines the impact of science and technology on the full range of national interests and develops policy option analyses regarding relevant Federal actions. This program shows a reduction of $2.0 million in anticipation of the establishment of the White House Office of Science and Technology. NSF Planning and Evaluation supports research and analysis designed to strengthen the Foundation's ability to plan and improve its programs and management activities. Although there is a $.3 million reduction in the Evaluation section, the overall agency effort in this area will increase because evaluation studies will be supported by funds from the programs being evaluated in FY 1977.

PROGRAM DEVELOPMENT AND MANAGEMENT

Program Highlights

The Program Development and Management (PD&M) activity provides for the operation, support, management and direction of all NSF programs and activities and includes the salaries and operational expenses of NSF staff and the National Science Board.

Effective July 10, 1975, the National Science Foundation was reorganized to provide a more efficient management structure for carrying out current and future program responsibilities and to meet problems arising from increased scope of activities. The new structure consists of six program directorates and an Administration Directorate together with four staff offices reporting to the Director. The six program directorates are directly concerned with the operation and management of one or more major discrete segments of the Foundation's overall science programs.

Basic research is more strongly represented at Foundation top management level by three assistant directors, each representing related groups of scientific disciplines. Major applied research activities are identified and grouped in a separate Research Applications Directorate. Science education programs continue to be managed under a separate directorate. International programs, science information activities, and the Foundation's policy analytical activities and science resources studies have been consolidated and integrated more efficiently. The staff offices reporting to the Director include the Planning and Resources Management function, Equal Employment Opportunity, Government and Public Programs, and the General Counsel. In addition to the major reorganization, operational procedures have been refined to strengthen administration and management within the directorates.

The $43,500,000 budgeted for this activity in FY 1977, although an increase of $1,330,000, will only be sufficient to approximately maintain the FY 1976 level of overall operation in support of 1,300 permanent positions.

The overall increase includes $830,000 for: staff compensation; staff and consultant travel resulting from increases in per diem and transportation rates; space rental; increased costs of contractual services provided on an reimbursable basis by other government agencies (GSA, Federal Audit Agency, etc.); equipment rentals; communications and equipment other cost increases of goods and services. Also, an amount of $50,000 is included for the full year personnel compensation and related costs of ten positions to staff and manage the NSF portion of multi-agency Joint Commission Activities for development and implementation of cooperative science programs in the middle East and India.

SPECIAL FOREIGN CURRENCY PROGRAM

Program Highlights

The Special Foreign Currency Programs support collaborative scientific work between U.S. and foreign scientists in countries where the United States owns foreign currencies derived largely from the sale of surplus agricultural commodities. There are currently seven participating countries: Burma, Egypt, Guinea, India, Pakistan, Poland, and Tunisia. Funding is provided for joint research projects, travel of U.S. scientists for participation in research and in technical conferences, and the translation into English of foreign scientific and technological publications that have been identified as important for U.S. scientists.

An increase of $0.7 million is requested for FY 1977. Approximately $0.5 million will be used to support high priority projects with India, Pakistan, Egypt, and Tunisia. The remainder will offset the increased costs of translation projects.

NATIONAL SCIENCE FOUNDATION
ROLE AND PURPOSE

- SUPPORT A SOLID BASE OF SCIENTIFIC RESEARCH AND EDUCATION WHICH SERVES THE LONG RANGE NEEDS OF THE NATION THROUGH:
  - UNDERSTANDING THE STRUCTURE OF MATTER
  - UNDERSTANDING THE NATURE OF THE ENVIRONMENT
  - UNDERSTANDING THE PROCESSES OF LIFE
  - UNDERSTANDING THE BEHAVIOR OF HUMAN SOCIETY
- POLICIES SET BY NATIONAL SCIENCE BOARD
- PROJECTS CARRIED OUT PRIMARILY IN UNIVERSITIES AND COLLEGES THROUGHOUT THE NATION
- SOME PROJECTS SUPPORTED IN INDUSTRY, NON-PROFIT LABORATORIES AND IN MISSION AGENCY LABORATORIES

O/D 76-1376
1-20-76

Chart 1

TOTAL DOLLAR SUMMARY
FY 1975-FY 1977
(OBLIGATIONS IN MILLIONS OF DOLLARS)

	FY 1975 ACTUAL	FY 1976 BUDGET REQUEST TO CONGRESS	FY 1976 PLAN BASED ON ACTUAL LEGISLATION & APPORTIONMENT	FY 1977 BUDGET REQUEST TO CONGRESS	FY 1977 REQUEST/ FY 1976 PLAN
NEW OBLIGATIONAL AUTHORITY	768.2	755.4	715.4 2/	802.0	86.6
TRANSFERS, DEFERRALS, CARRYOVER, LAPSES, AND ADJUSTMENTS	-75.0 1/	20.0	16.2	10.0	-6.2
TOTAL	693.2	775.4	731.6	812.0	80.4

1/ REFLECTS SHIFT OF RESPONSIBILITY FOR MORE THAN $50 MILLION OF ENERGY RESEARCH PROGRAMS TO ERDA AND DEFERRAL ACTIONS

2/ INCLUDES $1.4 MILLION PROPOSED SUPPLEMENTAL APPROPRIATION FOR FY 1976 PAY RAISE COSTS

Chart 2

O/D 76-1377
1-20-76

BUDGET PROGRAM COMPARISONS FY 1975-1977
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING	180.9	193.4	233.3
ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES	184.1	219.3	245.0
BIOLOGICAL, BEHAVIORAL, & SOCIAL SCIENCES	104.2	110.4	132.3
SCIENCE EDUCATION PROGRAMS	74.0	64.8	65.0
RESEARCH APPLIED TO NATIONAL NEEDS	83.6	73.6	64.9
SCIENTIFIC, TECHNOLOGICAL & INTERNATIONAL AFFAIRS	24.9	22.2	22.0
PROGRAM DEVELOPMENT AND MANAGEMENT	37.9	42.6	43.5
SPECIAL FOREIGN CURRENCY PROGRAM	3.6	5.3	6.0
TOTAL	693.2	731.6	812.0

Chart 3

O/D 76-1378
1-20-76

SUMMARY OF FY 1977 PROGRAM CHANGES
(MILLIONS OF DOLLARS)

MAJOR PROGRAM INCREASES

MATHEMATICAL AND PHYSICAL SCIENCES & ENGINEERING	39.9
ASTRONOMICAL, ATMOSPHERIC, EARTH, & OCEAN SCIENCES	25.7
BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES	21.9

Chart 4

O/D 76-1379
1-20-76

SUMMARY OF FY 1977 PROGRAM CHANGES
(MILLIONS OF DOLLARS)
PROGRAM DECREASES AND MINOR CHANGES

RESEARCH APPLIED TO NATIONAL NEEDS	— 8.7
SCIENTIFIC, TECHNOLOGICAL & INTERNATIONAL AFFAIRS	— .2
SCIENCE EDUCATION	+ .2

Chart 5

O/D 76-1380
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
MATHEMATICAL SCIENCES	16.4	17.5	20.9
COMPUTER RESEARCH	11.8	12.6	15.8
PHYSICS	42.2	44.8	55.5
CHEMISTRY	32.7	35.4	42.3
ENGINEERING	34.3	36.3	44.7
MATERIALS RESEARCH	43.5	46.8	54.1
TOTAL	180.9	193.4	233.3

Chart 6

O/D 76-1381
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
ASTRONOMICAL, ATMOSPHERIC, EARTH AND OCEAN SCIENCES			
ASTRONOMICAL SCIENCES			
ASTRONOMY PROJECT SUPPORT	10.9	11.3	16.2
NATIONAL ASTRONOMY & IONOSPHERIC CENTER	3.2	3.8	4.0
KITT PEAK NATIONAL OBSERVATORY	7.7	8.4	8.9
CERRO TOLOLO INTER-AMERICAN OBSERVATORY	3.0	3.5	3.6
NATIONAL RADIO ASTRONOMY OBSERVATORY	19.3	21.6	22.0
SOLAR ECLIPSE	-0-	.2	-0-
SUBTOTAL	44.1	48.8	54.7
ATMOSPHERIC SCIENCES			
ATMOSPHERIC SCIENCES PROJECT SUPPORT	13.8	14.4	18.7
GLOBAL ATMOSPHERIC RESEARCH PROGRAM	4.0	4.0	4.8
CLIMATE DYNAMICS PROGRAM	1.0	2.0	4.9
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH	17.5	23.8	23.0
SUBTOTAL	36.3	44.2	51.4

Chart 7

O/D 76-1382
1-20-76

BUDGET ALLOCATIONS –(CONTINUED)
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
EARTH SCIENCES			
EARTH SCIENCES PROJECT SUPPORT	13.0	13.6	18.8
OCEAN SEDIMENT CORING PROGRAM	10.5	12.0	13.4
SUBTOTAL	23.5	25.6	32.2
OCEAN SCIENCES			
OCEANOGRAPHY PROJECT SUPPORT	15.3	15.5	18.8
INTERNATIONAL DECADE OF OCEAN EXPLORATION	14.8	15.8	18.4
OCEANOGRAPHIC FACILITIES AND SUPPORT	20.6	16.5	19.2
SUBTOTAL	50.7	47.8	56.4
U.S. ANTARCTIC RESEARCH PROGRAM	25.9	48.9	45.0
(LC 130 AIRCRAFT PROCUREMENT)	(-0-)	(18.0)	(-0-)
ARCTIC RESEARCH PROGRAM	3.6	4.0	5.3
TOTAL	184.1	219.3	245.0

Chart 8

O/D 76-1383
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES			
PHYSIOLOGY, CELLULAR AND MOLECULAR BIOLOGY	41.9	44.6	54.2
BEHAVIORAL AND NEURAL SCIENCES	18.5	19.7	24.4
ENVIRONMENTAL BIOLOGY	26.1	28.1	32.5
SOCIAL SCIENCES	17.7	18.0	21.2
TOTAL	104.2	110.4	132.3

Chart 9

O/D 76-1384
1-2076

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
SCIENCE EDUCATION PROGRAMS			
SCIENCE MANPOWER IMPROVEMENT	20.9	22.8	23.0
SCIENCE EDUCATION RESOURCE IMPROVEMENT	28.4	25.6	26.9
SCIENCE EDUCATION DEVELOPMENT & RESEARCH	23.0	13.4	11.7
SCIENCE AND SOCIETY	1.7	3.0	3.4
TOTAL	74.0	64.8	65.0

Chart 10

O/D 76-1387
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
RESEARCH APPLIED TO NATIONAL NEEDS			
RESOURCES	38.9	16.1	10.0
ENVIRONMENT	23.8	27.0	24.5
PRODUCTIVITY	16.9	24.5	24.4
INTERGOVERNMENTAL SCIENCE & R&D INCENTIVES	2.8	4.6	4.6
EXPLORATORY RESEARCH & TECHNOLOGY ASSESSMENT	1.2	1.4	1.4
TOTAL	83.6	73.6	64.9

Chart 11

O/D 76-1385
1-20-76

BUDGET ALLOCATIONS
BY MAJOR ACTIVITY AND PROGRAM
(MILLIONS OF DOLLARS)

	ACTUAL FY 1975	CURRENT PLAN FY 1976	BUDGET REQUEST FY 1977
SCIENTIFIC, TECHNOLOGICAL AND INTERNATIONAL AFFAIRS			
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES	7.9	7.0	8.7
SCIENCE INFORMATION ACTIVITIES	5.4	6.0	6.0
SCIENCE ASSESSMENT, POLICY & PLANNING	11.6	9.2	7.3
TOTAL	24.9	22.2	22.0

Chart 12

O/D 76-1386
1-20-76

NSF PROGRAM SUMMARY FY 1971-77
BY MAJOR PROGRAM ACTIVITY
(OBLIGATIONS)

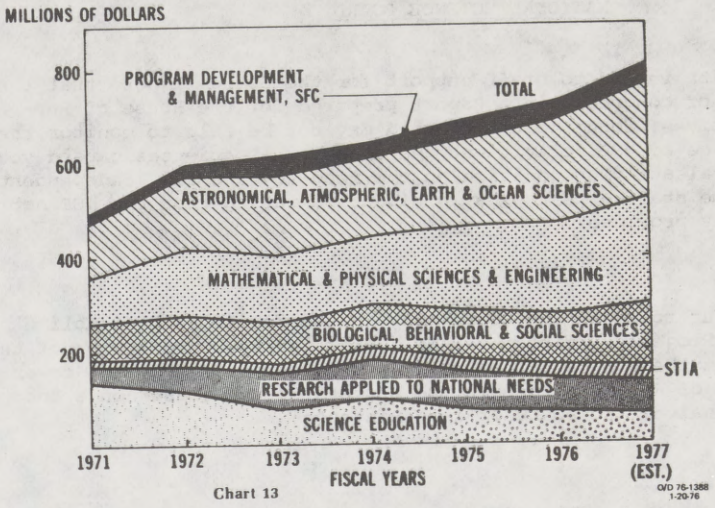

Chart 13

NSF PROGRAM SUMMARY FY 1971-77
BY MAJOR PROGRAM ACTIVITY
(OBLIGATIONS)

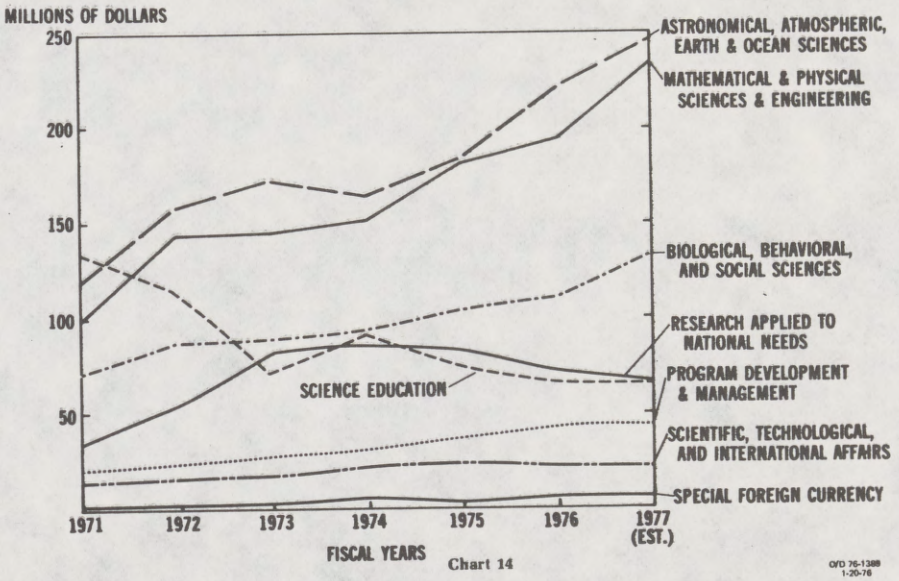

Chart 14

QUESTIONS SUBMITTED BY SENATOR EDWARD M. KENNEDY, CHAIRMAN,
SPECIAL SUBCOMMITTEE ON THE NATIONAL SCIENCE FOUNDATION

NATIONAL SCIENCE BOARD

With regard to staff support for the Board, I note that the Library of Congress, in a Report prepared for the House of Representatives, found that the Board may not be able to monitor the full range of NSF activities. Have recent experiences caused you to re-evaluate your position on the need for a small, independent full time staff - perhaps at a higher GS rating than the NSF Act currently provides?

What role did the Board play in the decision to establish a Western Projects Office for RANN. What is the Board's view of the fact that the Office has only six active projects and that fewer than 20% of RANN grantees in the Western States (based on a Subcommittee questionnaire) are aware of its existence?

QUESTION: With regard to staff support for the Board, I note that the Library of Congress, in a Report prepared for the House of Representatives, found that the Board may not be able to monitor the full range of NSF activities. Have recent experiences caused you to re-evaluate your position on the need for a small, independent full time staff--perhaps at a higher GS rating than the NSF Act currently provides?

ANSWER: Since first proposed by Mr. Emilio Q. Daddario in 1966, the National Science Board has from time to time considered the matter of a professional staff responsible directly to the National Science Board. On each occasion the Board has concluded that arrangements for assistance to it provided by the Director from the staff of the Foundation have been satisfactory.

As has often been the case, the Board is currently reconsidering its responsibilities under NSF's enabling legislation and exploring mechanisms which would allow appropriate support of these Board functions. The Board may well decide that it requires its own staff to perform its special functions.

The Board has, however, consistently concluded that it is unsatisfactory to have a staff permanently removed from the operational activities of the Foundation. Nonetheless, since it is a question which is frequently under consideration, the Board may reach another conclusion.

QUESTION: What role did the Board play in the decision to establish a Western Projects Office for RANN? What is the Board's view of the fact that the Office has only six active projects and that fewer than 20% of RANN grantees in the western states (based on a Subcommittee questionnaire) are aware of its existence?

ANSWER: The establishment of a Western Projects Office for RANN was an administrative action taken by the Director in his capacity as chief administrative officer of the Foundation. In line with his usual practice of reporting major transactions to the National Science Board, he informed the Board in September 1974 that he had established, as a two-year experiment, an office to serve the Foundation and its RANN grantees on the West Coast. It was understood by the Board that this office would be limited in scope and that the Projects Office would be evaluated in its second year of operation. The comments of the Subcommittee and its survey will be carefully considered in this review.

BASIC RESEARCH

How is responsibility for funding high energy physics divided between E.R.D.A. and N.S.F.? What is done administratively to coordinate the two programs? What is the relation between this area of research and E.R.D.A.'s statutory mission?

How is the chemistry program coordinated with industrial research programs, for example, in synthetic organic chemistry?

Why are optics and acoustics not included in the engineering program?

What are the statutory limitations on the funding and support of astronomy facilities in foreign countries? How does this compare with statutory limitations on support for researchers who are not U.S. citizens?

How is the biology program coordinated with N.I.H.? How is funding responsibility divided?

How is the biology program coordinated with the Department of Agriculture? How is funding responsibility divided?

Does the biology program fund research programs at hospitals? If not, why?

Question:

How is responsibility for funding high energy physics divided between ERDA and NSF? What is done administratively to coordinate the two programs? What is the relation between this area of research and ERDA's statutory mission?

Answer:

Total funding for high energy physics is divided between ERDA and NSF in the respective ratio of approximately 10 to 1. ERDA provides support for operating the major installations at national laboratories such as Fermilab, Brookhaven, Argonne and the Stanford Linear Accelerator Center as well as support for many university based user groups. The Foundation's program is entirely university based and consists of support for user groups at the national laboratories, and for the operation and research program of the Cornell electron synchrotron.

A great deal of coordination exists between the two agencies arising from the need to maintain coherence in the national program, and in particular adequate balance in having NSF funded user groups using the ERDA funded major facilities. The coordination takes place in the forms of frequent meetings and discussions between staff of the two agencies, joint attendance at High Energy Physics Advisory Panel (HEPAP) meetings and reliance upon that committee for advice to both agencies, joint attendance at Program Advisory Committee meetings of the various laboratories, and joint sponsorship and monitoring of special studies of matters relevant to the field.

The relationship between this area of research and ERDA's statutory mission can only be answered in a long term perspective. Research in this area is required because the understanding of phenomena at the elementary particle level underlies a great deal of the complete understanding of the physical world. Although it is not possible to predict that understanding which is obtained will ultimately lead to new sources of energy, past experiences of the nature of basic research has led us to expect that results of that research will have profound impacts upon future life. Maintenance of a broadly based program of development, applied research and basic research represents a prudent approach to the achievement of long term as well as short term solutions to society's problems in energy resources.

2. How is the chemistry program coordinated with industrial research programs, for example, in synthetic organic chemistry?

It is the nature of basic research in chemistry that it is curiosity motivated and performed largely in academic institutions. The chemical industry has limited support for curiosity motivated basic research and since their purpose has a profit motive there is more interest in supporting only mission oriented basic research, but even here, expenditures are low. Academic chemists, as individual scientists, feel they cannot compete well against any group efforts fostered by goal oriented industrial thrusts. As a consequence academic chemists, with some notable exceptions, refrain from competing with industrial chemists in basic research. The industrial community and academic chemists keep a very close eye on research of mutual interest through:

a) interaction via consultantships

b) national and international scientific meetings, conferences, NSF workshops, etc.

c) sabbatical leaves for industrial chemists in academic labs and vice versa

d) seminars

e) reviewing of NSF and other Federal agency proposals

f) the extensive primary scientific literature in chemistry

g) service as panel members.

Recently, the Chemistry Division has been visited by industrial scientists from Union Carbide Corporation and Sun Oil Corporation. Several competent researchers from these corporations have visited with our program directors and exchanged information on forefront research of mutual interest.

Notable exceptions to these practices where more cooperation exists are in 1) catalysis and 2) total synthesis of biological molecules and/or pharmaceutical chemistry. In the first case research has been coordinated in the field of catalysis through an NSF sponsored workshop. A significant fraction of the invited participants at our workshop (1975) were from industrial companies. Unfortunately, their contributions and participation were limited since they must protect their patent positions. However, the industrial chemists were cooperative and engaged actively in preparing a workshop report on future research in this field.

In the pharmaceutical area, organic chemists often send selected compounds for screening as possible new drugs and intermediates are synthesized in collaboration with colleagues in industrial companies. There is significant collaboration between academic scientists and industrial scientists in this domain of research.

We would note finally that analytical chemists in the academic world correspond with their counterparts in industry. Chemists in both domains are active at the forefront in analysis research and our community cooperates effectively through many of the mechanisms noted previously.

Why are optics and acoustics not included in the Engineering Program?

Answer:

The National Science Foundation's Engineering Program includes significant amounts of work in both acoustics and optics. Acoustics work appears primarily in the Fluid Mechanics Program and to a lesser extent in the Solid Mechanics Program. Because light is electro-magnetic radiation, optics appear in several of the programs in the Electrical Sciences and Analysis Section.

Question: What are the statutory limitations on the funding and support of astronomical facilities in foreign countries?

Answer: There is no statutory limitation except that projects must be related to a cooperative activity with approval of the Secretary of State.

Question: How does this compare with statutory limitations on support for researchers who are not U.S. citizens?

Answer: There are no limitations on the support of researchers who are not U.S. citizens except that they cannot receive Foundation fellowships.

Q. How is the biology program coordinated with NIH? How is funding responsibility divided?

How is the biology program coordinated with the Department of Agriculture? How is funding responsibility divided?

Does the biology program fund research at hospitals? If not, why?

The NSF is the only Federal agency charged with maintaining the general overall health of the science enterprise in the United States. The Biological, Behavioral, and Social Sciences activity provides the major portion of Federal support for Basic Research at universities in a number of research areas. This is particularly the case in new techniques and methodology, non-health related biological research, ecology, systematics, basic plant sciences, and the social sciences. Foundation support in some of these areas amounts to as much as 70 percent of the Federal total and in some cases such as systematics is the sole source of Federal support for fundamental research at universities. Thus, the health of these sciences is affected profoundly by the level of Foundation support.

The staff of the Biological, Behavioral, and Social Sciences Directorate coordinates with other Federal programs through continuous contacts at both formal and informal levels, in order to insure effective planning and evaluation and avoid the duplication of efforts. Many of the program staff serve as liaison representatives on established Advisory Committees within other Federal agencies (including all of those at NIH, NCI and ex officio member of the Board of Regents at NLM). Joint participation in the support of workshops of concern to other agencies (e.g., USDA, NIH, ERDA) or joint funding of research facilities for use by researchers whose support comes from difference agencies occurs as required by the topic or subject matter.

Basic research in Physiology, Cellular and Molecular Biology is being carried out in most graduate level universities, medical schools and non-profit research centers. Annually, NSF supports about 1,000 investigators most of whom are in arts & science graduate schools and universities. HEW support is provided mainly to institutions associated with the health professions. NSF has a major role in the support of investigators outside of the health related institutions, providing some 54% of the support for basic research in Physiology, Cellular and Molecular Biology

All of the programs in the Behavioral and Neural Sciences maintain continuous liaison with their counterparts in the National Institutes of Health and the Alcohol, Drug Abuse, and Mental Health Administration, as well as with other programs within the Foundation. Staff members also serve on the Interagency Primate Steering Committee and the Interagency Round Table for Language Study.

Almost half of the research support provided by NIH in the life sciences goes to clinical research. In excess of 85 percent of the NIH money goes to investigators at medical schools or health related institutions of other types--where the projects are related to biomedical areas. Except for a small program associated with improved diagnostic instruments in RANN, NSF supports no clinical research. On the order of 85 percent of the BBS funding goes to

70-027 O - 76 - 10

the arts and science graduate institutions which are not associated with medical schools. This is not by deliberate design, but it turns out that more of our requests come from the basic university departments as opposed to medical schools.

In terms of scientific content, fields such as biochemistry are supported by NIH and the Foundation with established procedures to avoid duplication. NSF is more heavily involved in the biochemistry of plant cell systems, lower organisms, sea urchins, tadpoles, the whole range of animals and plants in the living world, as opposed to NIH, which tends to emphasize studies associated with mammalian and human organisms or direct disease-related systems.

The Department of Agriculture generally does not have extramural support programs, but historically has had the major responsibility for research in the plant science area. NIH for awhile supported some plant science research but since 1971 has virtually discontinued its efforts in plant sciences and the Foundation has now become the major source of competitive funding in this area.

Informal relationships are maintained with elements of the Department of Agriculture engaged in support of agricultural research.

Through membership on interagency committees, the staff interacts in a more formal way for information exchange and coordination of efforts. A contract with the Environmental Protection Agency formalizes joint support between DOA and NSF of the large Integrated Pest Management Program at the University of California at Berkeley. Involved from the beginning with this program, the Department of Agriculture has provided land and technical advice and is continuously informed of the status of the research.

The Biological, Behavioral and Social Sciences program in FY 75 provided 180 awards totalling $7.8 million to 68 medical institutions (generally medical schools but including seven awards to hospitals totalling $319,700). This was approximately 15 percent of the BBS biological programs other than environmental. Medical schools and other health institutions can compete for basic research grants and often do in areas that are not problem or clinical oriented.

RESEARCH APPLIED TO NATIONAL NEEDS

Is the NSF concerned that the small scale advanced solar energy research sponsored by RANN in the past may not fit into the solar energy research program which ERDA will be funding and that, as a result, important opportunities to advance in this area may be lost?

Why have RANN personnnel levels not been adjusted to reflect proposed decreases in the RANN effort.

Does RANN clearly identify potential users of the research it sponsors? Are users involved in the original proposal; in the evaluation of proposals; in the carrying out or monitoring of the research? Do users have an opportunity to comment on research upon its completion.

Does RANN have procedures for determining the degree of utilization of research it sponsors? How is this accomplished? Does RANN attempt to specify barriers to the implementation of research at the proposal stage; during the performance; after completion? Does RANN have data to show whether improvements have been made in ensuring that research gets applied?

RANN has recently successfully 'spun off' its energy programs to ERDA. What of RANN's current programs are perceived as growing and perhaps being 'spun off' in their turn? Which areas are decreasing in emphasis at this time.

Does RANN attempt to determine the effects of research it has sponsored for a few years after fudning has stopped, for example, by requiring a report of some kind? It would be of interest to this Committee in attempting to evaluate the overall impact which the RANN program has had.

" Is the NSF concerned that the small scale advanced solar energy research sponsored by RANN in the past may not fit into the solar energy research program which ERDA will be funding and that, as a result, important opportunities to advance in this area may be lost? "

The Foundation has always been concerned that the potential of new and innovative concepts be assessed and that innovation be stimulated. As the lead agency in solar energy research prior to the establishment of ERDA, the Foundation through the RANN programs placed a major emphasis on determining the technical and economic feasibility of new concepts which showed promise of significantly contributing to the successful development of new and alternative solar energy technologies. Such research must nessarily be characterized as high risk, which makes the establishment of research priorities quite difficult when budgets are limited. Major breakthroughs in one research approach may result in changes in research priorities, with a possible reduction of funding levels available for the other alternative research approaches. While success in all approaches cannot be expected, the thorough investigation and evaluation of successful approaches can be expected. For this reason, coordination with ERDA has been maintained through interagency committees and through interactions at the program levels. Also, in funding actions taken by the Foundation during the phase down of the RANN energy programs, care has been taken to fund each project to completion, i.e., to the point at which a credible measure of potential success can be made. This approach has been taken to simplify decisions relating to possible implementation, and to minimize the impact on ERDA planning and budgets.

Why have RANN personnel levels not been adjusted to reflect proposed decreases in the RANN effort?

If one considers a decrease in the RANN budget as a decrease in the RANN effort then a corresponding decrease in personnel would appear logical. However, rather than a decrease in the RANN effort, there has been a significant expansion in two major areas. The new Resources program has required extensive planning and negotiations throughout the government, the academic world and with industry to focus divergent research efforts on this critical area. The second major area of expansion has been in facilitating the utilization of RANN research results. This effort in itself requires much more activity by the individual program managers and focuses more attention on negotiations with the units of State and local government.

The establishment of the RANN program in 1971 did not provide for sufficient personnel to effectively manage the $34 million program. In subsequent years as budgets were increased, personnel were also increased but not at a rate to overcome the initial shortage.

	FY 1972	FY 1973	FY 1974	With Energy FY 1975	FY 1975	FY 1976	FY 1977
Budget	$53,767	$69,887	$75,079	$148,900	$83,590	$73,600	$64,900
Personnel	73	118	135	201	143	143	143

In January 1975, the National Science Foundation transferred $51,700,000 and thirty-eight staff members to ERDA. A further reduction in personnel was made through attrition to the 143 level. With the increased RANN efforts in resources and utilization, the Directorate is now just about sufficiently staffed to meet its management responsibilities. As programs

are transferred, further reductions in personnel may occur such as in the case of the Fire Research program transfer to the Department of Commerce The program manager for this program was also transferred to the Department of Commerce. But as programs are transferred, other programs are expanded as in the case of Productivity, and levels in personnel tend to stay the same.

Does RANN clearly identify potential users of the research it sponsors? Are users involved in the original proposal; in the evaluation of proposals; in the carrying out or monitoring of the research? Do users have an opportunity to comment on research upon its completion.

Interaction with the user community is an integral part of the funding approach of RANN. It must be remembered, however, that the form of this interaction depends upon the type of project. The ultimate utilization of products depends upon whether the product will lead to further research, to immediate use by the public or private sector user community, or by users in the medium or long term. Some products are information, some hardware, and some management techniques or models. The form of utilization activities designed into the project will depend upon these factors.

User involvement with RANN begins with their involvement in planning future programs for RANN and guiding current ones, and continues through their assistance in reviewing proposals, overseeing ongoing projects, evaluating results, helping in dissemination activities, and finally in using the product themselves.

At the same time that users work directly with RANN staff, they work more closely with the researchers under RANN support. This association often begins at the proposal development stage. More frequently, it begins during the course of the project as users serve on advisory boards attached to the project. Users also become involved during the course of the project if the product is being developed with a data base supplied by users or is being tested with the cooperation of the users. Finally, users are involved at the end of the project as the researcher begins to carry out dissemination and utilization activities.

Does RANN have procedures for determining the degree of utilization of research it sponsors? How is this accomplished? Does RANN attempt to specify barriers to the implementation of research at the proposal stage; during the performance; after completion? Does RANN have data to show whether improvements have been made in ensuring that research gets applied?

Determining the degree of utilization in a formal way would require a utilization metric which we do not now have. The research community does not now know how to set relative values of various types of utilization, e.g., end use of utilization versus utilization by other researchers; or utilization of a chemical process in food manufacture versus utilization of information in making policy decisions. Therefore, capability for formal measurement of utilization is not satisfactory at present. Research studies are currently in process (Contract NSF C76-11438) to investigate these measurement problems as part of our evaluation research. They are coordinated with HEW, ONR, and NAS personnel who face similar problems.

We currently employ two methods of evaluating utilization. The first is case studies. See, for example, the case studies of Attachment 1.* Further case studies are being contracted for, with the work coming into better focus on utilization barriers and providing guidance to RANN on procedures for maximizing research utilization. The second method is based on responses by users to a questionnaire (See Attachment 2)*. A report on the results of its use on a sample of 100 projects should be completed in April of 1976.

As a part of their responsibilities, each program manager works with the researcher during the course of the project to help ensure the relevance of the project to user needs and to encourage utilization. As the projects are completed, the program managers continue to monitor and interact with project teams to encourage utilization. For projects or groups of projects that warrant it, RANN

*Attachments 1 and 2 may be found in the files of the subcommittee.

sponsors conferences to bring the products to a wide range of users. This program manager-centered utilization monitoring results in not only a tracking of utilization of past and current projects but also in gradual improvements in the utilization activities of future programs and projects as experience is gained.

Within the last year or so, RANN has begun to institute central procedures to assist the program managers in their utilization work, and at the same time to acquire meaningful quantitative data on utilization experience. This work is under the direction of the Deputy Assistant Director for Planning and Evaluation of RANN. Three components of this effort were already noted (Attachments 1 and 2 and Contract NSF C76-11438). A fourth component is part of the "external product evaluation" which RANN is in process of instituting. This procedure involves peer and potential user evaluation of projects immediately after completion and it is heavily oriented toward utilization. For example, the reviewers are asked to identify the potential user communities and tell how the report or the research might be changed or added to, or promulgated, so as to better serve those communities. Utilization - regardless of what quantitative measures one uses to define it - is certain to mature at different rates and to peak at varying times after project completion for different types of projects. Since this effect is hard to track, at present we have no hard data to compare utilization of recently completed projects with those completed some years ago. Some years of experience in tracking utilization will be required before such comparisons can be made in the form of hard data.

RANN has recently successfully 'spun off' its energy programs to ERDA. What of RANN's current programs are perceived as growing and perhaps being 'spun off' in their turn? Which areas are decreasing in emphasis at this time.

During FY 1976, RANN is transferring its program in fire research which was located in the Environment Division to the Department of Commerce. In order to facilitate this transfer and help assure a continued high quality fire research program, the program manager in charge of that program has been transferred to Commerce as well. The Environmental Effects of Energy program of the Environment Division is being transferred to ERDA during FY 1976.

No other transfers are planned for the near term.

Does RANN attempt to determine the effects of research it has sponsored for a few years after funding has stopped, for example, by requiring a report of some kind? It would be of interest to this Committee in attempting to evaluate the overall impact which the RANN program has had.

RANN does not have a regular procedure requiring reports from principal investigators to be submitted some years after the completion of the project. Currently, our procedures for tracking utilization originate with RANN as described above. The question is provocative, though, and some thought will be given to instituting such a procedure.

SOCIAL SCIENCE

The National Academy of Sciences has just issued a comprehensive report on the NSF's social and behavioral science programs. Serious deficiencies were identified in the applied research area, and concerns were also raised over the adequacy of the support for basic social science. What steps does the NSF plan to take based on the Academy's recommendations?

References

1. FY 1972-77 NSF/RANN Budgets to the Congress

2. GAO Report, MWD-74-84, 1975.

3. COPEP Report entitled, "Priorities in Applied Research: An Initial Appraisal," 1970.

4. COPEP Report entitled, "Federal Support of Applied Research," 1970.

5. COPEP Report entitled, "Priorities for Research Applicable to National Needs," 1973.

Q. The National Academy of Sciences has just issued a comprehensive report on the NSF's Social and Behavioral Sciences Programs. Serious deficiences were identified in the applied research area, and concerns were also raised over the adequacy of the support for basic social science. What steps does the NSF plan to take based on the Academy's recommendations?

A. Naturally the Foundation was pleased that the Academy Committee commented on the high quality of the basic research projects we have been supporting; and we were of course aware of the number of excellent projects we have not been able to assist. We are intensifying our efforts to communicate the importance to the nation of strengthening research in the social and behavioral sciences, and the current budget request would improve the funding situation over the level of recent years.

We shall explore vigorously opportunities for projects of significantly larger scale than those customarily supported in the social and behavioral science programs in previous years. Several such projects are already being studied to ascertain their scientific merit and cost effectiveness. We appreciate the encouragement the Academy Committee has given us in this regard. We have been in the process of expanding panels for our programs, and will continue to do so.

NSF response related to the RANN programs is attached.

March 8, 1976

Dr. Philip Handler
President
National Academy of Sciences
2101 Constitution Avenue, NW.
Washington, D.C. 20418

Dear Phil:

As you know, the Academy recently issued its Interim Report on the "Social and Behavioral Science Programs in the National Science Foundation." We have conducted an analysis of the Report's views related to the RANN program and I am forwarding it to you for transmittal to the Committee on Social Sciences in the National Science Foundation. Our response to the Report's views related to the basic research programs of the Foundation will be forwarded in the near future.

We are looking forward to working further with the Committee during the development of its final report over the next several months.

Sincerely yours,

H. Guyford Stever
Director

Enclosure

COPY

Comments on Interim Report

on

"Social and Behavioral Science Programs
in the National Science Foundation"

by

Committee on the Social Sciences in the National Science Foundation
Assembly of Behavioral and Social Sciences
National Academy of Sciences
February 16, 1976

The Interim Report on "Social and Behavioral Science Programs in the National Science Foundation" has been reviewed in some detail and it has been concluded that no useful purpose would be served by commenting at this time on any of the findings and recommendations in this report that relate to the RANN program. The reason for this conclusion is that there was apparently insufficient time available for the committee to perceive and probe into the current status and the historical and statutory background of the purpose of RANN and the criteria for RANN problem choices. These are, of course, determining factors in the origin and evolution of RANN, and they are essential considerations in any judgment of RANN. They may be summarized as follows:[1]

> "The Foundation's program of Research Applied to National Needs (RANN) focuses U.S. scientific and technical resources on selected problems of national importance for the purpose of contributing to their timely, practical solution."

"The basic criteria used to decide whether a specific societal problem should be addressed by RANN include consideration of the importance of the problem to the Nation; the payoff to be realized in relation to the anticipated costs of dealing with the problem; the leverage of science and technology on the problem; the readiness of scientific and technical manpower to deal with the problem; the capability of institutions to mount an effective research effort; the need for Federal action on the problem; and, the role of NSF in support of this specific problem-focused research. The decision on this last criterion may be affirmative for:"

- "Problems falling between or outside areas of responsibility of other agencies;"

70-027 O - 76 - 11

- o "Problems spanning the areas of responsibility of other agencies;" and
- o "Problems related to meeting longer range or special requirements of other agencies."

These statements of purpose and criteria for RANN are never referred to in the Interim Report although they have been determining factors in the overall development of RANN from its inception; this includes its organization, staffing, and management from planning through program implementation and evaluation.

It is especially noteworthy in this connection that the General Accounting Office (GAO) of the United States recently completed an in-depth study of RANN entitled, "Opportunities for Improved Management of the Research Applied to National Needs (RANN) program."2 This study included not only an extensive "in-situ" examination of all aspects of RANN management for a period of over a year, but also interviews with, and surveys of hundreds of researchers and other representatives from universities, industry, national laboratories, other Federal agencies and State and local governments. This study was carried out at the request of the Chairman, Special Subcommittee on the National Science Foundation, Senate Committee on Labor and Public Welfare. The summary of the GAO report on this study is as follows (See Title Page):

> "The RANN program staff are highly qualified, have made a continuous effort to develop research efforts responsive to national needs, and have placed increased emphasis on use of research results."
>
> "Primary areas for improvement are in research program development (views of major public and private interest groups and Federal agencies 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)."

RANN management has already taken steps in the specific areas recommended by the GAO to further strengthen research program development, proposal evaluation, and planning for use of research.

Concerning the adequacy of the RANN response to the GAO, Senator Kennedy, Chairman of the Special Subcommittee on the National Science Foundation, Senate Committee on Labor and Public Welfare,

stated at the FY 1977 Authorization Hearings on March 1, 1976: "The GAO has completed a study for this subcommittee pointing to the need to strengthen the management of applied research programs. I am pleased to note that the NSF is implementing most of the recommendations made by the GAO."

In carrying out its investigation, the GAO examined the major background studies influencing the origin and evolution of RANN,* including two major studies by the National Academy of Engineering Committee on Public Engineering Policy (COPEP) which resulted in two 1970 reports: first, "Priorities in Applied Research: An Initial Appraisal,"[3] and, second, "Federal Support of Applied Research."[4] The GAO report noted that COPEP[3] recommended that "in general, applied research be problem-oriented and interdisciplinary". The GAO report noted further that RANN's criteria for evaluating potential program areas closely resemble those recommended by COPEP.[4]

In addition, the GAO report noted that the task force on the second COPEP report:[4]

> "recommended a combined 'top down' and 'bottom up' approach to program management. It advised the Foundation to be selective in choosing projects to support, and, if necessary, actively seek and stimulate proposals to meet its objectives (the 'top down' approach). The task force felt that the Foundation could currently maintain an open door policy to encourage researchers to submit proposals in the selected program areas (the 'bottom up' approach)."

The GAO notes further that the subsequent major COPEP study[5] in 1973:

> "emphasized that RANN should integrate applied social science, natural science, and engineering research to examine such major national problems as (1) functioning of society's policymaking institutions, and (2) management of energy, environmental, and material resources."

These COPEP reports have provided essential guidance in the formulation of the RANN program by the Foundation and the National Science Board. Each year, the RANN program is reviewed by and receives specific guidance and approval as to program directions from the Administration and the Congress. Concerning Congressional

*RANN first appeared as a Major Program Activity in the NSF FY 1972 Budget, and the Research Applications Directorate was established on March 15, 1971, to manage the RANN program.

guidance and approval, most recently the House-Senate Conference Report on H.R. 4723, Authorization for the National Science Foundation (FY 1976), directs in Section 2(a)(9) (re RANN) as follows:

> ". . .of the total amount authorized under Section 1, category (4), not less than $23,000,000 shall be available for 'Applied Social Research' and for 'Policy-Sciences Research' directed toward increasing the cost-effectiveness of policies and programs at the Federal, State, and local government levels."

This directive in the RANN applied social science area further "focuses U.S. scientific and technical resources on selected problems of national importance for the purpose of contributing to timely, practical solutions." But this purpose is in contradistinction to the purpose assumed in the Interim Report (page 19) to wit, "The real goal of applied research, whether in the natural or in the social sciences, is to devise and improve prospective technologies, institutions, and methods which, after they have been carefully and broadly evaluated, can be considered for application in situations where they would be appropriate and useful."

In essence, then, according to the Interim Report, the purpose of RANN should be to produce knowledge applicable to the solution of problems, whereas the approved purpose of RANN is to apply knowledge to the solution of problems. These purposes are basically different, as are the criteria for choosing and judging research to achieve these purposes. Clearly, then, the findings and recommendations of the Interim Report on RANN are derived from an incorrect basic premise and they are therefore inevitably uninformative and often misleading.

RANN management would be pleased to discuss this basic issue with the NAS Committee, and further to discuss the merits of their findings and recommendations as they relate to a possible new and additional programmatic thrust for RANN.

MANAGEMENT

The NSF budget does not make any changes in the allocation of personnel to reflect the increase in basic research and the decline in applied research. Are you re-working these figures and can you provide them to the Subcommittee before we mark-up the authorization?

NSF Daily Notification of grant awards has been most helpful to the Congress. What is your view of the merits of issuing announcements of all completed research, so that we can keep track of the progress of NSF grants and utilize the information they contain?

NSF has not been consistent in the use of 'disclaimers' on research reports. Is this policy now under review? Would it not serve the interests of the Foundation and those it supports if all reports carried such disclaimers, rather than only those which may be the subject of public controversy.

MANAGEMENT

Q. The NSF budget does not make any changes in the allocation of personnel to reflect the increase in basic research and the decline in applied research. Are you re-working these figures and can you provide them to the Subcommittee before we mark-up the authorization?

A. The fiscal year 1977 budget provides no additional personnel for the National Science Foundation. This decision followed a careful review by the National Science Foundation and the Office of Management and Budget including an examination of increases of the personnel ceiling in prior years, a review of the allocation of personnel in the various Directorates, and the objectives of the Administration with regard to constraining growth of employment in the Federal sector. At the time the NSF reorganization was implemented in July 1975, the general objectives as they related to the allocations of personnel in the various Directorates were reviewed by the Foundation and by OMB. The implementation of the reorganization and the restructing of the Foundation Directorate-by-Directorate have gone on through the autumn and winter, 1975-76, but this generally has been carried out too late to include the planning in the material sent forward with the budget justification to the Congress.

Some reallocations of strength in the various Directorates have already taken place, e.g., the Directorate for Scientific, Technological, and International Affairs has been reduced by five positions since the July reorganization and an additional reduction is in process. On the other hand, the Directorate for Biological, Behavioral,

and Social Sciences has been increased by five positions since July 1975. It is anticipated that there will be further allocations made in the Research area, particularly in the biological and social sciences where the primary need exists. Further, in considering the allocation of personnel, there are a variety of factors that must be taken into account including the degree of staff management needed in the various research activities. In applied research and the overall management of research facilities, there is a need for a somewhat larger program staff than there is in other research management where all of the work is performed by way of smaller research grants to colleges and universities. The overall plans for fiscal year 1977 will be available prior to the commencement of that fiscal year and they will, of course, be in the total constraints of the appropriation requests. However, it is not possible to have this analysis completed prior to the Subcommittee mark-up.

Q. NSF Daily Notification of grant awards has been most helpful to the Congress. What is your view of the merits of issuing announcements of all completed research, so that we can keep track of the progress of NSF grants and utilize the information they contain?

A. It is possible to issue a list of research projects that have been completed and "closed out" by the Foundation. Such a list would bear a great similarity to the NSF Daily Notification of NSF grant awards. While this list would have some utility, it would tend to be a listing of projects rather than a description of research results. Another approach would be to expand the entry of research results into the various bibliographic and technical information systems, e.g., NTIS. Another possibility being studied is the publication of an annual volume containing abstracts of research results of completed projects. In summary, the Foundation agrees in principle with the objective that additional information concerning research results would be beneficial to the Congress. The Foundation is looking into the methods that would be most appropriate for accomplishing this objective efficiently and effectively.

"NSF has not been consistent in the use of disclaimers on research reports. Is this policy now under review? Would it not serve the interests of the Foundation and those it supports if all reports carried such disclaimers rather than only those which may be the subject of public controversy?

Answer:

The NSF policy with respect to the use of disclaimers in various reports has been discussed by the National Science Board. A statement which seems to reflect the consensus of Board Members has been prepared. However, it is not a published issuance and it may be subject to some editing.

In short, the policy requires disclaimers to be placed on all free-standing publications, such as curricular materials, books, monographs, proceedings of symposia, and the like, which arise from activities supported by the Foundation. However, with respect to articles reporting the findings from basic research that normally are published in technical journals, the long-standing tradition in the scientific community is that disclaimers are not required. It is felt that the articles obviously describe the work of the author and readers would not attribute the views expressed as being those of the sponsoring agency. Publishing express disclaimer is felt to be unnecessary and somewhat demeaning. In addition, as a practical matter, enforcement would be impossible due to the enormous volume.

We estimate that there are approximately 8,500 technical professional journals published regularly. We also estimate that from NSF-supported basic research projects, some 8,000 to 10,000 articles are published each year. Consequently, the Foundation is adopting the policy of including in its published announcements of programs, proposal solicitatins, and other publications, disclaimers in general terms applicable to all products of NSF research grants, but making no attempt to assure that every journal article contains a disclaimer. It should be noted that this policy is in no way related to the presence or absence of public controversy.

MINORITIES AND WOMEN

Our Committee Report last year directed NSF to work with groups representing minorities and women to recruit qualified individuals to serve in policy level positions at NSF. Have you met with these groups and have you discussed opportunities which exist for NSF to use its leverage to encourage academic institutions to provide greater employment opportunities for minorities and women?

Question: Has NSF met with groups representing minorities and women to recruit qualified individuals to serve in policy level positions at NSF?

Extensive efforts have been made to identify minority and women recruitment resources that can be effectively utilized in obtaining candidates to serve in policy level positions.

Some of the specific groups NSF staff has met with include;

1. American Foundation for Negro Affairs
2. National Association of Black Chemists and Chemical Engineers
3. American Women in Science
4. Minority Affairs Division of the American Association for the Advancement of Science
5. Federally Employed Women, Inc.
6. National Business and Professional Women's Association
7. Heads of Predominantly Minority Colleges and Universities

To further expand NSF's recruitment efforts, many position openings are now being advertised in scientific journals.

Question: Has NSF discussed opportunities which exist for NSF to use its leverage to encourage academic institutions to provide greater employment opportunities for minorities and women?

The leverages used by NSF in encouraging academic institutions to provide greater employment opportunities for women and minorities fall in two major categories: (1) by example; and (2) through the programs NSF funds.

In addition to all grants and contracts funded by NSF containing appropriate non-discrimination clauses, the Foundation recognizes that for multiple and complex reasons, only a small number of minorities and women pursue careers in science. The Science Education Directorate of the Foundation administers projects aimed at identifying barriers to participation by women and minorities in science careers and experimenting with mechanisms to overcome these barriers with the overall objective of increasing the numbers of women and minorities in science.

On May 9, 1975, NSF Director H. Guyford Stever, sent letters to all college and university presidents and affirmative action staffs emphasizing NSF's affirmative action programs (with particular emphasis on International Women's Year goals and objectives).

In this letter, Dr. Stever stated:

> "There are few areas of national life for which the concept of 'affirmative action' is more relevant than science and technology. Ours is a field in which lifelong motivation and specific educational preparation are preconditions to professional fulfillment. We have, therefore, a particular opportunity and responsibility to advance affirmative action programs in spirit as well as in letter."

This correspondence stimulated dialogue between the Foundation and academic communities on many problems and a range of possible solutions to them.

The National Science Board established a Committee on Minorities and Women in Science, which has been pursuing the most effective role NSF can play in improving minority and women's participation in the sciences. Specific recommendations on some possible programs which might be initiated have come forth.

Foundation staff has, on occasion, discussed with grantees such matters as the exclusion of women and minorities as speakers or panelists at meetings sponsored by them. The results have been positive.

NSF has made every effort to fully utilize the talents of women and minorities in academic institutions to serve as program reviewers; consultants; active participants, speakers and/or panelists at Foundation sponsored meetings and conferences.

PUBLIC PARTICIPATION

The Administration's NSF authorization bill asks the Congress to make deletions in the U.S. Code - most in areas affecting public participation. What is the basis for this recommendation?

The NSF report to the Congress on plans for the Science for Citizens Program includes a number of excellent proposals which are not included in the NSF budget? Why is the budget submission so much more limited than the recommendations included in the Plan?

Q. The Administration's NSF authorization bill asks the Congress to make deletions in the U.S. Code -- most in areas affecting public participation. What is the basis for this recommendation?

A. Several sections of recent NSF authorization acts have been codified or have been made notes to U.S. Code sections which the Foundation believes are not appropriate for inclusion in a permanent body of laws. With one exception -- the repeal of section 2(b) of P. L. 94-86, discussed in more detail below -- the NSF request is to remove such sections from the U.S. Code but is not made with the intent of repealing the sections of the public law themselves.

Only two of the requested deletions are in areas affecting public participation. These are the notes to section 1864 of Title 42 U.S. Code that set out the provisions of sections 3 and 4 of P. L. 94-86, directing the Foundation to prepare comprehensive plans to establish the "Science for Citizens" program and to facilitate participation of the public in the formulation, development and conduct of NSF programs, policies and priorities. NSF has not requested repeal of sections 3 and 4 of P. L. 94-86 and in fact preparation of these plans is under way. However, since these plans are expected to be completed in FY 1976, they are clearly temporary and have no apparent historical value. We do not believe they should be included in the permanent body of laws as notes or otherwise, and for this reason the Foundation has proposed that the notes be struck from the Code.

The other deletions proposed by NSF do not affect public participation. NSF has proposed that the note to section 5280 of Title 42 U.S. Code be deleted. That note sets out section 5 of P. L. 94-86, which directs the Foundation to coordinate all new RANN energy research with the Energy Research and Development Administration. Since the RANN energy program for FY 1977 will be limited to a small number of modest basic studies which are routinely coordinated, no need is seen for this section to appear as a note in the U.S. Code. It should be noted that the Foundation is not requesting repeal of section 5 itself, and this directive can be reenacted so long as the Congress wishes. Since such need as there may be is transitory, the Foundation has requested that the terms of section 5 be removed from the Code.

Section 1882 of Title 42 U.S. Code is a codification of section 6 of P.L. 91-120, the NSF FY 1970 Authorization Act. That section, and substantially identical sections that have appeared in prior NSF authorization acts, direct NSF to keep its Congressional oversight committees "fully and currently informed with respect to all of the activities of the National Science Foundation." The Foundation is glad to furnish the committees with whatever information they require. Indeed, we consider that we have a continuing responsibility to

keep the committees fully informed in timely fashion of our major activities. This can best be done as it has been done by agreement from time to time. Making such an exceedingly broad requirement permanent law is both unnecessary and could lead to misunderstanding on the part of those who are not familiar with the agreements.

The NSF request to make deletions to the U.S. Code is made only to correct what we believe to be unnecessary or undesirable codification and is not made with the intent of repealing the sections of the public law during the year that they are effective. The one exception to this is the proposal to repeal both section 2(b) of P.L. 94-86 and its codification as 42 USC 1869a. Subsection 2(b) requires the Foundation to impose certain obligations on grantees of all pre-college science curriculum development awards and directs NSF to take such action as may be necessary and feasible to modify existing awards to impose similar obligations. The Foundation has found that the subsection has given rise to serious problems involving interpretation, enforcement, and interference with the authorities of state and local governments.

The principal problem of interpretation arises from the words, "made available." This refers to course materials generated under NSF grants or contracts. It is stated that the materials must be made available within the school districts using them. No guidance is given as to when they must be made available, that is, before adoption by the school system concerned, or afterwards, nor for how long or under what conditions. The Foundation is directed to establish as a condition to any award for the creation of such materials that they be made available, but it is not clear who shall bear the ultimate responsibility for doing so. Even though it is stated in general terms where these materials are to be made available, it is not clear whether the school authorities must do so or whether the grantee which prepared them or the publisher which publishes them, must provide space with projectors and sound equipment and suitable personnel.

Enforcement of this provision could prove impossible. The Foundation is required to establish as a condition of its grants for development of the materials that they will be made available. However, by the time any course materials are ready for use the bulk of the grant funds have been expended and cannot be recovered. Although a contractual obligation can readily be established, it is hard to see what sanctions could be provided in view of the difficulties of interpretation as to what constitutes availability mentioned above. In addition, the grantee during the test-phase of the materials and the publisher after they have been introduced into commerce might be faced with an impossible task if the school authorities declined to cooperate.

Another major problem arises from the effect of section 2(b) in exerting some form of Federal control over state and local governments. Responsibilities for selection and implementation of course materials is a purely local matter. Independent display of these materials may well interfere with that process and it might be resented by the local school authorities.

Finally, it should be noted that this provision applies only to materials generated by NSF, a discriminatory practice which could place such materials in a disadvantageous position that might impair their effectiveness.

In short, we believe that the decision as to what course materials a school district should adopt and how to use them is and should remain the exclusive prerogative of the appropriate school authorities. Intervention by the Federal Government as provided by section 2(b) might be a source of friction and disruption of the state and local decision-making process.

70-027 O - 76 - 12

The NSF report to the Congress on plans for the Science for Citizens Program includes a number of excellent proposals which are not included in the NSF budget. Why is the budget submission so much more limited than the recommendations included in the Plan?

During the month of December the Foundation held seven public meetings in different regions and received thousands of pages of suggestions. While most of the suggestions did favor a Science for Citizens Program, there were some who argued that there should be no such program. It is fair to say that we do not really know how such a Science for Citizens Program would work out. We are proposing during FY 1977 to design and conduct a number of experiments based on what appears to be the most promising suggestions from the public meetings and to evaluate these after a reasonable period of operation. Until more experience has been gained both by the staff and by the proposing clientele for this program, the prototype experimental approach seems appropriate. The government should not invest large sums for untried programs.

FREEDOM OF INFORMATION ACT

Most agencies of the Federal government waive fees under the Freedom of Information Act as they relate to inquiries from the press, as well as for cases in which a waiver is considered to be in the public interest. What is the policy of NSF with regard to waivers for press inquiries?

Q. Most agencies of the Federal Government waive fees under the Freedom of Information Act as they relate to inquiries from the press, as well as for cases in which a waiver is considered to be in the public interest. What is the policy of NSF with regard to waivers for press inquiries?

A. It is our understanding that some other scientific agencies like NSF do not automatically waive fees to members of the press. Like these agencies NSF has a policy of making no charge if the cost of search and/or duplication is less than a certain minimum amount. We make charges for search and copying as authorized by Congress to balance the public interest in having press coverage of the activities of the Foundation, with the public interest in maintaining normal administration of day-to-day NSF activities. We believe that a necessary balance must be struck between these aims, and that the imposing of reasonable service charges for requests reimburses the Government for services rendered by public personnel for the benefit of private interests, including the press. However, we do not exclude the possibility of waivers for press inquiries where circumstances warrant.

SCIENTIFIC, TECHNOLOGICAL AND INTERNATIONAL AFFAIRS

The proposed budget for fiscal year 1977 reduces programs for Science Assessment, Policy, and Planning activities by $1.9 millio With the establishment of a White House Science Advisor and the supporting activities required for that activity, N.S.F. will be required to increase its activities in this area. What was the basis for the recommendation that Science Assessment, Policy and Planning activities be reduced, and how will this impact N.S.F.'s ability to provide necessary support to the Science Advisor?

What plans does N.S.F. have to develop a strengthened capability for policy studies in the area of technological innovation? What specific actions are being taken to provide policy leadership on matters affecting national policies with regard to technological innovation, as opposed to efforts related to research and development policies?

Scientific, Technological and International Affairs

The proposed budget for fiscal year 1977 reduces programs for Science Assessment, Policy, and Planning activities by $1.9 million. With the establishment of a White House Science Adviser and the supporting activities required for the activity, NSF will be required to increase its activities in this area. What was the basis for the recommendation that Science Assessment, Policy and Planning activities be reduced, and how will this impact NSF's ability to provide necessary support to the Science Adviser?

Last month (February) the NSF created a new Division of Policy Research and Analysis, combining three related policy research, analysis, and advisory offices -- the Office of Science and Technology Policy, Office of Energy R&D Policy, and the Office of National R&D Assessment.

Funding being requested for the new Division for FY 1977 is $4.5 million -- down from $6.5 million budgeted for the three offices in FY 1976.

These reductions reflect the creation of ERDA and FEA, which reduce the need for NSF's sponsorship of special studies pertaining to energy R&D policies, and the anticipation of legislation which would transfer the President's Science Advisory responsibilities from the Director of NSF to the Executive Office of the President.

Pending the establishment of a new Science Advisory apparatus, the new Division, as well as other parts of NSF, will continue to support the Director of NSF in his continuing role as Science Adviser. With the establishment of a new Science Adviser the NSF will continue to deal with

the longer-term issues and anticipates close working relationships with the new Science Adviser's office. It is not expected that the transfer of responsibilities for Presidential science advice from the Director of NSF to a new adviser who will have his own support staff will require an increase in NSF activities. The amounts requested in the FY 1977 budget request are considered to be sufficient to provide adequate support for science policy related activities within the Foundation assuming current plans to transfer certain activities such as the FCST are implemented. Resources available for these activities will be reviewed with the Office of Management and Budget and the proposed Office for Science and Technology Policy upon its establishment and adjustments may be made or requested, as necessary.

What plans does NSF have to develop a strengthened capability for policy studies in the area of technological innovation? What specific actions are being taken to provide policy leadership on matters affecting national policies with regard to technological innovation, as opposed to efforts related to research and development policies?

The new Division of Policy Research and Analysis will address issues in the broad area of technological innovation as well as issues directed more specifically at research and development. For these purposes, a working definition of "technological innovation" has been developed as follows:

> Technological innovation includes the processes from conception or generation of an idea to its widescale utilization by society including activities involved in the creation, research, development, and diffusion of new and improved products, processes, and services for private and public use.

A significant part of the effort of the Offices which have been combined into the new PRA has and will continue, to deal with technological innovation which includes R&D, but is much broader as the above definition indicates. Building on work initiated previously in the NSF and elsewhere in the Federal Government, the new Division of Policy Research and Analysis will also address issues pertaining to the social and economic effects of science and technology.

National Science Foundation Subcommittee, hearing on NSF Authorization, March 1,1976.

Questions Submitted by Senator Pell:

1. The Foundation, again this year, has included in its budget proposal no funds for oceanographic vessel construction. Is this because there is no need to improve and update the academic oceanographic fleet, in the view of the foundation, or does it reflect budget restraints in this year?
2. Did the foundation seek vessel construction funds in its submission to OMB?
3. I recall the Foundation indicated last year that it was preparing a long-range comprehensive plan for oceanographic vessel construction, with particular attention to the need for coastal research vessels. What is the status of that plan?
4. Would you provide for the record please a summary of the academic oceanographic fleet by size, age and efficiency of utilization?
5. Will the funds requested by the Foundation for ship support and operating expenses be sufficient to assure full utilization of the oceanographic research fleet? Does the NSF budget envision laying up any vessels, or reducing the vessel utilization? If so, how much additional money would be required to provide full utilization of the fleet?

Questions Submitted by Senator Pell:

Question 1. The Foundation, again this year, has included in its budget proposal no funds for oceanographic vessel construction. Is this because there is no need to improve and update the academic oceanographic fleet, in the view of the foundation, or does it reflect budget restraints in this year?

Answer: Budget increases for oceanography are being directed toward research program support and related ship operations support this year. This is essential to offset the erosion of program support over the past five years owing to inflation. Although improvement and updating of the academic oceanographic fleet is a continuing need, it is less pressing at this time than the need to sustain research and researchers. Without the latter, the requirement for the fleet can only decline. It is important to note that only seven ships more than 20 years old remain in the fleet.

Question 2. Did the foundation seek vessel construction funds in its submission to OMB?

Answer: Vessel construction funds were not included in the base budget to OMB but were included among high priority add-ons, support for which was sought at the same time.

Questions Submitted by Senator Pell:

Question 3. I recall the Foundation indicated last year that it was preparing a long-range comprehensive plan for oceanographic vessel construction, with particular attention to the need for coastal research vessels. What is the status of that plan?

Answer: Under sponsorship of the National Science Foundation, the Office of Naval Research, and other federal agencies, the University National Oceanographic Laboratory System (UNOLS) conducted a study to determine what the university operated research ship requirements will be from now till approximately 1990. Senior representatives from essentially all universities presently operating research vessels contributed to the study. A final report is now being prepared.

In brief summary, the study had two major findings: Make up of the future fleet in terms of number and size of ships will not differ greatly from the present fleet. Scientific capabilities, however, will need to be signficantly upgraded and may include ships dedicated to a particular scientific discipline. Critical needs include new vessels suitable for coastal research and a specially constructed research vessel for operating in ice. As an initial step toward meeting these needs, the National Science Foundation has made four awards for conceptual design studies of coastal research ships and one award for the conceptual design of a Polar research vessel. Using the designs deriving from these studies, we will be able to proceed rapidly, when construction funds become available, to build ships suitable to the needs of the oceanographic community.

Questions Submitted by Senator Pell:

Question 4. Would you provide for the record please a summary of the academic oceanographic fleet by size, age and efficiency of utilization?

Answer: Below are two tables giving the fleet profile in terms of ship size, age and utilization. In general the average days at sea for each size group indicate full utilization; however there is a considerable range in days at sea from ship to ship. In 1976, ships operating in remote areas will log an unusually high number of days at sea, while others operating closer to home will be less intensively utilized.

PROFILE OF ACADEMIC FLEET
BY AGE & SIZE

	UNDER 10 YRS.	10-20 YRS.	20-30 YRS.	OVER 30 YRS.	TOT.
Over 200 ft.	2	5	0	0	7
150 - 200 ft.	7	0	0	2	9
100 - 150 ft.	2	1	1	0	4
Under 100 ft.	3	2	2	2	9
All Ships	14	8	3	4	29

1976 UTILIZATION

	No. Ships*	Avg. Days at Sea
Over 200 ft.	7	264
150-200 ft.	6	245
100-150 ft.	4	247
Under 100 ft.	8	172

In spite of the fact that several major ships will not be fully utilized this year, the average days at sea for the academic fleet are still the highest for any portion of the overall Federal fleet.

* Ships under construction or undergoing shakedown during past of the year are not included.

Questions Submitted by Senator Pell:

Question 5. Will the funds requested by the Foundation for ship support and operating expenses be sufficient to assure full utilization of the oceanographic research fleet: Does the NSF budget envision laying up any vessels, or reducing the vessel utilization? If so, how much additional money would be required to provide full utilization of the fleet?

Answer: The funds requested by the Foundation for academic fleet support and operating expenses are sufficient to support the ship time required for oceanographic research projects which will be sponsored by the Foundation in FY-77. Ship time required for NSF research usually constitutes 60% to 70% of the total academic fleet time available. The remainder of the support comes from a variety of sources -- the Office of Naval Research (ONR), Bureau of Land Management (BLM), ERDA, EPA and others. The degree of ship utilization (or under-utilization) in 1977 will depend on the amount of non-NSF ship support that materializes. Whereas increasing ship requirements from BLM, ERDA and EPA are assuring full utilization of the small and intermediate size ships (up to 200 ft.), declining support from ONR is adversely affecting the utilization rates of the large open ocean ships.

Senator KENNEDY. Our next witness, Dr. Margaret Mead, is undoubtedly the most widely known social scientist in the Nation. She has served as President of the American Academy for the Advancement of Science and moved the AAAS toward a greater role in science policy, in the advancement of science internationally, in assisting disadvantaged scientists and furthering public understanding of science. We look forward to her testimony this morning and to her future work in anthropology, which has already spanned half a century and which has taken her around the globe.

We value very much your presence at this hearing this morning, Dr. Mead. We look forward to your testimony.

I want to mention, Dr. Mead, I have to recess the hearing at 5 of 12 for 10 or 15 minutes, and then we will come back and conclude.

STATEMENT OF DR. MARGARET MEAD, CURATOR EMERITUS OF THE AMERICAN MUSEUM OF NATURAL HISTORY AND CHAIRMAN OF THE BOARD OF THE AMERICAN ASSOCIATION OF THE ADVANCEMENT OF SCIENCE

Dr. MEAD. Mr. Chairman, I address myself to the series of questions that you sent me. I want to emphasize first how pleased we are that the biological, behavioral and social sciences have been raised in status in the Foundation's table of organization, and at any increase in the money spent on basic research in this country. This has been seriously lacking.

I want to address myself to the distinctions that appear still in the arrangement of the Foundation between the behavioral and social sciences. I think these distinctions are very dangerous. If we want to address the sorts of problems that have come to our attention to make sure we understand the interrelationships between the social environment and human capacities, in connection with nutrition, poverty, isolation and levels of technological development, it is useful that we do not separate the biological capabilities of human beings somehow from their social relationships or we will end up with such things as "economic man" or "political man."

These are fictions—creatures with no brains.

If we are looking for the kind of research that will give us genuine breakthroughs in the human sciences, so that we can identify areas of concern and flexibility in human beings and alternative directions of social change, it is extremely important that we pay a great deal more attention to the interrelationships between man's physiological and biological capacities, social learning in different cultures, and then his performance in different sectors of our complicated life. Animal behavior studies provide us a particularly useful meeting place between these different ways of looking at human beings.

I also want to emphasize the importance of developing trends in the study of national, cultural and regional capacities.

During the forties in this country, we developed a very considerable capability in the different foreign institutes devoted to different parts of the world—Russia, South Asia, China—and they made an important contribution to training people in understanding the language and culture of other places; then in the early fifties a good many other

patterns of cooperative research, counterpart team work, were developed bringing young scientists and older scientists from developing countries to the United States.

At present most of these programs are faltering very badly. Many of them are being wiped out. There is almost no support for them. We have people who were trained as young people, especially in Asian studies, who are not using their abilities at all. Here if we are at the very point when we are emphasizing the interdependence of the world; we are not following up the kind of training that we should be giving people, and it is very important that in some ways these interdisciplinary regional and country studies should be given far more backing than they are given today.

You have examples where there is a surviving professor, but no provision for the students who should be learning from him today.

Then I want to emphasize not only the very important task that we have of preserving records of preliterate peoples, but also that all over the world people's behavior is changing; it is not only the inhabitants of the central part of New Guinea or the Philippines that we should be preserving in the greatest possible auditory and visual detail, but that all over the world people are living differently than they ever lived before; they are losing their old skills, and unless they have full, competent types of records, we are not going to be able to understand our past well enough to understand and predict our future. So that the things we said 25 years ago about the importance of preserving the historical experiments provided by preliterate people, we have now to say about the peasant peoples of the world everywhere and also very often of urban groups that are living so differently that if we don't preserve a record now, we will be permanently impoverished because kinds of behavior that are being historically produced in natural situations cannot be simulated in the laboratory yet, and, therefore, we need these actual situations.

At present, any attempt to simulate complex behavior, breaks it up into little pieces and we do not get the total result as we should.

I think it is especially important that we should be emphasizing regions of the world and competency in these regions. That takes, of course, interdisciplinary teams in all cases and a very thorough exposure of the young student and the older student to what is going on.

Then, transdisciplinary activities are also in many cases on the wane. We have made attempt after attempt to establish transdisciplinary careers, and they continue to fail, and we are continuing to penalize people who work across disciplines in favor of people who stay narrowly within their own discipline. Transdisciplinary programs should include research projects which provides for apprenticeship training, fellowship programs for people who want to shift careers are essential if we are going to do the sort of thing that you are asking NSF to do. It is true that we need funding for narrowly disciplinary basic research, but any sort of application to the problems that you have outlined, Mr. Chairman, requires multidisciplinary work, and we are not educating people for it, we are not giving adequate recognition to it, and especially we are not dealing with

career shifts in midterm, which are one of the most important ways of getting interdisciplinary work done by putting at least two disciplines in one head.

You asked us about the development of science careers for women and minorities. I think one of the very serious things that is happening at present is that we are looking on women, minorities, and people who come from disadvantaged parts of our populations, such as very rural groups, as if the only thing we had to do was to turn them into replicas of those who have been privileged to live in a majority environment, or have been male. We are trying to bring all of these people up to those already existing levels instead of considering they may have strengths that are lacking in the other group. We have had ample evidence that women do very well in areas where they have had historical experience such as relating to people and in fields like nutrition and child rearing. If we merely attempt to bring women up "to the position of men," middleclass men in the same profession, we may be neglecting many of the skills that we could use. This is equally true of minority groups of people who have come from occupations where in the past no one has had a high education and, of course, people from developing countries; they should not all be made into simply replicas of our present set of scientific personnel. Of course, it is also important to be sure that they enter all the traditional fields because we do not know what new contributions they may make to those fields.

In the relationship between basic research and educational programs, there are some points that I want to emphasize particularly. If we are going to address the sorts of problems that you have asked to be addressed, these are going to be controversial; inevitably they are going to be the sort of thing about which lay people think they know a great deal. I have heard psychology defined as "something that my mother always knew, put in technical language," and the public are going to take an interest in it. If we study political institutions or family life or the physiology of the human body or the life of other countries, there are bound to be difficulties.

However, the answer is not to make a Manhattan project and swear everybody to secrecy while we discover what family life is like in this country at present, because the social sciences do not work that way. We can only use the findings of sociocultural research if they are well enough infused in the public so that the public can understand them and work with them.

So it is very important that the Congress, if they ask the scientific community to do something, be prepared to support them and protect them while they do it, because it is going to be hazardous without any doubt. In the late 1940's I lived through the problems of protecting groups of students who were working on Soviet studies,[1] because they were likely to be called security risks if they bought anything connected with the Soviet Union in a bookshop. This is always true when we deal with foreign country research. It is inevitably sensitive. We have had 40 or, I should say, 50 years' experience of some piece of research that strikes the public eye, upsetting the applecart of research funding.

[1] M. Mead, "Soviet Attitudes Toward Authority", New York: McGraw-Hill, 19551.

I would suggest that it is very important to try to separate the field of basic research in which there will not be as much public interest and involvement from science education because education is an area where the public feels so strongly. They feel it is their right to decide what their children are going to be taught. A great deal of research funding in this country has gone on under disguises of one sort or another. I think there is a danger when science education has a big program and basic research has a small one, to put basic research under an education program and then make it vulnerable in one form or another.

I think this should be rigorously avoided.

It is now 5 minutes. Would you like me to stop now?

Senator KENNEDY. Wonderful discipline.

We will recess very briefly and then I will come back for some questions that I would like to go over with you.

Dr. MEAD. I have not quite finished.

Senator KENNEDY. All right.

[Short recess taken.]

Senator KENNEDY. Come to order.

I apologize to you.

Will you proceed?

Dr. MEAD. I have just one more point that I would like to make myself, if I may, Mr. Chairman, and then I will answer questions, and that is in response to this science for citizens program in which you are so much interested.

I think that the dichotomy between scientists and citizens is wrong, that its scientists and its sciences, different kinds of ones, and those who are lay to that particular science, you know, and that its scientists or the sciences and laymen, because within the sciences one scientist is so lay to another science that he might just as well be a man in the street, and that we ought to realize that what we are setting up is a program for laymen, which includes preachers and orators and people—plumbers, people who know something about something else and do not know the particular science that is being discussed, and then the problem is to make it intelligible to them, because I think it is an insult to any human being to ask them to express an opinion on a subject that is being presented to them so they can possibly understand it.

It is important to have lay groups discuss what ought to be done, problems that ought to be addressed, and it is important for them to criticize the application of the results, but if you put them in a position of monitoring basic research, which they are fundamentally incapable of dealing with, because that is not their specialty, you are insulting them. So I hope the program will be set up so that it invites comment from responsible laymen of all walks of life and responsible post-research discussion, but not involve the layman in things that they are incompetent to deal with, because we then spread the idea that there is no such thing as technical and scientific knowledge, and get only laughter and sneers from the press.

I remember there was a psychology meeting once when they discussed the whole question of what they called "manual punishment" that is, boxing ears, you know, and slapping kids on the wrist

70-027 O - 76 - 13

and beating with a razor strap and all the rest of it, and the press made fun of it right across the country, you see, because everybody knew about a good, old-fashioned whipping. The psychologists were trying to make a point, a very specific point, to use a word that would be technical and all we got was trouble. If we get to the point where we are asking laymen to decide whether particular basic research ought to be done at all and whether this basic research is applicable to this mission, I think that would be very bad. We have to watch very carefully and set citizen participation in the programs of NSF up in a very sophisticated way.

That was my last—oh, I have one last point, yes.

Senator KENNEDY. Let me ask you, do you see the value, though, of that kind of participation on the Advisory Council for the NSF?

Dr. MEAD. Well, if you can find at the advisory level people of enormous sophistication that come from many different places, I mean kinds of background. What I am more worried about is when we get out to regional centers and begin asking varieties of people to pass on programs that have not been technologically reviewed, translated and made intelligible. I believe that the citizen in the end should also make the final decision about the use of science, but I do not think that the citizen layman is in a position to decide whether that piece of basic research is relevant or not. That is where we continually get into trouble.

I have just one more point and that is the question of these profit-making research institutions competing with universities and with nonprofit institutions. In this country we have on the whole been unwilling to trust education to profitmaking or to trust health service to profitmaking.

Senator KENNEDY. We have profit in the health area.

Dr. MEAD. I know we do, but on the whole we are not very happy about it. Witness the recent nursing homes scandal. In general we feel that these are things that should be nonprofit, and now we have these profitmaking research agencies mushrooming around impact statements, for instance, doing very often very bad work for very large sums of money. They compete successfully because they have a big staff and if they are called for making a submission in 30 days, they can get it in! They can carry research that is funded only for a year or 2 years, which is very hard for a university to do. I think this matter ought to be very seriously considered, whether we should not insist that basic research and research that is related to social policy be nonprofit.

This is a different problem, as I see it, from the one that you were discussing earlier of research done in industry by industry. I am talking about research as an industry in this case.

Senator KENNEDY. Yes, I see. I am glad to get that distinction because it is one that we did not really develop or hear.

Can you give us what reaction you have to the Academy of Sciences' report on the NSF's behavioral and social science programs?

Have you had a chance to look at that?

Dr. MEAD. I think that we are very fortunate not to have the medical, biological and behavioral and social sciences together, and I understand that some of the apparent separations that I object to because they sound too formal are being overcome by intragency or intradirectorate committees, but it is very important that they

should stay together and that we should not assume that there is something in social sciences that does not include the human body or the human brain but exists on cloud 9 somewhere, and I hope that raising the status in the new reorganization in NSF I think is a very good thing.

Senator KENNEDY. Have you got any comments on the quality of the research that is being done in those areas?

Dr. MEAD. There are being very, very important things being done, and I am mainly worried about the connections between application, which is primarily education, and the quality of the original research. When they get mixed up then I think we get into difficulties.

Senator KENNEDY. What about the application of social science research by the NSF?

Dr. MEAD. Of course I am most competent to speak about anthropology. I have been a consultant in anthropology, and the NSF has done a great deal of very important funding in anthropology. It is our principal support now, and I do not think they are able to support yet the use of film and tape as they should. Films and tapes make anthropology an accessible science, and until we use them, we have to take people's word for too many things, and people's word is nonresearchable by other people.

Senator KENNEDY. I think there is a general concern among all of us about the decline of scientific literary among the population generally. I am wondering what thoughts you have about this, how we can reverse this trend. Do we need curriculum changes in schools or are there other types of educational needs?

Are you alarmed by that movement or trend?

Should we be concerned about it?

Dr. MEAD. I think we should be very much concerned and that the original effort after Sputnik to upgrade science education has had some very bad gaps in it. There was no attention paid to the children who were going to learn whatsoever and there was almost no attention paid to the teachers, so we did not know anything about the learners and we did not know anything about the teachers; we just made up programs. An MIT professor thought out what he would like to have his students know when they came in, so these vast programs were organized in almost total disregard of other considerations—I finally persuaded them to spend $2,000 to look at biology teachers, and $2,000 was appropriated. No work was done at all except one study that Dr. Metraux and I did for the AAAS[1] on what the students thought and what they thought they were learning. We predicted 20 years ago the swing against science that we have got now.

The quality of science teaching remained very bad. We still think that men make better teachers of the physical sciences, and so you get the football coach to teach them, and this still happens in many parts of the country. A whole series of such distortions exist, and we are now reaping the consequences. We had a temporary tremendous upsurge in interest in science education everywhere and funding for it and funding for workshops. Now we are getting that generation who are getting to positions of prominence and who are very antiscientific who do not understand at all what happened.

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[1] M. Mead and H. Metraux, "Image of the Scientist Among High-School Students," *Science* 126, No. 3270 (1957), 384–390.

Senator KENNEDY. We have benefited here in Congress as you are very much aware, from the AAAS program which enables outstanding scientists to work with us. I find myself, from a personal point of view, that it has been very, very valuable in helping us better understand the area of science and technology.

I am wondering whether a similar kind of program in which the NSF would enable scientists and engineers to make their services available to citizen groups might contribute to public understanding of science and improve the quality of debate on issues which have scientific and technical components.

Dr. MEAD. I think this program needs a very careful examination, an examination in light of the experiments we have already made. You see, the Scientist's Institute for Public Information [1] has been experimenting for 20 years with getting groups of scientists to take complex things like atomic energy reports and digest them and simplify them so they could be presented to all sorts of citizen groups, and this is the kind of thing that needs to be done; we need some instrumentality of this sort.

Senator KENNEDY. I want to thank you very much for your appearance here for your helpful comments. It is always a pleasure to have your testimony, and I am glad to welcome you here to the committee.

[The prepared statement of Dr. Mead follows:]

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[1] SIPI, 49 E. 53 St., New York, N.Y. 10022.

Statement for Senator Edward M. Kennedy's Hearings on the authorization for the National Science Foundation, with particular reference to the Social and Behavior sciences, March 1, 1976.

From Dr. Margaret Mead, Chairman of the Board of the American Association for the Advancement of Science; past President of the American Association for the Advancement of Science, the Society for General Systems Research, the American Anthropological Association, the World Federation for Mental Health, the World Society for Ekistics; Fogarty Scholar, International Center of the National Institutes of Health; President of the Scientist's Institute for Public Information (SIPI), North American Committee for Non-Governmental Organizations Concerned with the Environment; Curator Emeritus of Ethnology, The American Museum of Natural History; Adjunct Professor of Anthropology, Columbia University; Visiting Professor of Anthropology, Department of Psychiatry, University of Cincincinnati Medical College.

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Initially, I wish to commend the proposal for the increase of the budget of the National Science Foundation. The encouragement of basic research and the development of relevant mission-related research are both essential for the well-being of the people of the United States and for the exercise by the United States of a responsible role within the developing planetary community. The new position of the biological, behavioral and social sciences within the Foundation's table of organization is also a matter for congratulation.

I will address myself to the following points:

(1) The distinction presently made between the behavioral and social sciences. This suggests that there is some basic difference between the behavioral sciences which emphasize the physiology of growth and the study of the brain on the one hand, and the social sciences, dealing with the inter-relationships between human beings and social institutions, on the other.

I suggest that this distinction is arbitrary and unproductive and that more attention should be given to studies of animal behavior which link our knowledge of heredity, behavioral patterns and social learning, and studies of the interrelationships between the social environment and human capacities, in connection with nutrition, poverty, isolation and levels of technological development. We may reasonably expect that with adequate resources for research on these relationships, a breakthrough in the human sciences (behavioral and social) will occur which will identify areas of conservatism and flexibility in human beings, and alternative directions of social change. These will in turn throw light on such problems as the emergence of innovative behavior, the increase in alienation with accompanying criminal behavior, and ways in which human beings may be strengthened to meet the increasing stress and pressure of the modern world.

(2) The importance of developing transnational, transcultural and transregional capacities. During the 1940's, programs were developed in many of our universities and colleges to prepare students to work in different parts of the world. These regional institutes have been losing support and we are not using the people we trained, nor are we providing for a new generation of young scholars and scientists who are well versed in the language and culture of other countries. In the course of technical assistance programs of the 1950's many new patterns of cooperative research and training were developed: counterpart team work, joint research programs including local personnel, bringing scientists from developing countries to the United States. We now have the experience to provide first class research and training in the international field, with reference to communication, technical interchange of all sorts, and the attainment of consensus in areas of international cooperation such

as the recent agreements on the protection of the Mediterranean, the pursuit of simultaneous cross-national studies of the relationship between nutrition and development, and the invention of appropriate new and middle technologies suitable to the cultural and technical background and resources of different regions of the world. The socio-cultural rationale for the effective regionalization of the world urgently needs attention. Ties of increasing importance between the United States and other parts of the world call for the kind of expertise emphasized during World War II, but currently neglected. At the very moment when the interdependence of the peoples of the earth is being stressed in our political stance, we lack the kinds of ongoing research and training needed to support it. In basic research and studies of variation in animal and human behavior and rapidly changing pre-literate societies who traverse in decades what it has taken older societies centuries to accomplish, provide a background for our understanding of the dynamics of rapid change.

(3) The full utilization of the surviving examples of technologically simpler and socially diverse examples of preliterate people by the modern methods of visual and auditory instrumentation are transforming the behavioral and social sciences, and are making possible the necessary replication of analyses. Opportunities for these recordings are disappearing every day, and the loss of a possible record of each divergent and different type of culture impoverishes our future ability to understand and provide for a guided evolution of human society (see Margaret Mead, "Towards a Human Science," Science, March 5, 1976).

(4) There is a need for greatly increasing transdisciplinary activities in broadly based undergraduate programs, in research projects which provide for apprenticeship training, in fellowship programs permitting career shifts, and arrangements for systematic higher and post graduate degree training

in more than one discipline. These are badly needed if we are to contribute to some of the most pressing problems of the modern world: hunger and malnutrition, urban crowding and disorganization, the degradation of the environment and proliferating weaponery. Funding for narrowly disiplinary basic research is often essential for many problems, but the application of deep research into human society requires a multi-disciplinary team approach (e.g., findings on the prevalence and social consequences of thyroid deficiencies, as illustrated by Lawrence S. Greene's paper, "Hyperendemic Goiter, Cretinism and Social Organization in Highland Ecuador," presented at the annual meeting of the American Association for the Advancement of Science, Boston, February 19, 1976).

(5) Development of science careers for women, minorities and, I should add, for all those for whom such careers are new in this generation, which would include certain sections of the United States rural and urban populations and citizens of other nation states - old and new - newly entering the world of science and science-based technology. Here the emphasis is all too often inclined to try to bring those whose background has not prepared them to do scientific work into the identical type of capability which is now being displayed by majority, historically better suited individuals. It would be worthwhile to explore intensively the specific contributions which individuals of groups previously excluded from the scientific enterprise might make by drawing explicitly on their special capabilities. Women have done conspicuously well in fields in which they have historical experience such as child rearing, nutrition, understanding of human communication. But the unaccustomed may well make new contributions to traditional fields of endeavor if there is less effort to make them conform to old patterns.

(6) The relationship between basic research and educational programs. Two aspects of the proposed projects on educational improvement and citizen participation need comment.

If basic research is tied too closely to educational programs or funds under the heading of educational program, the research will be endangered because of the deeply held disaggreements among the American people about the appropriateness of including such subjects as family life, the life of primitive peoples, the study of the political institutions of other countries and the physiology of the human body. The implications of these sentiments which so easily become politicized in the funding or conduct of research programs are most undesirable. Furthermore, vested interests in the curriculum field will come into play. I strongly suggest that no basic research - even research on the process of education itself - be done under the heading of SUPPORT FOR SCIENCE EDUCATION.

The proposed Science for Citizens program also presents special problems. Citizen understanding of science, and citizen participation in suggesting topics for research and for the application of science, are of great importance. Citizen criticism of the attempts to apply science to human problems or ecological problems, is of the greatest importance also. But the presentation for citizenship review of raw material, undigested scientific results or research programs couched in technical scientific language with which only specialists are conversant is a mockery and an insult to the intelligence of laymen and laywomen. And it must be remembered that everyone - scientist, humanist, artist, technologist, politician - is lay to the speciality of each other citizen. The dichotomy of scientist and citizen is oversimplified and misleading. What is needed are social mechanisms through which the issues embedded in the

reports of scientific commissions of inquiry and gigantic research projects may be organized so that they are intelligible to the lay public who can then participate in asking questions. But setting lay people to provide criticism or set priorities in matters of basic science is non productive. The Scientist's Institute for Public Information, through its constituent committees and its publication, Environment, has long taken the position that it is the scientist's obligation to clarify the scientific issues in such a way that laypeople and citizens can all make informed choices.

There are those who call for Manhattan projects - crash, well funded and secret - to solve our urgent human problems of turning our just emerging post-electronic society into a sustainable society. But the human sciences can not be so isolated from the people who must understand the results if those results are to be put into practice. Therefore the creation of an enabling climate of opinion is essential; diffusion of the knowledge so obtained and its incorporation into our education systems and in the media in informal as well as formal education is necessary. But the special hazards for funding agencies, for individual institutions and for individuals must be understood, and adequate protection given.

Finally, when the Congress agrees to fund research and education in areas which are politically sensitive and subject to many differences of opinion, it should agree to protect the agency programs that it has funded from the attacks that are inevitable if areas of controversy are involved. To request the National Science Foundation to take an active role in controversial areas and then to expose it to criticism and attack of a sort that would not occur in more esoteric and less sensitive areas of scientific research, is unfair. Congress, as the representative of the people must protect what it asks for on behalf of the people. No agency can be expected to risk its budget and its credibility without adequate support against inevitable criticism from those who disagree or represent partisan interests.

I would additionally like to comment on the problem of the competition that is developing between non-profit and profit making research. Non-profit institutions cannot compete, in short term funding, in turn-around time, or in speed of response to requests for research, and may increasingly be forced out of their legitimate research fields. In this country we have on the whole thought it best that education and health be non-profit activities, rather than profit making. This is different from research conducted by industry; it is making an industry of research. I think this needs very serious thought.

Research is becoming an industry in itself: large companies which lose contracts of one sort, for example for making airplanes or other war materials, may turn a large skilled staff loose to work on some project, very often unrelated to what the members of that staff have ever done before. This is one aspect of the question. The other is the proliferation of groups of incorporated "consultants" ready to take on government contracts, sometimes at huge and disproportionate cost, to meet the requirements of our increasing demand for impact statements, or surveys of the state of public opinion, or the state of an art. There are no controls over the quality of work of such groups; it is often extremely sloppy, as well as extremely expensive, and in the end the citizen pays. We need a thorough governmental review of research organizations existing for profit and a comparison of their performance with non-profit research units located in universities, or government agencies. However, even when such research activities are located within non-profit areas, like government or universities, there is a great temptation to "make work", to find areas of research that pay, even if they are trivial and inappropriate or beyond the competence of the agency in question, just to keep the staff employed - and swelling - and the agency or section of the university in business.

Senator KENNEDY. The subcommittee will stand in recess until 3:45 this afternoon.

AFTERNOON SESSION

Senator LAXALT [presiding pro tempore]. First of all, I would like to thank the Foundation officials for appearing here this afternoon.

I understand that this morning Dr. Stever and Dr. Hackerman gave a very enlightening explanation of the Foundation's budget for fiscal year 1977 and underscored its importance in the continued excellence in research and development in our Nation's colleges and universities.

While I am, of course, very concerned with the full range of the Foundation's activities, in view of the time constraints, I would like to proceed this afternoon directly to a discussion of the Foundation's science education activities.

As you will recall, last year this subcommittee expressed its serious concern for some of the Foundation's controversial implementation activities.

The tempered approach the subcommittee finally adopted does not appear to have addressed the full range of problems. This is not a reflection on the subcommittee per se, but rather the result of the burgeoning of any agency without sufficient internal review and policy assessment.

Senator Kennedy apparently raised some of the issues this morning, and I will look forward to continuing that examination with him. I do not want this to be tightly structured or formal. It is simply informative as far as I am concerned. I would like to ask questions of all of you as a group, and have whoever is most appropriate answer the particular question.

Dr. Stever, as I indicated in the office the other day, we had substantial inquiries a year ago concerning where we were going with the NSF funded textbook entitled "Man: A Course of Study"—MACOS—and the reservations expressed at that time were generally along the lines of whether or not the Foundation was, to put it mildly, overly aggressive in the marketing of the program.

I would like for the record here, for you to indicate to me in relation purely to MACOS what its present status is and what has transpired since our last hearings in connection with the program generally.

STATEMENT OF DR. H. GUYFORD STEVER, DR. NORMAN HACKERMAN, DR. RICHARD C. ATKINSON, DR. HARVEY A. AVERCH, CHARLES F. BROWN, DR. ELOISE E. CLARK, DR. EDWARD C. CREUTZ, DR. ALFRED J. EGGERS, DR. ROBERT E. HUGHES, DR. JACK T. SANDERSON, ELDON T. TAYLOR, AND THEODORE W. WIRTHS—Continued

Dr. STEVER. The MACOS program is off the books of the National Science Foundation, except for one project for $15,000 to preserve some films.

Dr. AVERCH. It is more expensive than that.

Dr. STEVER. How much more?

Dr. AVERCH. About $100,000 a year.

Dr. STEVER. About $100,000 a year for keeping a fairly large number of films.

As far as the implementation is concerned——

Senator LAXALT. Well, explain that point to me.

Is this just purely preservation of film?

Dr. AVERCH. That is correct.

EDC, which was the MACOS developer, has a number of valuable films and other material which have to be kept in good condition. They used to use the royalty moneys to take care of administering, publication, and distribution arrangements and cataloging, storing, inspecting, and maintaining quality control of film materials. But since they cannot do that anymore they have come back with requests for program money for this type of administrative and maintenance function. There are no funds for support of MACOS or implementation in that arrangement.

Dr. STEVER. Let me ask a question.

How long will that go on, Harvey?

Dr. AVERCH. Well, we are looking at the options now. The EDC is not the only developer who has NSF materials. What we are looking at now is the best means of maintaining these kinds of materials but reducing the cost of doing so.

Senator LAXALT. Have there been any activities this past year in connection with the marketing of the materials at all?

Dr. AVERCH. Of MACOS?

Senator LAXALT. Yes.

Dr. AVERCH. None by NSF. I believe there were some implementation grants that involved MACOS that were made earlier in fiscal year 1975 before the Director stopped all implementation concerned with MACOS.

Dr. STEVER. Senator Laxalt, you will remember that in an agreement with Mr. Teague's committee along in the spring of 1975, I said we would allow no new grants for implementation. MACOS had some implementation money left over, and there was some discussion of recalling all implementation funds. We left it that we would let all the implementation grants run out, not only MACOS but others as well; is that correct?

Dr. AVERCH. Yes, but there will be no new participants coming into these old implementation grants, and we are not providing extensions on them, either. They have just been allowed to run out.

Senator LAXALT. Can we say then that the marketing efforts of NSF are substantially on the shelf?

Dr. STEVER. Senator Laxalt, there is no NSF marketing. The entire policy of our curriculum development and implementation was reexamined by Dr. Averch under our direction when he became the Acting Assistant Director of the science education program. We have presented a fairly detailed review, again to Mr. Symington's committee, of the changes in the science education area. Our attitudes have changed on what we should be doing and what we should not be doing, and perhaps Dr. Averch could summarize that for you for the best framework.

Senator LAXALT. I would like that for the record.

Dr. AVERCH. First of all, let me distinguish between information, dissemination, implementation, and marketing. As I understand promotion and marketing in the business world, they connote advertising campaigns and distribution systems of various kinds, salesmen

going into school districts, and so on. I do not believe that NSF ever did marketing in that sense.

We did do what is called implementation, that is, the training of teachers, administrators, and resource personnel to place curriculum in the classroom, as well as demonstration activity. As I examined the data, it appeared to me that most of the funds for implementation were going to NSF—developed curriculum, not all, but most. This was true in fiscal year 1974, and in fiscal year 1975. Before that, there really was no heavy implementation activity. There were many teacher institutes and much retraining of teachers, but not much implementation.

I can go into the history of how NSF got into implementation, if you want, but as I examine the data, it seems to me that we could easily bias school districts toward particular curriculum as a means of innovation and reform, and it seems to me that we should not be doing that. There are other ways of getting innovation besides curriculum, and there are other kinds of technologies, and so the only thing that we finally came to recommend after some detailed analysis and discussion was information and dissemination programs with no implementation in the sense that I have defined it for you, no training of teachers, administrators or resource personnel to actually place curriculum into use. I do believe that if the Federal Government supports curriculum development as a form of R. & D. we have some obligation to make people aware of the R. & D. We are proposing a modest program of information dissemination.

Dr. STEVER. What is modest?

Dr. AVERCH. One and a half million dollars for fiscal year 1977. This would cover all of our proposed R. & D. efforts, and also other Federal efforts that are connected with science education, but no implementation.

Senator LAXALT. Let me get to the next point, which probably is of more concern than anything else separate and aside from MACOS.

I think this type of thing, obviously, has created a lot of problems for NSF. I am now coming to the point in my own thinking where I have some serious reservations as to whether NSF should be distracted by this type of activity at all, because your general function, obviously, is extremely important as indicated by the administration's strong support. I think you have equally strong support here in Congress.

Should we be in the business at all in NSF of curriculum development?

Dr. STEVER. I think several of us ought to take a shot at that.

Dr. Hackerman is the Chairman of the National Science Board. By the way, Dr. Saunders MacLane, from the University of Chicago, is another Board member who happened to be in town and came over.

Dr. Averch has questioned some of our previous rationale for being in curriculum development. I would appreciate it if he would give the opening remarks on what we now think is the reason for being in it and then let some others comment on it.

Senator LAXALT. Let me tell all of you that I understand the historical reason why we became originally involved, and I think perhaps with some justification at the time. I just wonder about the present justification.

Dr. STEVER. Well, it certainly grew fast and big.

Dr. AVERCH. Senator Laxalt, since there are private suppliers and private publishers in the curriculum field, I was particularly concerned about why NSF or other Federal agencies should be in the area, again, the three biggest Federal agencies in the curriculum field have been NSF, the Office of Education, and the National Institute for Education. I have looked at all of their programs. In my testimony before the House Authorization Subcommittee for NSF of the Science and Technology Committee, I tried to lay out three conditions which have to hold for any Federal R. & D. activity to take place. These were: One, that in the particular industry there is a relatively low level of R. & D. by the private suppliers, and there is a low or perhaps insufficient rate of technological progress.

Second, there have to be some kind of institutional barriers to doing R. & D.

Senator LAXALT. Are we speaking of science education?

Dr. AVERCH. Yes. I was speaking in general, but what I am trying to do is apply these general principles specifically to curriculum development.

Third, you have to place some special value, public value, on the product of the industry, and let us consider curriculum development as an industry here. What I did was try to see if those three conditions held in the curriculum field.

We will take condition one.

Is there an insufficient rate of technical progress by the private sector?

Are there reasons why there would be a low level of R. & D.?

What appears to happen is that we have a basic and applied research system that creates a lot of knowledge, and the Federal Government pays for much of this knowledge. We have an educational system or a knowledge transfer system that is supposed to translate that knowledge or educate people about that, but there are gaps continually opening up between what we teach and what we know. That is an inherent condition of that kind of market—the gaps that are always opening up.

Second, if you want to close that gap, who should do it?

If the private publishers can do R. & D. and have the intellectual capability to carry it out, then I would say they should do it.

Senator LAXALT. Do they presently, in your opinion?

Dr. AVERCH. In my judgment they do not. I think if you look at the House hearings, there was a lot of discussion of that issue. Many of the leaders of industry themselves say that at the moment they do not have the kind of R. & D. capability that has developed over the last 20 years, partly with Federal support.

Senator LAXALT. Did they indicate a desire to develop that capability?

Dr. AVERCH. Some of them do and some of them do not.

A number of the major publishers that I am aware of say they want to have closer ties with the R. & D., the curriculum R. & D. industry, if we can call it that.

Senator LAXALT. Is this a problem basically of economics as far as they are concerned, that they cannot compete successfully with us in the field?

Dr. AVERCH. Well, it is a problem of the amount of money that they can devote to innovative R. & D., and then the amount of money required for a truly innovative curriculum.

Five hundred thousand dollars is a lot of money to a publisher. For better or worse, the development of an innovative curriculum involves sometimes several millions of dollars, although I hope the Federal Government can become more efficient at it.

In terms of the current condition of the industry, it appears that you can make a reasonable case for the Federal Government to be in it. There is some dispute about that, but I think you can make a reasonable case.

The third condition is that you have to attach some high value to the product of this particular industry, and we do. I mean, the debate itself over the last year has suggested that there is just a lot of public interest in what we teach our kids, the material. Not everybody though, I think in all fairness, wants new knowledge transferred. New knowledge can bring with it changes in perspective by students, by children. That disturbs some people. In the social science area new knowledge can create tensions with old values, and that again disturbs many people.

Senator LAXALT. Is that not a judgment to be made, though, on the local school board level?

Dr. AVERCH. That is correct. That is why I recommended to the Director that there was a case for R. & D. development, but not a case for implementation. That is a choice that should be made at the local level.

We have some obligation, though, in the R. & D. itself to make clear what the knowledge structures are and what the implicit value structures are of these materials. I do not think we have made them clear in the past. If you want local school districts to make informed choices, if you want this particular marketplace to work efficiently, then the people in it have to have information about the alternatives before them. So I think there is some case for an information program, but no case for implementation.

Dr. STEVER. Senator Laxalt, I think a very important thing we learned this last year was that the dynamics of the system that we had developed over many years had gotten so strong that the question of what is the need for a particular curriculum development was not asked strongly enough in the beginning. In my book we sometimes got too far down the road without asking that. I think this was one very important thing——

Dr. AVERCH. May I comment on that?

As I looked at the historical record, it was natural for the Foundation to treat curriculum development the way they treated unsolicited basic research proposals. Thus, the assertions of need for a curriculum came in unsolicited from the prospective developer. The fact of the matter is that curriculum development is not like basic research. It does involve the creation of materials or, to put it bluntly, products. You have to make sure that in a particular case that there is a need, that the private sector cannot meet the need, that the proposed curriculum passes tough criteria of scientific merit and educational appropriateness and so on. Because of the analogy to the basic research side of that house, I think we did not do that as well as we should have.

Dr. STEVER. That's putting it mildly.

Dr. HACKERMAN. Senator Laxalt, the Board heard Dr. Averch's conversation at its February meeting, and some of us talked to him before that. We did come to a position that curriculum development as an activity was a satisfactory one in which to be, provided, as he has already said, that needs analyses were carefully done, that the quality of the material was high, and that the use would be by local choice. The question was how the choice could be made locally. If those in the locality did not know about it, it would pose a problem. Thus the question of supporting curriculum development did, indeed, get an affirmative response.

Senator LAXALT. This is from the Board, Dr. Hackerman?

Dr. HACKERMAN. Yes, from the Board itself.

We did have the problem, as has already been indicated and we still do have the problem. The kinds of spontaneous proposals that are received in the area of research, in science itself, rather than in education, involve predominently deferred judgments. There is nothing to judge until sometime considerably after something has been done. Consideration of the proposal is more on the essence of the idea, the quality of the individual who will do the work, and the facilities available to do it.

The curriculum development proposal is indeed different. You set out with the view of finding someone to produce a curriculum in a given science area. It is expected that the curriculum would make it possible to increase the understanding of students in that subject. You are already into a current judgment position. However if there is a real need and the action is carried out carefully, then the desirability of such development did indeed exist.

On a personal basis, if it came from some other source, I would be just as satisfied with it, but it is true that the classroom material follows behind the front of understanding, and that, of course, bears just not to the elementary and secondary schools, but also to the college and university.

Some of the curriculums which were developed did indeed produce marked improvement in the understanding of the field for the instructor and, therefore, for the student.

Senator LAXALT. Who is the prime mover in this situation?

Does this come from the educational institution, or has it been coming from our people?

Where does a given need for additional science material, or to make it more current, come from ordinarily?

Dr. HACKERMAN. Well, for example, if the professional mathemetician feels that the material being taught at whatever level we are talking about is inadequate to the current knowledge of the field, then that would be one force.

Senator LAXALT. And he may be in or out of the educational framework, is that it?

Dr. AVERCH. If I might comment again, Senator Laxalt, by taking a specific case in point, there has been a revolution in geological theory. We know a good deal more about crustal evolution and so-called plate tectonics, knowledge that has come from the basic and applied research community, and now there is some concern by high school teachers and administrators that some of that knowledge

should be made available to high school students. Then you get some discussion of that in the science education community, so actually the impetus comes from the system of basic and applied research; the knowledge diffuses out to the education community and they become concerned about their students having obsolete knowledge and then they would come back in the old days, with an unsolicited proposal to create a new curriculum.

Dr. HACKERMAN. I might see it in lecturing in freshman chemistry. I might be talking to a level of the current understanding, thorough understanding, not the forefront of research, and find that the students are not able to follow; that is, their background is insufficient. So, in a sense, I might then turn to the high school and say, "Why don't you do something about this? Why don't you improve your system so we can move a little faster?"

That is a proper force, it seems to me.

Dr. STEVER. Dr. Atkinson.

Dr. ATKINSON. Senator, Laxalt, let me respond to a few things here in a random fashion.

One of the real strengths of the American science is the fact that there are many different agencies of the Federal Government having responsibilities for supporting research.

Now, one could argue that any science curriculum development that was done in the Federal Government should be in a particular organization. You might pick the Office of Education or the National Institute of Education and say the National Science Foundation should not have a role in the development of science curriculum, and I assure you that a large part of the scientific community would say, "Fine, we would like nothing better than to see that removed"——

Senator LAXALT. Why would we then say that?

Dr. ATKINSON. I am going to argue against that.

Dr. STEVER. It is the very argument that Senator Laxalt brought out in the first place. There are a lot of people who feel NSF should stick——

Dr. ATKINSON. Let me give you my strong view of the arguments.

Senator LAXALT. Are there any strong arguments in support of consolidation?

Dr. ATKINSON. Yes. I believe that the fundamental thrust in scientific education is not going to be made by the publishers, and, to put it bluntly, by the educational community and schools of education and the like in this country.

Senator LAXALT. Could the publishers do it if they had additional economic help?

Dr. ATKINSON. I'm sure they could conduct research within the publisher's environment by getting Federal grants to do it. I am not sure that would be the——

Senator LAXALT. Could they do it as capably as we have done it?

Dr. ATKINSON. I do not think so. I think if you look at the history of NSF's involvement in various curriculum areas from about 1958 to 1968, there was a really distinguished record. What was really clearly evident in 1958 to I think any scientist looking at the scene was that the quality of teaching materials was really atrocious and was 10 to 15 years behind the times and that somehow publishers had to move in and really begin to improve the quality of those curricula.

Now, you hear a lot about mathematics education and the fact that NSF has not really done a good job and that it has put on a very special mathematics curriculum on the whole country.

I do not think that is really the true case. What happened in that area was that NSF supported a wide range of activities in mathematics curricula and that wide range of activities led to a whole revolution in terms of the quality of mathematics curricula.

Now, some peole would say, "Well there have been some changes there that have been negative changes." Well, that is a point to debate, but one thing that is clear is that every country in the world has really adopted and followed the changes in mathematics curriculums that we have instituted here in the United States, so if these curriculums are not the best in the world, we are at least assured that no other country has better ones.

Now, I personally believe that it is important for the Federal Government to have several different agencies concerned with the development of quality curriculums. I think that we may have done too much of this.

There may have been too much of a self-generated effort in curriculums activities in the early seventies. I think a lot of the gaps have been filled, and we may have been looking for activity when that activity was not necessary, but there are certain areas——

Senator LAXALT Have they been filled, in your judgment?

Dr. ATKINSON. Not all. There is always going to be a continuing need and the National Science Board has to assess that need and decide, of course with the Congress, as to what that level should be, and maybe there has not been enough care in that.

Let me give you another example. The whole role of computers in education and what is called computer-assisted instruction is a very key development. It is becoming a very key development now, particularly in the military area in terms of training military personnel. It has important applications in the grade schools and high schools. We are just beginning to get into that area.

There is a real industry out there for Hewlett Packard, IBM and many other companies, but it really took the NSF commitment in this area to develop the necessary computer technology, to develop some curriculum materials for those computers and to really test these matters out, and without that background of research supported by NSF I do not think you could have really expected the computer companies or the publishing companies to develop the necessary background, so there is always this issue of just when we should be in the business.

Senator LAXALT. On that point, how do we determine within our own shop as to whether or not there is the sufficient capability among publishers so that we have to fill the gap on a backup basis?

How do we do that within the agency?

Do we examine that periodically?

Dr. STEVER. That is the big emerging question, that needs analysis.

Dr. ATKINSON. That is where I think we have been delinquent and we are coming up with some very sharp plans for that needs analysis.

I am just going to wander for 1 minute more and I will be quiet.

I was really somewhat dumbfounded when a year or so ago I looked at my daughter's high school chemistry textbook because I brought her another book to supplement her education in chemistry

and they looked identical, page by page. I thought it had to be two different editions of the textbook, and actually it was two different publishers' textbooks in chemistry, and they were almost example by example, illustration by illustration, identical. What happened was that both publishers were taking the curriculums that originally were developed by NSF and essentially copying that material.

Dr. STEVER. Well, that also brings up another question.

When does Government-supported development material become available to everyone?

That is another big argument that we have had, but I think Dr. Averch might help.

Dr. AVERCH. Senator Laxalt, I was once an economist before I became a scientist.

Senator LAXALT. We will forgive you for that.

[Laughter.]

Dr. AVERCH. I think in this particular case we have to do what in the education fraternity is called needs assessment. That involves getting the opinion of publishers. Many have been offered, I looked at a number that Senator Kennedy solicited last year, and getting their positions on issues. In none of the debates that I have heard and in none of the materials, have I seen any really rigorous economic analysis of the state of the industry. What we are proposing to do in our needs assessment this year and next year is to really get that economic analysis done so that you will know what the state of the industry is with respect to its capability for doing R. & D., whether they can do R. & D. with respect to a specific curriculum, and so on.

I think the positions that I have looked at by the publishers are quite provocative; I know that you will be looking at some more, but I really have not found a rigorous, hardnosed economic analysis, and that is part of needs assessment. Economic analysis is not the only thing to be considered in deciding on curriculum development; but an important part. I think besides assuming that the general conditions for Federal support of R. & D. hold, you really want to know for a specific prospective curriculum, say, a new course in geology, can the industry really deliver on that? If it cannot, then perhaps the NSF should do it, or perhaps some other agency should do it.

I might close with a comment on the historical debate as to where precollege curriculum belongs, and as you know, there have been suggestions from time to time that precollege curriculum be sent to the Office of Education in HEW. In fact, there have been suggestions that science education be sent to HEW. The argument for that is that it consolidates a particular activity in one agency and, presumably, you get more top management attention or more integration of activity.

Senator LAXALT. Do you agree with that?

Dr. AVERCH. I think Federal agencies have trouble integrating their activities, whatever the organizational arrangement.

Dr. STEVER. With the exception of one, certainly.

Dr. AVERCH. I think the controlling argument that has prevented science education curriculum from being sent to HEW has been that in this particular area, substantive disciplinary kinds of activities, the scientific community proper should be involved, and that HEW's contacts with the scientific community are not well-developed;

maybe they should have been developed, but on the part of the scientific community there is a feeling they would have great difficulty dealing with HEW. HEW's primary mission in education, you will recall, is at the primary cognitive levels and assuring the equality of opportunity in education. So I would argue like Dr. Atkinson that some plurality is a good thing. You do not want to carry plurality to the point where it becomes duplication or waste.

We do talk with the NIE people and we do talk to the OE people, who again do curriculum, especially curriculums at the elementary levels, and to insure that we do not end up with waste and duplication.

Senator LAXALT. Tell me, do we have any kind of reading from the publishers as to whether they want this help from us in this area?

Dr. AVERCH. Well, again, I do not really think anybody has taken a true random survey of the publishing industry. I know that in the material that the American Association of Publishers sent to Senator Kennedy last year, where he queried them on exactly this question, they again said there was a Federal role in terms of the kind of gaps that I discussed with you, not in an overriding Federal role, but a gap-filling role.

Some publishers that I have interviewed argue that NSF's publication policies may have prevented the progress of the industry. You know, NSF has had this 5-year exclusive licensing arrangement after publishers' bids are taken. We are taking a look at those publication policies. Whether everything should go into the public domain as NSF has done on some occasions, or whether one should have nonexclusive licensing arrangements is something again to look at in terms of benefits and costs. We have not yet done that, but we are beginning.

Senator LAXALT. Do we presently have any kind of capability to determine whether there is a need or a gap?

Dr. AVERCH. For a particular curriculum?

Senator LAXALT. Yes.

Dr. AVERCH. We have gone out with three requests for proposals to get that kind of information in general and we are now committed to the new policies that we will not do any major kind of curriculum project without an establishment of need, and that means establishing or installing some capability within the Directorate for Science Education to do that. We have begun to do that in a small office independent of the curriculum program. So the needs are determined in one part of the shop and the program funding would take part in another. We would solicit proposals based on need rather than wait for unsolicited proposals.

Dr. STEVER. Senator Laxalt, in the complete examination of the 16 active and total of 19 cases which Dr. Averch undertook this year, it often appeared that the time between a statement of a need from a fairly small group to curriculum development was a very short time and it was rushed forward. In fact, some good curriculums emerged even though the selection process was not done right, and I think Dr. Averch is saying we must change our practices right now. As I say, the self-examination that we have had over the last 9 months has taught us a great deal about this business.

Senator LAXALT. Tell me for my own frame of reference, how many publishers are we talking about in this field?

Dr. AVERCH. It actually depends on a particular area. I would think there are really 10 or 15 majors, so-called and maybe 35—not minors, but lessers.

Senator LAXALT. We are talking less than 100 overall?

Dr. AVERCH. I think so.

Dr. STEVER. How many of them have published something from an NSF program?

Dr. AVERCH. I do not have the exact numbers. I believe all the major ones at one time or another have been involved with NSF curriculum.

Senator LAXALT. Do we plan now on the basis of our experience in the last several months to canvass these various publishers to find out if they have the need of the type we are describing here?

Dr. AVERCH. Yes, that is part of it.

Senator LAXALT. Is it contemplated that we would, on a systematic basis, ask them if there is the type of need?

Dr. AVERCH. Well, last November the Science Education Directorate issued three requests for proposals for a contract to do exactly that. We can go at it in a rigorous way and get the whole industry this time, not a selection of some subset of the industry, but a reasonable representative sample of the whole industry.

Dr. STEVER. How many responded?

Dr. AVERCH. No, this is to be done. In December I had the Association of American Publishers nominate a number of publishers to come down and help us in our curriculum review. Because of potential conflict of interest problems, they did not review all of the curricula, but I had them address these general questions that we are discussing here, and I am giving their views as well as the views of other publishers.

Senator LAXALT. I understand, and I have not seen the report at all, but in the House in their hearing, there were a number of publishers who indicated that they would prefer to develop their own curriculum.

Is my understanding correct?

Dr. AVERCH. Yes, sir. I think during the hearings there was one comment by another witness and one of the publishers, which I thought was striking. The publisher said something to this effect: "This is a beautiful course, I wish I could have developed it, but I can't." And he was again, I think, referring to the barriers to doing R. & D. and the risk capital involved. But, certainly, some of the majors probably could do the R. & D.

Dr. STEVER. How many at that meeting expressed the point that they were not interested in having this done by the Government?

In other words, counter to that enthusiastic supporter?

Dr. AVERCH. In our own reviews?

Dr. STEVER. Yes.

Dr. AVERCH. Yes. I think they felt that the NSF involvement had been beneficial but may have been discriminatory with respect to the whole industry. They argued that perhaps we should use the techniques that NSF used in the SMSG curriculum, which is a math curriculum. It went essentially into the public domain, and then anybody who wanted to could pick it up. They were arguing that we should perhaps come closer to that model on the grounds that it

would push the whole industry ahead rather than a particular publisher. I have not seen a really good benefit-cost analysis of the alternatives.

Dr. HACKERMAN. Senator, publishers have used as their R. & D., the people who are available and who want to write books. They go around and try to extract manuscripts from various professors, which means that it is done somewhat systematically—but not as systematically as the development discussed here, particularly with the needs analysis report. Often they are written with only minor advances over the current textbooks. It then becomes less a matter of a major advance in the material than in whether there is something new enough to make it worth advertising.

Senator LAXALT. Tell me, if we conduct this analysis, as I hope that we do, so that we can determine whether there in fact is the type of justification to warrant our getting involved, and, if so, to what extent, what procedurally will be our situation within NSF as to who reviews it and who ultimately makes a judgment as to whether we are receiving that type of curriculum development?

Dr. AVERCH. Under the new policies that I described in my House testimony, we would do a needs assessment and establish these gap areas, and we would do that, of course, with someone from the outside, a contractor, or grant. Then, based on the identification of these gap areas, I stated we would take these guidelines or solicitations to the public. We would hold the kind of hearings perhaps that we held for the CAUSE program and get some public comment on these guidelines.

Then we define the solicitation, and issue it. It would be a competitive solicitation, and we would go through a peer review, which in solicitation cases is panel peer review, we would then make not just one award but perhaps three or four small ones, develop some prototype materials and evaluate them and then narrow down the number of people working in the area. Thus we might end up funding two developers in competition. I think that is a better way to go because what the peer review tells us at the beginning is a prediction; it predicts performance.

The peer review, I think, works quite well in basic research. When you are essentially in product development, it does not always work so well. So you want to evaluate the actual product or the actual materials rather than the predictions of what the materials will look like. Part of our new policy is to have an ongoing evaluation system so that we know where we stand with these curricula. We also propose to just be much more active in monitoring, that is, management, of these projects. I think the prototype approach, which has not been tried in this area, would be a much more cost-effective way to do this.

Senator LAXALT. Can you fix a time frame at all as to when we could anticipate when they would be implemented overall?

Dr. AVERCH. We are committed to having this done by the transition quarter of 1976. There are other approaches to this and other approaches that NSF has taken. Let me give you an example.

It became clear teaching college mathematics that college textbooks did not have examples that represented work in the biological and social sciences. All the examples were coming from engineering and

physics. Through a grant from the National Science Foundation, a group of biologists, social scientists and mathematicians met one summer and pulled together large numbers of examples that could be used in any calculus book, any algebra book, and the like. That is of recent origin. It is not designed to implement a particular curriculum or a particular textbook; it was really to provide series of sophisticated examples for textbook authors who were writing textbooks at the college level. Now, you might think with some 50 or 60 active calculus textbooks that we would have people who could really do a job of getting good examples from the social and biological sciences into those textbooks.

It is just not that easy, but with this pool of information you really begin to see change in the nature of the examples that are occurring in the college textbooks in mathematics.

What I am trying to do is give you a different example of curriculum development, not the development of the total curriculum, but the development of auxiliary materials that then feed into many different curricula.

Senator LAXALT. Very well. It is very helpful. Let me ask you in this general field. I do not want to take too much more of your time here.

What processes do we have within NSF to edit the materials prior to release?

Do you make an independent evaluation and edit materials?

I understand in the past we have pretty much taken the work of the particular scientist who has produced materials and whose judgment in the areas have been fairly sacrosanct.

Dr. AVERCH. Well, when I came to Science Education, the Board had several months before adopted a policy of de novo review; that is, there would be an independent review of curriculum material, especially with respect to its substantive content and whether or not it was error-free. In December the materials from all the 19 curricula we had on the books at that time were evaluated.

We are committed to continuous evaluation now of the content of the material. It poses a difficult problem which you should be aware of; the more we evaluate the more we imply that a curriculum is either good or bad or indifferent. That is a danger that we are aware of, but we are going ahead. How you do that, of course, is important. We did have panels in December to look at the materials and they did talk to the project directors. I think as we go we will want to take panels out into the field and look at how well "control" groups of students perform on old curricula compared to students that are exposed to the new curricula and to carry out more field evaluations.

All of that would require more money, so I would expect that given all these new policies, including evaluation, we may end up funding far fewer curricula but with much more resources going to monitoring and evaluation. Evaluation comes in two forms; again, you should be aware of that. There is no single good theory of curriculum development so there is an extensive process of what is called formative evaluation.

As the developers go, they test out the materials. I think in the past it has sometimes been true that the materials first going into testing were prone to error because developers were assuming they would

correct them in the second or third pass. We are now saying that the first trial materials have to be much more error free than they were in the past—the children who are participating in the first test have a right to as error-free materials as possible. That will again up the cost and maybe take longer.

At the very end you try to assess what the impact of the curriculum has been. It is a very difficult area technically. NSF has done some of that in the past, but on an ad hoc basis, and now we are saying that we will do that systematically for everyone. Again there will have to be added the costs for doing that. When you put an evaluation out by a Federal agency, it can tell a school district that this particular one looked OK, or this particular one looks terrible. So there is a delicate balance that has to be struck.

Dr. HACKERMAN. I know the question was put with regard to science education curriculum development, but it may be misinterpreted, and I thought that ought to be on the record.

Senator LAXALT. Yes, I intended to confine the question purely to science education.

Do you have anything further to add?

Summarizing what we have been discussing here then, I gather that there has been a rather intensive evaluation of where we are going in the field and an appreciation that in the future our role should be limited perhaps on a more quality level after consultation regarding need based upon assessment of the capability of industry and of publishers——

Dr. AVERCH. And I think the public——

Senator LAXALT. And greater public participation in the process.

We are in general agreement on this because that was pretty much my concern in this area.

Just for the record, I philosophically feel that the Federal Government should be the least involved in most of these areas as possible, but I am becoming increasingly of the belief that in the areas of research generally, it is a very, very proper function of the Federal Government as an overlay of whatever the private sector does. I think that is a proper function here, and it is based principally upon the fact that we have the capability on this level.

Let's get into something for just a few minutes that relates to your internal mismanagement problems.

I have heard the usual amount of scuttlebutt.

Just exactly what is happening in connection with the peer review?

Was there some misadministration?

Dr. STEVER. Let me try to summarize the peer review situation that we have developed.

As you know, from the beginning of the National Science Foundation, the award process has involved peer reviews. They are all sent in confidence with the choice of each project, either for or against, made first by a project manager, with the input from the peer reviews but they are not necessarily controlling. If there was a good reason why a project manager felt that there should be research in a field and the reviews were reasonable, or that there was not enough research in a field, we would move in that direction, and, in fact, NSF has over the years influenced the direction of new research, which was important.

Senator LAXALT. Getting to the mechanics of peer review, how many peer reviewers are selected to a given project, and how is that developed?

Dr. STEVER. We have in round numbers 20,000 to 25,000 applications per year, and on those we get an average of 6——

Dr. ATKINSON. There are about six independent reviewers on each proposal on the average.

Senator LAXALT. How are these people selected?

Dr. ATKINSON. Well, it is a complicated process. We have essentially three forms of peer review. One is a panel review where the proposals will come in, a panel will meet at the Foundation and review the proposals there.

Senator LAXALT. How would that panel be selected?

Dr. ATKINSON. Well, that panel would be selected by the program officer in consultation with the division director and eventually in consultation with the director of that directorate. The panel would be widely representative of the scientific community. Those names are public, so that in a sense the public and the scientific community at large can check the quality of those panels because they are public.

Senator LAXALT. Are they compensated?

Dr. ATKINSON. They are compensated for the travel and for the days that they are at the Foundation.

Senator LAXALT. On a per diem basis, but not otherwise?

Dr. ATKINSON. Often it takes 3 or 4 days prior to coming to Washington reading proposals and the like to prepare for the panel meetings, so they are compensated for their travel and receive $75 per day. The other major form is the ad hoc review, where the panel officer will receive the proposal and then select a group of names to whom he will send that proposal for an evaluation. Those names will be selected in the scientific area, that will often be done in consultation with the division director or the section head. The proposal will then be sent out and that is what we call the mail ad hoc review.

The Foundation will then receive these and the program officer's responsibilities will be to examine these reviews plus the original document and comment on it.

The third method involves the panel review plus ad hoc reviews. It turns out that about 40 percent of our proposals are handled by a panel plus ad hoc review process; that is, the proposal will be reviewed by a panel, and discussed by the panel and the program officer's evaluation of it will be augmented by a series of ad hoc reviews. Forty percent of the proposals will be handled by both panel plus ad hoc review, about 30 percent by ad hoc alone and about 30 percent by panel review alone. But I think the key thing to remember is that we are making a number of changes in our peer review process, that were started last summer with a very important change by the National Science Board.

We have a number of surveys underway surveying the scientific community on these matters. We have a special study being conducted by the National Academy of Sciences on the peer review process. We anticipate a number of other changes, but it is an evolving process. It is clear that the peer review process is really central to the success of American science and we believe some changes need to be made, but we are not anxious to rush into those changes quickly.

I think your question was not so much about the state of our peer review process, but about the issue of the GAO report.

Senator LAXALT. Yes.

Dr. STEVER. Let me continue on one thing, however. The extensive analysis that we have done for about the last 9 months has resulted in new staff memoranda from me on the subject of how the National Science Foundation reviews projects and programs. We will enter these into the record.

One is dated February 13, and is a new guideline for program officers setting criteria for the selection of reviewers. Another one establishes guidelines on instructions to reviewers. A third is on handling the other reviews after they are received. I would like to enter these into the record.

Senator LAXALT. Yes, they will be made part of the record.

[The information referred to follows:]

NATIONAL SCIENCE FOUNDAT N
OFFICE OF THE DIRECTOR
WASHINGTON, D. C. 20550

STAFF MEMORANDUM

O/D 75- 57

GRANTS AND CONTRACTS December 19, 1975

SUBJECT: NSB Review of Projects and Programs

For some time the National Science Board has been considering ways to increase the effectiveness and efficiency of its review of NSF projects and programs. As a result of discussions with various NSF staff and NSB members, the NSB Programs Committee has recommended that the following three modifications be made to the present system:

1. Reduce the size of NSB approval packages to the minimum necessary to present pertinent and appropriate information.

2. Adopt a standard format for the content of NSB approval packages.

3. Increase NSB emphasis on review of programs by requesting more frequent Special Program Reports for specific programs on particular areas of interest or concern.

Attached is a copy of the December 12, 1975 memorandum from the Chairman of the Programs Committee to the NSB Executive Committee which includes the recommendations, a summary of major ways in which NSB reviews projects and programs and a standard format and guidance for NSB approval packages. The Executive Committee has considered the recommendations and the attachments and endorsed them. The Executive Committee has also requested that complete copies of all reviewers' comments be forwarded to the Executive Secretary of the NSB Programs Committee at least one week prior to the Board meeting at which the proposed award is scheduled for NSB review and approval.

I fully agree with the recommendations and believe that the adoption of a standard format for documenting individual cases is highly desirable and will facilitate the review process. Accordingly, the staff should begin using the new approach and format as soon as possible. Because some proposed award packages for the February Board meeting have already been prepared, it is recognized that the March Board meeting will be the first opportunity to use the new format exclusively.

H. Guyford Stever
Director

Attachment
Distribution E

OPTIONAL FORM NO. 10
JULY 1973 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

NSB/PC-75-34
(Limited Distribution)

TO : Executive Committee
National Science Board

DATE: Dec 12, 1975

FROM : Chairman, NSB Programs Committee

SUBJECT: NSB Review of Projects and Programs

As we all are aware, during the last several years there has been a marked increase in the number of proposed award packages being submitted to the NSB for review and approval. In addition there has been an increased number of cases submitted to the Board for information purposes. At the same time there have been increasing demands for Board attention to many other matters.

While it is highly desirable, and in many cases required, that the Board see and review individual cases, the volume of material presently prepared by the staff and transmitted to the Board for review has created a tremendous workload on both the staff and the Board.

It is believed that, without necessarily reducing the number of cases reviewed by the Board, a better system of staff documentation and Board review and oversight would be desirable. With the objective of conserving both NSB and NSF staff time, while at the same time increasing the effectiveness and efficiency of the NSB review function, discussions have been held with various NSF staff and NSB Members. The results of these discussions have led me to propose that the following modifications be made to the present system:

1. Reduce the size of NSB approval packages to the minimum necessary to present pertinent and appropriate information.

2. Adopt a standard format for the content of NSB approval packages.

3. Increase NSB emphasis on review of programs by requesting more frequent Special Program Reports from specific programs on particular areas of interest or concern.

I believe that adoption of a smaller standardized approval package containing basic information the Board needs will improve its ability to carry out its responsibilities while reducing the workload on NSF staff. The need for more Special Program Reports is obvious and will give the NSB a better understanding and overview of certain important areas which can not be attained in the review of individual projects. Such reports for the most part would be based on information that should be reasonably available to management.



Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

Attached is a paper which outlines for NSB Members and NSF staff the major ways NSF reviews projects and programs. The paper recognizes the Special Program Report concept mentioned above and has an attachment which provides guidance on the content, format and length of proposed award packages submitted to NSB for approval.

If you agree I will forward this memorandum and the attached documents to the Director as our recommendation for transmittal and guidance to the staff. It is believed that the new approach and format could be reflected in packages submitted for the February 1976 Board meeting.

Joseph M. Reynolds

Joseph M. Reynolds

Attachments

NSB Review of Projects and Programs

Purpose

This document identifies for NSB Members and NSF staff some of the major methods through which NSB reviews Foundation projects and programs. In addition it clarifies whether a proposed award action is required to be submitted to the NSB for approval or for information purposes. The document also identifies the need for Special Program Reports which the NSB may request from time to time.

Finally, the attachment provides guidance for NSF staff on the content, format, and length of documentation for proposed awards to be submitted to NSB for approval. It is expected that this guidance will result in less voluminous and more standardized presentation of Board cases which will not only reduce the amount of staff time required to prepare such cases and the amount of material the Board must review, but also provide the Board with the type of information it desires in a systematic way, thus assisting it in carrying out its review and oversight responsibilities more effectively and efficiently.

Further guidance on processing recommendations requiring National Science Board approval are contained in NSF Circular No. 107 (Rev. 1), dated February 8, 1973, and Staff Memorandum O/D 70-20, dated June 22, 1970.

NSB Review of Projects

NSB is apprised of specific proposals, projects and proposed or actual awards in a number of ways including the following:

(1) NSB review and approval of each grant, contract, or other arrangement involving a total commitment of $2,000,000 or more, or $500,000 or more in any one year as required by the NSF Act.

(2) NSB review and approval of proposed awards (regardless of dollar amount) initiated under any new program until such time as the Board delegates limited or general approval authority to the Director.

(3) NSB review and approval of a proposed award or other action which raises a policy issue which has not previously been resolved by the Board; or a proposed change in a policy previously approved by the Board.

(4) NSB review for information purposes of proposed or actual awards which NSB or the staff consider to be of "special interest". These include:

(a) any single award of over $400,000 which has not otherwise been submitted to the Board for review,

(b) any project which has received $1,000,000 or more in NSF support over a 5-year period which has not otherwise been submitted to the Board for review.

(c) any award which may be considered to be highly unusual or significant, potentially controversial, or otherwise considered to be of special interest by the staff or NSB.

Documentation for individual projects submitted to NSB for information purposes only will include the Project Summary Sheet (Form 4), Program Recommendation (Form 9), the Proposed Award Budget (Form 569 or other), and other appropriate information.

(5) NSB review and approval of Proposed Solicitations/Request for Proposals where resulting awards might otherwise require specific NSB approval.

(6) Listing of Monthly Awards, Declinations, and Withdrawals.

NSB Review of Programs

NSB reviews proposed, new, and existing programs in a number of ways including the following:

(1) NSB preliminary consideration of proposed plans.

(2) NSB review of program plans.

(3) NSB participation in Program Reviews.

(4) NSB review of specially requested Program Reports. From time to time NSB may request Special Program Reports which may be in written or briefing form and cover such areas as:

(a) comprehensive overview and summary of similar or related projects, activities, or facilities.

(b) a summary listing and brief description of projects, principal investigators, or facilities supported over 5 or 10 years and the level and date of the latest thorough review.

(c) a detailed description and summary of the review process including decisions on reviewer selection, avoidance of conflicts of interest, avoidance of undue geographical concentration, etc. and discussion of the number and quality of declined proposals.

(d) identification of projects, Principal Investigators and facilities for which future commitments exist (whether moral, implied, or expressed), as well as statistics and analyses of the amount and percentage of program dollars committed for future years.

Attachment

ATTACHMENT

CONTENTS

NSB APPROVAL PACKAGE

1. Transmittal Memo and Proposed Resolution (1 page)
2. Project Summary Sheet (Form 4)
3. Project Description (If necessary. Not to exceed 2 pages)
4. Reviewer's Comments (Not to exceed 1 page)
5. Program Award Recommendation (2 pages)
6. Proposed Award Budget (Form 569 or other)

NOTE: All information may become available to the public if award is made.

70-027 O - 76 - 15

SUMMARY MEMO AND PROPOSED RESOLUTION (1 page)

NATIONAL SCIENCE FOUNDATION

PROJECT SUMMARY

NSF GRANT NO.

NAME OF INSTITUTION (NSF DIRECTORY NAME)	ADDRESS OF INSTITUTION (INCLUDE BRANCH/CAMPUS & COMPONENT)
PRINCIPAL INVESTIGATOR — SOCIAL SECURITY NO.	DIVISION (OFFICE) AND DIRECTORATE
	SECTION
PROPOSAL NUMBER	PROGRAM
TITLE OF PROJECT	
SUMMARY OF PROPOSED WORK (LIMIT TO 22 PICA OR 18 ELITE TYPEWRITTEN LINES)	

INSTRUCTIONS FOR USE

1. Program Office will complete all items appearing on the first copy; place Proposal Folder copy in the folder; retain Program Suspense copy; and place other copies inside the folder envelope with carbons intact.

2. Grants and Contracts Office will post grant number, amount granted and inclusive project dates on the S.I.E. copy and make distribution of remaining copies.

NSF Form 4, Jan. 1970

1. PROPOSAL FOLDER

PROJECT DESCRIPTION (If necessary. Not to exceed 2 pages)

REVIEWER'S COMMENTS (Not to exceed 1 page)

Pertinent non-attributable excerpts from reviews. Actual review sheets will not be part of this package but will be available for NSB Programs Committee when they review the case.

PROGRAM AWARD RECOMMENDATION

Project Title:

P.I./P.D.:

Institution: State:

Amount: Duration:

Type of Proposal:
(Unsolicited or solicited. If solicited then identify solicitation mechanism and number of competing proposals. If unsolicited then identify applicable announcement/ brochure.)

Type of Project Activity:
(Basic research, study, conference, applied research, curriculum development, etc.)

Evaluation Criteria:
(Criteria used to evaluate proposal and relative importance.)

Review Mechanism and Summary of Reviews:
(Peer review (indicate whether by mail or panel), NSF staff only, other agencies, etc., indicate number, and characteristics of reviewers and brief summary of reviews. Identification of reviewers and individual ratings (Form 7) will not be furnished as part of NSB package but may be made available at time of NSB review.)

Merit/Objectives of the Scientific Research/Project Activity:

Qualifications/Experience of P.I./P.D., Key Personnel, Institution:
(A brief summary statement. Indicate extent of previous NSF support.)

Relevancy of Project to Program Objectives/Responsibilities:

Relationship of Project to Other Program Awards/Plans/Activities:

Potential Results/Benefits from Project:

Program Monitoring and Reporting Requirements:

Identification of Deliverable End Items:

Funding:
(Indicate any prior NSF funding, recommended funding level at this time and reasonableness, possible future funding and commitment.)

Coordination with/Funding from Other Agencies/NSF Programs:

Other:
(E.g., educational component, special facilities, major milestones, organization and management plans, major subawards, substantial cost sharing, income, patent and data rights, special issues, etc.)

_____ _____(Signature)
Date

RECOMMENDED AWARD: _____(Typed Name)
Program Official

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

RESEARCH GRANT BUDGET WORKSHEET

INSTITUTION AND ADDRESS	NSF PROGRAM	PRINCIPAL INVESTIGATOR(S)

PROPOSAL NUMBER	RECOMMENDED DURATION	GRANT NO.	RECOMMENDED GRANT AMOUNT
			$

	NSF Funded Man Months (to the nearest tenth)			NSF GRANT BUDGET
A. SALARIES AND WAGES	Cal.	Acad.	Summ.	
1. Senior Personnel				
a. _____ (Co) Principal Investigator(s)				$
b. _____ Faculty Associates				
Sub-Total				
2. Other Personnel (Non-Faculty)				
a. _____ Research Associates—Postdoctoral				
b. _____ Non-Faculty Professionals				
c. _____ Graduate Students				
d. _____ Pre-Baccalaureate Students				
e. _____ Secretarial—Clerical				
f. _____ Technical, Shop, and Other				
TOTAL SALARIES AND WAGES				
B. STAFF BENEFITS IF CHARGED AS DIRECT COST				
C. TOTAL SALARIES, WAGES, AND STAFF BENEFITS (A + B)				
D. PERMANENT EQUIPMENT				
E. EXPENDABLE EQUIPMENT AND SUPPLIES				
F. TRAVEL 1. Domestic (Including Canada)				
2. Foreign				
G. PUBLICATION COSTS				
H. COMPUTER COSTS IF CHARGED AS DIRECT COST				
I. OTHER DIRECT COSTS				
J. TOTAL DIRECT COSTS (C through I)				
K. INDIRECT COSTS				
L. TOTAL COSTS (J plus K)				
Less Residual Funds				
M. AMOUNT OF THIS AWARD (ROUNDED)				$

REMARKS: Use extra sheet if necessary

NSF FORM 569, NOV. 1974

Relationship of Project to Other Program Awards/Plans/Activities:

Potential Results/Benefits from Project:

Program Monitoring and Reporting Requirements:

Identification of Deliverable End Items:

Funding:
(Indicate any prior NSF funding, recommended funding level at this time and reasonableness, possible future funding and commitment.)

Coordination with/Funding from Other Agencies/NSF Programs:

Other:
(E.g., educational component, special facilities, major milestones, organization and management plans, major subawards, substantial cost sharing, income, patent and data rights, special issues, etc.)

_____ _____(Signature)
Date

_____(Typed Name)
RECOMMENDED AWARD: Program Official

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

RESEARCH GRANT BUDGET WORKSHEET

INSTITUTION AND ADDRESS	NSF PROGRAM	PRINCIPAL INVESTIGATOR(S)

PROPOSAL NUMBER	RECOMMENDED DURATION	GRANT NO.	RECOMMENDED GRANT AMOUNT
			$

	NSF Funded Man Months (to the nearest tenth)			NSF GRANT BUDGET
A. SALARIES AND WAGES	Cal.	Acad.	Summ.	
1. Senior Personnel				
a. _____ (Co) Principal Investigator(s)				$
b. _____ Faculty Associates				
Sub-Total				
2. Other Personnel (Non-Faculty)				
a. _____ Research Associates—Postdoctoral				
b. _____ Non-Faculty Professionals				
c. _____ Graduate Students				
d. _____ Pre-Baccalaureate Students				
e. _____ Secretarial—Clerical				
f. _____ Technical, Shop, and Other				
TOTAL SALARIES AND WAGES				
B. STAFF BENEFITS IF CHARGED AS DIRECT COST				
C. TOTAL SALARIES, WAGES, AND STAFF BENEFITS (A + B)				
D. PERMANENT EQUIPMENT				
E. EXPENDABLE EQUIPMENT AND SUPPLIES				
F. TRAVEL 1. Domestic (Including Canada)				
2. Foreign				
G. PUBLICATION COSTS				
H. COMPUTER COSTS IF CHARGED AS DIRECT COST				
I. OTHER DIRECT COSTS				
J. TOTAL DIRECT COSTS (C through I)				
K. INDIRECT COSTS				
L. TOTAL COSTS (J plus K)				
Less Residual Funds				
M. AMOUNT OF THIS AWARD (ROUNDED)				$

REMARKS: Use extra sheet if necessary

NSF FORM 569, NOV. 1974

NATIONAL SCIENCE FOUNDATION
OFFICE OF THE DIRECTOR
Washington, D.C. 20550

STAFF MEMORANDUM

O/D 76-10

ADMINISTRATION AND MANAGEMENT February 13, 1976

SUBJECT: Guidelines on Instructions to Reviewers

This Memorandum provides standards and general requisites applicable to Foundation requests for peer reviews and accompanying documents forwarded to NSF reviewers.

The excellence of Foundation-supported activities is heavily dependent on the evaluations received from the scientific community. This process is so important and so dependent on the cooperation of reviewers that it should not be treated routinely. The variety of review assistance solicited and the desirability of tailoring the request for review to a specific program or project argue for a degree of flexibility in form and content. To this end, neither standard letters requesting evaluations nor rating forms are prescribed. Program officers may design request letters to best meet the needs of their program, subject to the requirements set forth below, and any other requirements which may be established by Directorates and Divisions.

All form letters, standard enclosures and review forms used in requesting peer reviews must be approved by the responsible Assistant Director or his designee. The Assistant Director concerned may choose to exempt from approval special letters designed for individual proposals; such letters, however, must include the authorized statements below.

AUTHORIZED STATEMENTS ON CONFIDENTIALITY

a. Letters to Reviewers

The following paragraphs must be included verbatim in all letters soliciting reviews of proposals. Advisory committees or panels assembled for the review of proposals should, without exception, be made aware of the substance of these paragraphs.

- The Foundation receives proposals in confidence and is responsible for protecting the confidentiality of their contents. For this reason, we ask that you refrain from copying, quoting or otherwise using material from this proposal. If you believe that a colleague can make a substantive contribution to the review, please consult me before disclosing either the contents of the proposal or the applicant's name. When you have completed your review or if, for some reason, you find yourself unable to respond to this request, (destroy the proposal) (return the proposal in the enclosed franked envelope).

- Verbatim copies of reviews, ratings, and associated correspondence will be sent to the principal investigator/project director on request. The copies will not contain your name, the name of your institution or names which might constitute an invasion of the privacy of others. Subject to this Foundation policy and applicable laws, including the Freedom of Information Act, 5 USC 552, your participation as a reviewer and the content of your review will be given the maximum protection from disclosure.

- The Foundation will publish annually a list of the names and addresses of persons who have reviewed proposals. Individuals will not, however, be identified with specific proposals. In this way the Foundation can publicly acknowledge your service as a reviewer and at the same time protect the confidentiality of your comments.

b. Proposal Rating Forms

All review forms must prominently include the following statement:

Verbatim but anonymous copies of reviews will be sent only to the principal investigator/project director on request. Subject to this NSF policy and applicable laws, including the Freedom of Information Act, 5 USC 552, reviewer's comments will be given maximum protection from disclosure.

SUPPLEMENTARY CONSIDERATIONS

The length and style of letters soliciting reviews are matters of individual preference. It is important to remember that the Foundation is soliciting a service which most often involves an uncompensated effort. Therefore, it is appropriate to mention our dependence on reviews and our appreciation of such cooperation.

The request should provide the reviewer with criteria for judgment and some notion of the relative importance of the respective criteria. No criteria should be included which were not made available to the applicant. If the proposal is responsive to a specific program announcement, program solicitation or request for proposals, the appropriate criteria included in the solicitation document should be enclosed. For unsolicited research proposals, judicious paraphasing of NSB-74-300, "Criteria for the Selection of Research Projects by the National Science Foundation," would be appropriate as a means of eliciting substantive comments and constructive criticisms. Rating scales may be inappropriate in some programs; if they are used, the categories should be clearly described in either the letter or, preferably, an enclosure. Reviewers may be reminded that disagreement with Foundation policies, ranging from the kind of programs supported to allowable budget items, should not influence their evaluation of proposals prepared in accordance with those policies.

The materials sent to the reviewer should minimize the clerical burden on the respondent. Appropriate return envelopes should be included. The due date should be prominent.

A standard review form, NSF Form 173, is available, but special forms may be tailored to specific criteria in program announcements, program solicitations or requests for proposals. If rating boxes are used they will be subject to release to the PI/PD with verbatim copies of the review. The review forms should identify the NSF program soliciting the review.

INFORMING REVIEWERS OF ACTIONS

In general, workloads restrict the opportunity to notify each reviewer of the action taken on specific proposals which were reviewed. Some programs prepare lists of grants awarded, either for press releases or for internal use. It would be appropriate to send copies of such lists (or the press release) to persons who participated in the review process. The cost of reproduction and mailing is likely to be more than repaid in good will. Other methods of keeping reviewers informed are encouraged, so long as they do not involve divulging confidential information, and can be accomplished at nominal expense and with reasonable effort. For example, sending copies of the NSF Annual Report to each reviewer will generally prove to be excessively expensive.

Foundation personnel are encouraged to utilize appropriate opportunities for acknowledging the Foundation's indebtedness to reviewers for dedicating their time and effort in contributing to the effective operation of the NSF peer review system. Formal speeches, informal discussions and correspondence all provide suitable means of expressing the Foundation's gratitude for this service, and to cultivate the continued cooperation of the scientific community in this vital segment of the Foundation's activities.

H. Guyford Stever
Director

Distribution F

NATIONAL SCIENCE FOUNDATION
OFFICE OF THE DIRECTOR
Washington, D.C. 20550

STAFF MEMORANDUM

O/D 76-14

ADMINISTRATION AND MANAGEMENT February 26, 1976

SUBJECT: Guidelines for Program Officers on Release of Proposal Review Information In Response to Requests From Principal Investigators/Project Directors

The resolution on the peer review system adopted by the National Science Board at its 174th meeting in June, 1975, includes a provision which constitutes a substantial change to NSF policy:

> "3. Verbatim copies of reviews requested by the Foundation after January 1, 1976, not including the identity of the reviewer, will be made available to the principal investigator/project director upon request."

The foregoing requires a change in the provisions of NSF Circular No. 120, "Compliance with Requirements of the Freedom of Information Act (FOIA)." The Circular presently states that the statute exempts from disclosure, "Interagency or intra-agency memoranda or letters..." and interprets the exemption to include, "Evaluations and comments on specific grant applications, and research proposals, or potential contractors, whether made by NSF personnel or by external reviewers acting either individually or in committee." This exemption is being waived in the limited case of a request by a principal investigator/project director; other provisions of Circular No. 120 are not affected. Program officers are not authorized to release verbatim comments to anyone except the principal investigator/project director.

Review actions accomplished prior to January 1, 1976, will continue to be held in confidence after that date. This includes mail reviews requested before January 1, 1976, and individual proposal evaluations by committees and panels or reports of site visits held before then.

NSF policy, in compliance with applicable laws and Federal and agency records management regulations, has consistently required that all documents pertinent to the review and evaluation of a proposal are permanently maintained in the proposal file for its entire retention period. Diary notes should be made of all telephone discussions concerning the proposal, recording 1) the date, 2) parties to the discussion, 3) subjects discussed and 4) conclusions and recommendations reached.

The following types of documents are subject to release of verbatim written copies, from which must be deleted the names of reviewers or of parties not directly involved in the proposal or review, and letterheads or other marks identifying the reviewer's institution.

NOTE: In rare situations further deletions may be necessary to protect certain other rights and interests, where such deletions would be proper under the exemptions to the Freedom of Information Act, or as otherwise required by law. Such deletions will be made only with the approval of the General Counsel.

1. Written reviews and ratings of the proposal, including those from NSF staff or other Federal personnel, which were solicited as peer reviews by the procedures normally used in the program. This includes letters accompanying reviews.

2. Other documents containing peer reviewer comments on the technical or scientific content of the proposal or scientific competence of the applicant.

3. Diary notes of telephone discussions with reviewers concerning the proposal, after obtaining concurrence by the reviewer in the accuracy of the diary note.

4. Summaries of committee or panel discussions.

5. Written reports by peer reviewers of site visits made in connection with the evaluation of the proposal.

Program officers may wish to include comments on the Foundation's reasons for the decision made.

The NSB resolution also states, "The Foundation, upon request, will inform the principal investigator/project director of the reasons for its decision on the proposal." The information provided should be as explicit as possible, but should always be stated in terms of action by the Foundation as a whole--not in terms of an individual, an advisory group or a particular organizational unit of NSF.

The NSB resolution requires release of verbatim comments to the principal investigator/project director. However, comments ordinarily will be furnished only after final action has been taken on the proposal. In cases where criticisms by reviewers raise substantive questions which can best be answered by the applicant, the program officer may transmit the substance of the pertinent portions of reviews as part of a request for additional information. The purpose of such a request is to provide the program officer with adequate information on which to base an action recommendation. It is not a rebuttal process, and should not be characterized as such.

..pproval should be obtained from the cognizant Division Director before verbatim copies of mail reviews are made available to members of NSF advisory committees and panels.

The Foundation frequently discusses proposals with other agencies and with other branches of the Federal government that may have an interest in the particular matter. In such cases, information should be given judiciously and in a manner that will help the inquiring agency to determine its course of action. In general, this will not involve releasing verbatim copies of reviews. Program officers should obtain approval from the cognizant Division Director or Office Head in those cases where verbatim release appears to be justified. The same principles apply to requests from NSF personnel not directly involved in processing the proposal. Release of information to GAO representatives is discussed in NSF Circular No. 90, "Relationship with the General Accounting Office." GAO access to reviews requires approval of the Director, Office of Planning and Resources Management (PRM); copies may not be made.

It is inevitable that issues will arise concerning the release of proposal review information which are not comprehensively resolved by these guidelines. Foundation personnel should consult the NSF Freedom of Information Officer, the NSF Privacy Act Officer or the Office of the General Counsel for coordination or assistance on matters of implementation, as may fall within their respectively assigned areas of responsibility.

H. Guyford Stever
Director

Distribution F

70-027 O - 76 - 16

NATIONAL SCIENCE FOUNDATION
OFFICE OF THE DIRECTOR
Washington, D.C. 20550

STAFF MEMORANDUM

O/D 76-11

ADMINISTRATION AND MANAGEMENT February 13, 1976

SUBJECT: Guidelines For Program Officers On Selection of Reviewers

At its 167th meeting on October 17-18, 1974, the National Science Board adopted criteria for the selection of research projects by the National Science Foundation (NSB-74-300). This Memorandum establishes guidelines for the selection of reviewers based on those criteria. These guidelines are designed to ensure that the external reviewers used can give program officers the information needed to make a recommendation in accordance with the NSB criteria.

The NSB criteria for the selection of proposals fall into four categories:

Category A - criteria relating to competent performance;

Category B - criteria related to the internal structure of science itself;

Category C - criteria relating to utility or relevance;

Category D - criteria relating to future and long-term scientific potential of the United States.

SELECTION OF AD HOC REVIEWERS

Not all of these criteria apply equally to every proposal or every program; their relative importance will influence the selection of reviewers. Program officers should also consider the specific award criteria in program solicitations, when present, in deciding on appropriate reviewers.

Category A should be applied in every instance, as competent performance is the normal expectation. The following criterion should be used for some reviewers of every formal proposal.

> Criterion 1: Choose some reviewers who can evaluate the project director's ability and the facilities available for conduct of the project. Where possible, some of these should possess personal knowledge of the individual and the facilities as well as the evidence presented in the proposal itself. The group of reviewers chosen should provide a reasonable balance of known or expected professional viewpoints.

The criteria of Category B concern the intrinsic scientific merit of the proposal. These criteria should be used for formal proposals for applied as well as basic research, because the science judged best by internal standards has almost invariably turned out, in the long run, to be most useful. A second criterion for the selection of reviewers is:

> Criterion 2: Choose some reviewers who have a broad view of the subject of the proposal and of fields which the NSF program officer believes might be directly influenced by the successful completion of the proposed project. These reviewers must be sensitive to trends and the future development of these fields and should be chosen to reflect a diversity of opinion. Note that one may expect substantial but not necessarily complete overlap among reviewers who satisfy Criteria 1 and 2.

The criteria of Category C are most applicable to proposals involving utilitarian results and require information about the feasibility and the intended application of the results in addition to the factors of merit and competence. For formal proposals of this type, a third criterion is:

> Criterion 3: Choose some reviewers who can comment on the utility of the proposed work. These reviewers need not be expert in the specific field of the proposal but should have a comprehensive understanding of the problem which the proposal addresses. The group of reviewers should represent a spectrum of points of view, including those of the potential users of the results and groups concerned with the social or environmental impact of the use of these results.

Category D contains criteria relating to the future scientific potential of the U.S. The Board's discussion covering this item notes that "while these criteria are seldom dominant in project selection or program development, they are always considered. The policy of the Foundation is not to undertake for short-term reasons any action which would seriously jeopardize the long-range science potential of the nation."

In this regard, particular attention is needed for projects in science education, science policy and science information. In cases which could strongly influence the way science research is done, affect the future supply of scientific talent, or perturb the institutional structure of science, the program officer should obtain outside advice concerning these implications. These factors transcend purely scientific considerations and the choice of reviewers should provide adequate coverage of the principal communities which might be affected by NSF approval of the project. This leads to a fourth criterion.

> Criterion 4: Choose some reviewers who can competently represent each of the principal institutional, educational, regional or other elements of the relevant communities which might be affected by the project under consideration. The group of reviewers chosen should provide reasonable balance among the points of view on the issues in question.

To the extent possible, the set of reviewers for any single proposal should reflect a balance among various factors such as geography, type of institution, minority groups, etc. Over the course of a fiscal year, program officers should attempt to include a balanced representation in the aggregate group of reviewers used.

Several references have been made to the need to provide balance among differing points of view. Implicit in this concept is the responsibility of the program officer to be conscious of the scientific and personal biases of potential reviewers, and to be alert to indications of bias in the reviews received. Examples of situations which might lead to personal biases are the following:

a. Reviewer and applicant have been related recently as student and thesis advisor or postdoctoral advisor.

b. Reviewer and applicant are known to be close friends.

c. Reviewer and applicant have recently collaborated on research related to the proposal.

d. The reviewer has had a proposal recently declined.

When, in the opinion of the program officer, the reviews received are unfair to either the applicant or others competing for funding, the summary of the reviews should identify any significant biases and indicate the compensation made for them.

Program officers must not involve reviewers in situations which might constitute a conflict of interest. Examples of cases where this issue can arise include:

a. The reviewer would benefit directly from the project, e.g., as a consultant or paid collaborator, or as a speaker at a conference whose expenses would be paid from the grant.

b. The reviewer is from the same institution as the applicant

c. The reviewer and applicant have a family relationship.

NOTE: Members of the National Science Board may be used as reviewers only with the approval of the Director.

The program should involve as many qualified persons as possible and avoid too frequent use of any one reviewer or institution. The definition of "too frequent" will vary, mainly because some areas are more heavily populated with potential reviewers than others. The program officer should constantly seek new names for future use.

In selecting reviewers, the program officer should bear in mind that the purpose of external review is to provide information on which an informed judgment can be based. Reviewers assist but do not decide. The final responsibility for evaluation and judgment is the Foundation's, and the program officer is a crucial element.

SELECTION OF ADVISORY COMMITTEE AND PANEL MEMBERS

The criteria and concepts discussed to this point are most applicable to the choice of mail reviewers for individual proposals, or members of ad hoc evaluation groups for specific sets of proposals received in response to a request for proposals, program solicitation or program announcement. The Foundation also uses standing advisory committees and panels for proposal review, as well as outside advice on many questions of program management and development.

The criteria for the selection of reviewers apply to the choice of committee and panel members as well, but it is seldom possible to meet all these criteria with respect to all proposals in a small group of people reviewing a variety of proposals. It is important, however, that such groups be structured to provide representation of different points of view on the matters under the committee's or panel's purview. The Federal Advisory Committee Act, P.L. 92-463, provides that the membership of an advisory committee shall be "fairly balanced in terms of the points of view represented and the functions to be performed by the advisory committee." Similarly, the procedure prescribed by OMB Circular A-63 on the establishment of new advisory committees requires a statement describing "the agency's plan to obtain balanced membership on the proposed committee."

Although it may be difficult to define "balance" in specific cases, it is usually possible to avoid clearly imbalanced committees or sets of reviewers so long as the need to do so is kept constantly in mind. A regular rotation should be imposed upon all continuing bodies and replacements should be chosen to preserve continuity of representation for principal elements of concern but also to strengthen the representation of elements which are interested but have not been well represented previously. Some criteria which should be kept in mind to help in achieving reasonable balance are the following:

1. Individual qualifications-

   recognized scientific ability plus demonstrated ability as a reviewer (e.g. through prior service as an ad hoc mail reviewer);

2. Balance of specialty interest-

   even though limitations on committee or panel size make it impossible to cover many areas completely, consideration should be given to non-duplication and complimentarity of specialty;

3. User or "concerned public" representation, in areas where this consideration is relevant;

4. Geographic distribution - as wide as possible;

5. Institutional representation -

faculty members from a broad spectrum of universities and colleges should be considered; a mix of public and private institutions is desirable. Consideration must also be given to the selection of committeepersons or panelists from outside the academic community. Successive appointments of individuals from the same institution should be made only under exceptional circumstances.

6. Minority and female representation-

special attention should be paid to the availability of qualified committeepersons or panelists in these categories;

7. Age distribution - a balance of age groups is encouraged.

This Memorandum is intended to provide guidelines for all programs of the Foundation. However, where unique or non-standard situations exist, assistance in the interpretation or application of these guidelines should be obtained from the cognizant Division Director or Assistant Director.

H. Guyford Stever
Director

Distribution F

Dr. STEVER. Now, the other——

Senator LAXALT. Did we have some game-playing going on within our own agency in connection with peer reviews, as evidenced by the GAO report?

Dr. STEVER. We had some very serious breakdowns and we have changed our internal administrative procedure.

Let me again say that almost all of the people that I know in this system are very talented and quite trustworthy and they would do a good job.

Some of them are rushed because they do have heavy loads. There are two kinds of things that could happen in our old administration, and I look at them this way:

If a person is so rushed that he says, "OK, I have got my reviews, this is my judgment," he does not put enough data in the record given to his superior, and we end up with a proposal that may have been well considered, but we do not have a good record in our jackets.

The second kind of thing is, that cases have been found in our education sector, in which the people at the lower level felt that as soon as they had made the decision and checked with the reviewers and back with the investigators that the project would be OK, that they could write up very optimistic reports to the National Science Board, and we have how many of those under examination. Five or six.

Senator LAXALT. And you mean the eventual result was only the positive aspects would be depicted in your report with no balance whatsoever?

Dr. STEVER. That's right, and, Senator Laxalt, to me I have felt that this has been the weakest part of our system for two reasons. First, if one wants to misuse the system, it clearly is a way to misuse Federal funds. Second, for somebody who does not want to misuse the system, but in fact does a good job, he still is not very well protected. There were not enough people looking at his work to give him help.

Senator LAXALT. How did this occur?

Was it a lack of guidelines on a management basis?

Dr. STEVER. No. I think it grew up because we were a small agency in the beginning and everyone had more time—the first Director of the National Science Foundation read all of those grant jackets and signed off on them, and then we grew and grew and grew. I think we preserved some of the old system.

Senator LAXALT. Did it develop traditionally within the agency that if a given project was approved that only the favorable parts of the peer review would be passed on?

Dr. STEVER. No, this was an exception.

Senator LAXALT. These are isolated examples then?

Dr. STEVER. Yes. We have various degrees of it, and we are sure that it is not a general practice. On the other hand, there were some cases—we know of one case in which there was an outright misstatement. That was one of the things that GAO found. There were some others in which the statement was unjustifiably favorable—it was not a misstatement in the sense that a sentence was wrong, but it was a misstatement in the sense that the write-up of the review evidence was overly positive. That was most apparent in this par-

ticular area of education that we looked at. It has been my feeling that we had to change this. We have instituted a process which was first used by the RANN Directorate, which was introduced in education about September when Dr. Averch went there and it has since been introduced in all of our granting directorates. That is the Action Review Board. Every one of the actions is reviewed by a group from within the Directorate with a person from the counsel's office, from the business office and, possibly, from another Directorate. They ask the questions: Were the reviewers properly selected, do you have a balance? Is the title properly selected? You know we have run into trouble there. They ask the question, "Have our procedures been followed?" But most importantly they ask the question, "Is this really fitting into one of the approved National Science Foundation programs?"

I believe that it will work much better in the future, although one worry I have is that we have constructed a fairly complex system to solve a problem which emerged in the science education area.

Senator LAXALT. How many applications did you say we are receiving annually now?

Dr. STEVER. Is is about 24,000.

Senator LAXALT. And those go where in NSF initially?

Dr. STEVER. They go initially to central processing, and then they are sent out to the appropriate granting directorates.

Senator Laxalt, the heads of the directorates can approve grants. I do not approve proposals any more, but I do have to approve those proposals that go to the National Science Board, and you know, from what I have learned in the last year in some of those that I have approved, the work behind them was not done in the best way. So we are going to look at all those a little more carefully now with a review board of the same kind under Dr. Atkinson's direction.

Senator LAXALT. Out of this vast number of applications how many realistically, after the original screening process, do we work with, in percentages? A fraction?

Dr. ATKINSON. No. We work with all of them. We fund about half.

Senator LAXALT. They are all given consideration——

Dr. ATKINSON. When I say there is an average of six reviews per proposal, that is all proposals, whether rejected or accepted.

Dr. STEVER. I think Senator Laxalt is aiming at something else. Maybe you are aiming at what percentage of these do not have anything to do with NSF and are obviously no good so we reject them. Over the years the knowledge about NSF has grown so we do not get a large number of those; we get a few, but not too many that really have nothing to do with NSF, so we really do have to look at most of the ones that come in.

Senator LAXALT. Dr. Hughes, I would like to just ask you one question.

I understand the science curriculum review team of last May did not uncover the misrepresented items and the peer reviews.

Is there some explanation as to why this was not uncovered at that time?

Dr. HUGHES. Yes. Senator Laxalt, I am not sure I would agree with your statement in that particular form. The charge to the review team insofar at least as I understood it when I joined the team as

chairman, was to develop a review of the last 15 or more years of the Science Curriculum Activities at the Foundation with an eye to making recommendations to the Director for improvements in the procedure and the policies that were involved. It was a rush activity. I joined it on April 7 and it was due to report to the Education Advisory Committee on May 8, I believe, and then to Dr. Stever's office, and finally at the end to Mr. Teague through Dr. Stever on the 15th of May.

It involved an enormous amount of effort. I believe that the team did uncover eventually all of the basic concerns that you have heard expressed today. As a matter of fact, rather than go down the litany of the recommendations which I made as a result of having general oversight over that activity, I would ask simply that both the procedural and the policy recommendations be put on the record at this point because——

Senator LAXALT. I would like that.

[The information referred to follows:]

CHAIRMAN, SCIENCE CURRICULUM REVIEW TEAM RECOMMENDATIONS

The following recommendations were submitted to the National Science Board and the Director by the chairman of the special review team Assistant Director, Robert E. Hughes. They represent the conclusions of the chairman after due consideration of the results of the study conducted by the review team. The chairman also consulted with two members of the National Science Board who were associated with the review team for oversight purposes and with the Advisory Committee for Science Education.

Procedural Recommendations

The following recommendations are procedural in nature. They are intended to strengthen ongoing practices and to develop a somewhat more formal, structured approach to curriculum development and curriculum implementation activities of the National Science Foundation. They can be implemented through normal administrative action, but this, of course, does not preclude the possibility that the National Science Board might wish to speak to these or related issues in a general policy statement.

1. It is recommended that a continuing program be instituted to develop and establish priorities for curriculum development activities.

This needs assessment program should utilize a variety of mechanisms such as panels, conferences, symposia, workshops, etc., to develop priorities within and among prospective disciplinary and interdisciplinary areas. These activities should include representatives with professional experience in education, curriculum development, and in the disciplinary fields of interest. Active participation should also be solicited from school administrators, teachers and the interested public.

2. It is recommended that procedures be developed to guarantee: (a) that information is widely disseminated about needs for curriculum development activities that have been identified in certain specific or broad areas (b) that proposals received in response to such announcements are reviewed by appropriate panels in a competitive mode; (c) that the review panels are carefully constructed to provide a sound intellectual base and reasonably broad representation; (d) that, when appropriate, several of the best proposals be funded as pilot programs for approximately two years, after which time another competitive review should be conducted to determine whether one or more of these should be continued.

Many innovative and important ideas and programs arise from unsolicited proposals from individual investigators. It is vitally important that neither the needs assessment program nor the competitive review procedures

be structured so as to discourage or preclude the submission of independent ideas to the National Science Foundation.

3. It is recommended that more formal, structured procedures be established for periodic review of major curriculum development programs.

These reviews are not to be confused with "formative evaluation" or "summative evaluation" activities that are undertaken by the grantee as a normal part of the curriculum development activity itself. The reviews should be structured by NSF to include appropriate professional and public representation and should be directed toward an assessment of the merits of the total development activity. The review activity should involve an interactive panel and, whenever appropriate, an on-site visit with the grantee. Special care should be taken to ensure that the review panels, while free to express their views, do not stifle freedom of intellectual inquiry and innovativeness on the part of the investigators.

4. It is recommended that a formal mechanism be established for conducting an in-depth review of completed curriculum development programs.

The review panels should be carefully structured to provide balanced professional oversight and appropriate public representation. Such a review should be mandatory before curriculum implementation activities are considered. This should not preclude normal testing activities within selected school communities for the purpose of developing and revising elements of the curriculum programs.

5. It is recommended that a research program be developed to carefully explore existing barriers to diffusion of new curriculum materials in science education.

The program should be structured to provide basic information about the total system. The information should be made available to the Congress, Federal agencies, State and local authorities, the educational community, and the curriculum development community.

Total responsibility for adoption of curriculum materials in school systems rests with local and State authorities. There appears to be widespread concern among many professional and public groups about the complicated process of introducing new curricula into local school systems. It is important that all interested parties fully understand every aspect of the curriculum implementation process in order to ensure that Federal activity in this area does not infringe upon local and State responsibilities.

6. It is recommended that a legally binding codicil be added to every curriculum development grant to ensure that the grantees comply with the existing provision that a disclaimer of NSF endorsement be prominently displayed on all materials developed under the grant.

Although such a disclaimer is called for in the NSF Grants Administration Manual, it appears that the requirement has been ignored in some cases. This is an important issue and the disclaimer should be made mandatory with legally binding agreements.

Policy Recommendations

1. It is recommended that the National Science Board develop a definitive policy statement that speaks to the purposes and the objectives of curriculum development activity at the National Science Foundation.

The fundamental objectives of curriculum development activities at the NSF have gradually changed over the years. At first, the primary objective was to design curricula to attract the best minds and to improve the educational attainments of those students in secondary and primary school systems who were likely to embark upon careers as professional scientists. Gradually, another objective gained widespread acceptance. This involved a deliberate concern with providing a deeper understanding of the impact of science and scientific thinking on modern society to *all* students at every educational level. The first approach is directed toward developing competence in specific intellectual disciplines; the second toward illuminating the underlying nature of our technological world. The policy statement should delineate the extent to which future science curriculum activities at NSF should be directed toward these goals for both the natural and the social sciences.

2. It is recommended that the National Science Board formulate a clear policy statement on the role of the National Science Foundation in the implementation of science curricula.

In the public at large, in Congress and in the local and State educational communities there are widespread convictions that the role of the social sciences in school programs differs in some fundamental way from the role of the natural sciences. Traditionally, in many quarters, the social sciences have been regarded as a key element in introducing young students to the social and political environment in which they will live and work. Indeed, courses in local, State and Federal government—civics, history, and geography—have often been directed to that end. From this point of view, attempts to introduce alternative approaches to the social studies are sometimes regarded as having political implications.

Concern over new and controversial ideas is, of course, not limited to the social sciences; possible impacts of new developments in the physical and natural sciences have long been debated. In both cases, such concern is heightened whenever the Federal Government appears to be using its resources to deliberately disseminate or promulgate controversial material.

Since curriculum implementation activities are designed to disseminate materials that are sometimes regarded as controversial or even inherently political in nature, it is important that a clear NSF policy be developed for the guidance of future activities in this field.

3. It is recommended that the National Science Board initiate a study to develop new mechanisms for administering curriculum implementation activities that will allow the National Science Foundation to remain at "arm's length" from the process.

Analyses of the overall impact of NSF sponsored curriculum developments in the sciences suggest that there has been widespread acceptance of many of the programs in the Nation's school systems. The national educational establishment is not only huge, it is remarkably diverse and highly decentralized. It is generally accepted that organized curriculum implementation activities are necessary if new developments are to be brought to the attention of local authorities for their consideration. Thought should be given to new approaches that might directly involve State and local authorities, private institutes or academies in curriculum implementation.

Dr. HUGHES. I think it will show that most of the concerns that we heard here this afternoon were predicated on some of the recommendations that were made. The issue of needs assessment was the first. It was the strongest, clearest thing that came out of the study, that there was not a systematic attempt made to assess the real need for a curriculum before it was started. Open competition after a need was assessed did not exist. The question of open panel review, bringing in public participation; the question of starting up two or three pilot projects as Dr. Averch indicated before, to be followed by selection of one or two of those; the question of looking at curriculum development projects in midstream for evaluation because some of them are very long programs; the question of making sure that there was a final summative evaluation before implementation could be undertaken; all were directly addressed.

Finally, in the policy area I think two very basic policy issues were surfaced. One with respect to the reasons for the Foundation being in the science curriculum development field itself, and the second and the most profound and difficult one, the question as to whether or not the Foundation should be in the science curriculum implementation field.

I am not an expert in this area. My total exposure was about 1 month in part of April or May of last year, and I do believe that those recommendations do cover the basic issues. As far as the administrative practices are concerned, I think——

Senator LAXALT. Are we talking about irregularities?

Dr. HUGHES. As far as the actual daily practices are concerned, the executive secretary of the team did present to the Director, to the Science Education Division, a list of two pages of individual practices that ought to be looked into. These included, for example, making sure that more people in the line, should see the sign-off of the individual program managers, and a whole series of other practices. I think that the structure of the review was not designed as a detailed long-term investigation of the kind that would in fact command the word "investigation." It was a review done to look for both procedural issues and policy issues, and I think that I have not seen major procedural or policy issues that were not thus identified.

Now, as far as the fact that subsequent to the primary report appendix material was written to set forth the course of the review, and some errors crept into it, I have been assured that this is the case—I find very unfortunate but I really cannot speak to it because——

Dr. STEVER. I would like to speak to it because there is no question NSF did a good job and a bad job in the same report.

I would like to enter a letter which I sent to the Assistant Director for Education and the Assistant Director for Administrative Operations, which says that the science curriculum review team that I appointed on April 7 has completed its study. This is June 5, 1975, and I enclose actually 2½ sheets of exactly what he was talking about, and they are the major things that we found that were not good practice and it was a pretty critical report.

[The material referred to follows:]

UNITED STATES GOVERNMENT

Memorandum

CAMERA COPY—PLEASE SHOOT AND ~~from~~ P. 129
SUPPLY 2 SETS DYLUX
(Hold Page Numbers Thruout)

TO : Assistant Director for Education and the
Assistant Director for Administrative Operations

DATE: June 5, 1975

FROM : Director

SUBJECT: Report of the Science Curriculum Review Team

The Science Curriculum Review Team that I appointed on April 7, 1975, has completed its study. Its report, which is attached, includes a number of policy recommendations which are under consideration by myself and the National Science Board. In addition to the several major policy recommendations in the report, there are also a number of additional areas of concern the team has identified that are of less importance, or that can be resolved by normal administrative action. These comments are also attached. These are not discussed in detail in the report.

Please take all these recommendations under advisement, consult as necessary with other members of the senior staff, and give me your position on the policy recommendations and a plan for implementing necessary changes in practice and/or procedure by June 20, 1975.

H. Guyford Stever

Attachments

cc: Executive Council
Management Council

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

Comments and Recommendations for Administrative Action

GENERAL

Program and business management training for staff should be strengthened.

Requirements for increased review, analysis and assessment, improved documentation, and more broadly based advisory procedures may require increases in staff and/or employment of staff with management as well as scientific expertise.

Policies for fees, royalty income rights to products, and other business arrangements should be reexamined and more clearly established and documented, to include arrangements for funding of developers by publishers. Deviations from policies should be submitted to the NSB without regard to dollar cost. (Apparently, NSF policies differ from those of OE and NEH.) NSF(program office/GCO) should be more diligent in following up with grantees for information on royalty income.

REVIEW PROCESS

In all review processes criteria for evaluation should be clearly and explicitly established and made fully known to all parties. Standards and procedures for selection of reviewers, and the documentation of reviews to include their use in NSB submissions and other program packages should be established in a written document for the guidance and protection of all parties to NSF decisionmaking.

Reviewer selection criteria should ensure objectivity on the part of the reviewer. There have been instances of too many reviewers being selected from the same institution as the PI, and other instances where a reviewer was listed as a possible consultant to the project.

Where program decisions reverse significant reviewer or advisory board criticism, either due to changes in project design or overriding program judgments, reviewers or advisors should be informed of the essence of and the basis for the decision, and be given the opportunity to comment further prior to final decision.

In addition to outside technical reviews, internal NSF review should include technical reviews by non-AD/E technical staff, e.g. review of business, management and financial arrangements by GCO and Audit.

Acceptable proposals should be ranked in order of merit by technical review panels in accordance with published criteria.

Reviewer's complete comments should be forwarded to at least the next level of management above the program manager for review prior to concurrence in the award recommendation. This is to ensure that reviewers comments are fairly and accurately summarized for NSB officials who will approve the recommendation.

70-027 O - 76 - 17

The award recommendation, along with full documentation of decisions, program management plans etc. should be reviewed by AD/E and other appropriate offices in NSF. Tightening of review procedures along the program chain of responsibility seems in order.

Each proposal for continuance should be reviewed by a different set of reviewers. A comprehensive progress report should accompany a proposal for continuance of a grant. This progress report should accompany the proposal sent to reviewers.

MONITORING AND OVERSIGHT

While monitoring of most projects appears to have been extensive, vigorous and responsible, it has not been systematic. There are no regular procedures for collecting project status information. A systematic substantive reporting procedure should be developed and a phased time and effort plan required for all grantees and contractors to ensure that; 1) time-task records are established; 2) progress towards objectives can be clearly assessed;3) needs for alteration in the work plan can be assessed.

Reviews of progress should be made prior to all major commitments of funds or redirection of content. Such reviews should reassess the underlying rationale of the project independent of "sunk costs" or other implicit commitments to the project. The views of Federal, State and local authorities as well as scholars and educational specialists should be obtained..

The oversight or steering committee should be required to review the content of the project and to report on its appropriateness to NSF.

Review of contractual matters should be extended to subcontracts or other arrangements where use of federal funds or implied federal endorsement can be anticipated. In particular, this should include procedures for selection of subcontractors or other assignees.

The pattern and flow of work assignments among various NSF units involved in oversight and management such as the program office, General Counsel, Grants and Contracts Office and the Audit Office is in need of review to ensure that the appropriate expertise is brought to bear on complex program issues in a timely manner.

DOCUMENTATION

When there is only one proposal submitted for a particular project, the file should document the extent of the publicity given to the particular project.

Program staff should maintain a running chronology of program decisions, discussions, telephone contacts and other matters germane to the project and program decision process so that the pattern of program decision can be clearly recalled at a later date.

The program files should contain documentation relating to the royalty rate(s) accepted.

NSF should require from grantees, at the completion of a curriculum improvement project, a summary of units of materials produced, (by type or description), cost, number of units sold, sales income, and royalty income received.

A periodic survey of publishers should be made to determine prevailing royalty rates for the types of materials being developed and published under grants.

All contracts between grantees developing course content materials, and publishers/distributors should include a "right to audit" clause by NSF or other government agencies.

A standard for program records covering content, form, and organization of such records should be established.

Dr. STEVER. Now, I will have to say that we got a response. We got a satisfactory response from the Assistant Director for Administrative Operations. The Education Directorate never properly responded. In fact, we have had to replace all of that leadership; some resigned, some persons retired, and we now have completely new leadership. What Dr. Averch has been describing today is his past half year's response to past practices. We fell down very badly as an agency, and I think the blame goes everywhere in the agency. We rushed the second part of the study last year to get the job done. We put out an appendix or a second part which was not well done with respect to the editing, and one of the worst things of all as far as I am concerned, is that it was never sent back for absolute final sign-off of everyone who had been in the study saying this is what I agreed to.

Senator LAXALT. Are you satisfied, doctor, that the omission was unintentional?

Dr. STEVER. I think that almost everyone of those people had important work that they wanted to get back to after they had found out the basic facts. I guess I am not going to answer the question until I have a chance to look at it further.

Senator LAXALT. It is probably premature.

Dr. STEVER. I think everybody is astounded that we should do so well on the central theme of the thing and then put out a bad back-up report. We apologize and our face is red and we are going to live with that bad report I guess for a long time.

Senator LAXALT. One last question, Dr. Stever.

We discussed in my office the possibility of an independent management analysis.

Will you state for the record what your feelings are in that regard?

Dr. STEVER. Yes. I think I am in favor of looking at management and maybe looking at it from two or three points of view.

One is, as you know, these new administrative procedures that we have, the new action review boards, they need some kind of watching, a checkup to see if they are working the way we think they are going to work and they are working in some parts. The National Science Board has appointed a committee to do that. It may be that the National Science Board and the Foundation staff together should ask for an outside group to look at the administration. We have changed a lot and we worked awfully hard to bring out these new procedures that I have entered into the record, and there is a whole team here that has worked extremely hard, but I think it would be a good idea to have some unbiased criticism.

Now, we do have a number of outside looks at us right now, but we are going to take your suggestion and I would like to work with the National Science Board and see whether it fits in.

Senator LAXALT. Very well. Thank you very much.

Do you have anything more?

Dr. STEVER. No.

Senator LAXALT. Once again, I appreciate your coming here at this late time.

Dr. STEVER. Thank you, sir.

Senator LAXALT. We will now recess the subcommittee to reconvene subject to the call of the Chair.

[Whereupon, at 5 p.m., the subcommittee was recessed to reconvene subject to the call of the Chair.]

NATIONAL SCIENCE FOUNDATION AUTHORIZATION LEGISLATION, 1976

WEDNESDAY, MARCH 3, 1976

U.S. SENATE,
SPECIAL SUBCOMMITTEE ON THE
NATIONAL SCIENCE FOUNDATION OF THE
COMMITTEE ON LABOR AND PUBLIC WELFARE,
Washington, D.C.

The subcommittee met pursuant to notice at 2:12 a.m. in room 6202, Dirksen Senate Office Building, Senator Edward M. Kennedy, chairman, presiding.

Present: Senators Kennedy and Laxalt.

Senator KENNEDY. The subcommittee will come to order. I want to express my appreciation for the patience of our witnesses. A number of them have come from out of town and we had to reschedule the hearing from this morning to this afternoon. That was unavoidable, and involved some important matters that required me to return to the State of Massachusetts this morning.

I appreciate that patience and willingness of the witnesses in remaining with us until this afternoon.

Our hearing this afternoon is a continuation of the subcommittees consideration of the budget for the NSF for fiscal 1977. On Monday we heard from Margaret Mead, chairman of the board of the American Association for the Advancement of Science and from the leadership of the National Science Foundation. Today we will hear from three panels on the level of support and the structure of the NSF's programs.

The first panel will address science education and research. This is, I think, an extremely important area.

There is not as much interest and awareness of the importance of science and technology as there should be in view of its impact on our lives. We need to be aware of many of the kind of backgrounds in science and science education needed by our citizens. We will look forward to comments on this later.

The second panel will discuss the Science for Citizens program being developed by NSF. I think this is extremely important and we will have had some thoughts developed on that during earlier hearings which we will go into further this afternoon.

The third panel will discuss the status of women and minorities in science. We had some testimony on that earlier. I think we are impressed by the initial efforts that have been made in bringing some women into science, it appears that for minorities most of the efforts were channeled toward institutional assistance. We want to find out what ideas and suggestions can be made in both of these areas by interested and concerned women and minority scientists. We are also fortunate to have with us Dr. Jewel Plummer Cobb, a

member of the National Science Board. She will testify on her experiences on the Board and in developing programs to encourage the participation of minorities of women in science.

Included in the issues we want to raise with the witnesses is the emphasis which this year's budget places on the basic research—we are interested in that. Also the level of support provided for science education and for efforts to improve the level of scientific literacy of our young people. Programs to provide citizens groups with accounts to scientific and technical advice; to encourage scientists to participate in public policy debates and to improve the participation of non-scientists in development of policies and priorities for science and technology; and the level of support provided for efforts to improve opportunities for minorities and women in science and technology and to insure that minorities and women at the precollege level are encouraged to consider careers in science. These are issues that are issues that have been of longstanding concern to the subcommittee and we look forward to the testimony this afternoon.

We will ask the panel on science education and research to begin.

On the panel is Dr. Frank Hereford, president of the University of Virginia. It is nice to welcome back a law professor of mine from a great university. He instructed not only me but the distinguished Senator from California. We feel a great sense of affection for this university.

Also Dr. Thomas Wenzlau, the president of Ohio Wesleyan University; and, Dr. Robert Silber, executive director of the National Science Teachers Association.

I also want to recognize Senator Laxalt here who has been very active on our committee and in the efforts on science policy and science advice to the White House. He has followed the activities of the Foundation with great interest and has been a great help to the committee. We are glad he is here.

STATEMENT OF DR. FRANK HEREFORD, PRESIDENT, UNIVERSITY OF VIRGINIA

Dr. HEREFORD. Thank you, Mr. Chairman. It is always a pleasure to appear on any occasion before an alumnus of the university and particularly a pleasure here today.

My name is Frank Hereford. I am president of the University of Virginia, and a physicist by profession. I am testifying on behalf of the American Council on Education, the Association of American Universities, and the National Association of State Universities and and Land-grant Colleges. The members of these associations are responsible for virtually all of the Federal funds which are provided for academic science.

In our judgment, the President's proposed fiscal year 1977 budget for the National Science Foundation is a sound one. We support it in all essentials, and we hope that your committee will approve the authorizations on the scale which the President has requested.

Academic science today we believe is a healthy state. Three decades of Federal support, buttressed by State appropriations and private giving, have generated strong momentum. We have senior investigators in virtually all fields that are as comparable, or as good as, all

the best in the world. They continue to break new ground, and the future looks exciting. However, this national enterprise is endangered. Federal support for basic research in the sciences has declined since 1968 by more than 20 percent in constant dollars with serious adverse consequences for all of academic science. Support levels of individual projects have generally remained constant in spite of mounting inflation; and promising lines of investigation have had to be curtailed and some programs terminated. Scientists and agencies have tended to be cautious rather than venturesome and instruments, the central source for many lines of inquiry, have deteriorated and need upgrading or replacement.

This stagnation has derived in part from our tendency to support academic science in our universities on a crisis-to-crisis basis—from Sputnik to environmental concern to energy production. In each case universities have been called upon to establish emergency programs. We believe that the country has wasted resources with this approach. If continued, stable support for science and universities were provided their strength could be sustained as a national resource, and the Nation's capacity to deal with unforeseen problems would be considerably enhanced.

Our national commitment to science began only at the end of World War II and we need to mold it into a scientific tradition comparable to that which in some Western European nations—Germany and Great Britain, for example—extends back into the 19th century.

For these reasons we are particularly pleased that the President's proposed budget for the National Science Foundation provides increased funding for basic research. In terms of the total Federal research and development budget the increase is of quite modest proportions. We urge adoption of the President's proposal, and it is our earnest hope that it will prove to be a permanent turning point in Federal recognition of the importance of basic research to the national welfare.

While we support the proposed budget in broad outline, we believe that it has some deficiencies. We believe there is need to increase the proposed science education budget. We support the carefully considered recommendation of the National Board of Graduate Education. This independent group of high stature has reviewed national needs for hiring trained persons and recommends that the National Science Foundation support 1,000 rather than 500 new fellowship starts per year. We urge at least a restoration of fiscal year 1975 levels in the NSF graduate fellowship program and reinstatement of the minority institutions traineeship program recommended by the President.

Apart from the budget itself, there are broader issues concerning the relationship between universities, scientists, the Federal Government, and society which deserve discussion.

First, I want to emphasize the significance of the increasing rate of change in our society and its relevance to education. I doubt that any field matches science and engineering with regard to rapidity of change. Ideas change as new knowledge becomes available. Technology changes, and new tools—such as the computer and the laser—make tasks easier and yield new solutions to old problems. And finally,

national priorities shift, generating needs for new knowledge and for new professional competence—including, but not limited to, competence in science and engineering.

These changes have enormous implications for education. Students must in their initial academic training secure a firm grasp of fundamentals, in order that they can appreciate and understand new concepts. Furthermore, there is a need for continuing, career-long education of scientists and engineers.

Recognition of the necessity for continuing education has already occurred in law and medicine, for example. Many programs, designed to keep lawyers and doctors all abreast of new developments, exist throughout the country. In our judgment a serious effort by the National Science Foundation to enable engineers and scientists to adapt to change would be a handsomely rewarded investment.

Senator KENNEDY. President Hereford, would you be prepared to make any suggestion as to the level of support the NSF proposed—$1 million for continuing education programs? We had a provision in S. 32 that called for about $3.5 million. I do not know whether you are prepared to make any dollar recommendation or whether you would like to leave that for later on.

Dr. HEREFORD. At the very least we hope this level would be sustained in the course of congressional consideration, Mr. Chairman.

Senator KENNEDY. Your testimony emphasizes the underlying importance of this dimension of education in the area of science and engineering—continuing education?

Dr. HEREFORD. Yes, sir.

Senator KENNEDY. One which I completely agree with. Thank you.

Dr. HEREFORD. Second, colleges and universities strongly support the peer review system. A reasonable rationale for public support of scientific research is that support of the best science should provide the best yield of new knowledge. History, I believe, discloses that the developments which have increased the quality of life can be traced to the discovery of new knowledge at some time in the past. We believe that the best judges of proposed scientific endeavors in this regard are those who have themselves been successful in such endeavors.

At the same time we recognize that a peer review system must be watched closely. Potential exists for favoritism, distorted presentation of the opinion of reviewers, scientific faddism, and improper use of privileged information and we believe that it is not only proper, but virtually important, for the Congress to maintain a continuing overview of the system.

We believe that developments in the past year demonstrate the effectiveness of congressional overview, as now exercised. Applicants for NSF grants are now provided with reviewer's comments upon request; NSF reviewers are listed annually. The NSF conducted a study of the influence on grant awards of institutional prestige, geographical location of reviewers and proposed programs, State populations, and even State populations of National Academy members. In this study it demonstrated a high degree of objectivity in the award process. In addition, NSF has contracted with the National Academy of Sciences for a two-phase study of the peer review system. We believe that these developments represent reasonable and desirable responses to the concerns of the Congress.

In judging the research enterprise under the peer review system, it must be recognized that even high quality basic research can lead to a dead end. Some research produces negative findings, which are themselves useful because they lead future investigators away from plausible but fruitless lines of investigation. Some program titles appear frivolous. For example, a number of years ago, one of my colleagues at the University of Virginia, who is now a National Academy member and a National Science medalist became interested in rapidly rotating objects. Some of his early publications were on "spinning tops"—a schoolboy pasttime. Today the ultracentrifuge techniques which derived from his early work are of vital importance to the study of biologically significant molecules in the preparation of enriched fuels for nuclear reactors and in many other areas.

We believe that the best judges of scientific merit are the best scientists.

Senator KENNEDY. May I ask before we leave this point on the question of peer review. Do you think that is advantageous or useful or helpful or advisable that the names of specific reviewers as well as the text of the review should be released? Should the reviewer's name be identified with that peer review? What is your feeling about that?

Dr. HEREFORD. I think that it is important for the list which the NSF now provides for all reviewers to be made available to the public?

Senator KENNEDY. Right.

Dr. HEREFORD. I am doubtful about the wisdom of making the specific reviewer and the program that he reviewed known to all. The scientific community——

Senator KENNEDY. What about just known to the person whose proposal is being reviewed? Should he know who reviews the work?

Dr. HEREFORD. The individual, Mr. Chairman, who submitted the proposal?

Senator KENNEDY. Yes.

Dr. HEREFORD. Should he know it?

Senator KENNEDY. Yes.

Dr. HEREFORD. I am inclined to think not, sir. I believe that in the interest of—let me go back a bit.

Senator KENNEDY. I was happy with your first answer. [Laughter.]

Dr. HEREFORD. Any particular area of science is a fairly closed knit community. The individuals that are involved know one another very well. I doubt that one could get a truly objective appraisal of the scientific merits of a proposal if it was well known throughout the scientific community that the reviewer's name was going to be known.

Senator KENNEDY. Thank you.

Dr. HEREFORD. Third, there is a proper and important role for the Federal Government in funding the design of curricula for the scientists at the elementary and secondary levels. For example, 20 years ago textbooks and laboratory materials for high school physics were hopelessly outdated.

The textbooks were what might be called general science. Revision not only of textbooks but the curriculum and I do not think that any particular school or school system or individual nor could industry undertake the funding that was required for a complete overhaul of the type of textbooks available for science at the high school level.

Federal funding was needed and I think it was very significant that it was provided and that the results thereby obtained were very impressive. The same situation holds today on a continuing basis.

We believe this is an important area for the National Science Foundation to be involved in. At the same time it is an area where there is potential of abuse and particular care has to be taken to insure that local authorities and institutions and faculty members retain their freedom to determine curriculum.

Moreover, there must be safeguards to insure that the marketing of curricula does not produce improper private incomes for individuals and organizations. As with peer review, we are confident that sound guidelines and congressional overview will protect against such adverse conflicts.

Fourth, colleges and universities and a great majority of faculty in our universities support research in the social sciences. A central purpose of universities is to explore not only the physical and biological world, but the nature of man and the nature of society.

Senator KENNEDY. Dr. Hereford, in this area of science and education, about 6 years ago this feature of the NSF budget was probably 27 or 28 percent of the total budget. Now it is only about 9 percent. No increase is proposed in the budget submission. Given this situation, given your own testimony and comments about the importance of science education what kind of support should be available—could you make any comment on that? I am not trying to say the dollar value is necessarily the final word in terms of commitment but at least it has an important bearing on what is done.

Dr. HEREFORD. Well, for the particular area of science education that I was referring to, I believe that the proposals for the next fiscal year——

Senator KENNEDY. Of $55 million.

Dr. HEREFORD. Reductions in this area of——

Senator KENNEDY. Curriculum?

Dr. HEREFORD. Curriculum, that is correct.

Senator KENNEDY. Yes.

Dr. HEREFORD. We believe it is important for it to be restored to the previous level.

Senator KENNEDY. I suppose with regard to the longer range interest of our country this is important, too. Would you not agree that having strong programs at the high school level has to be important?

Dr. HEREFORD. No question about it. Not just in preparing students at the high school level who might be interested in going to higher education in the sciences and engineering but simply from the point of view of giving any citizen a reasonable degree of education in the sciences. We think this is vital and equally important for the general student, particularly the one interested in science.

Senator KENNEDY. Thank you.

Dr. HEREFORD. There are ultimate values and truths relating to social issues that do not lend themselves to the traditional approaches of science, but it is in the nature of universities that the search for truth pursues many paths.

Important and legitimate questions should be asked about federally financed research in the social sciences. The rights of individuals who give information or who serve as research subjects must be protected.

Research must be sound and investigators must be competent. Due regard has to be paid to national priorities in selecting investigations for support. These are all important aspects of social science research to which continuing attention must be paid. As with peer review and curriculum development, it is possible to design guidelines, review systems, and safeguards which will permit sound research to go forward while protecting the legitimate interests of all concerned.

I would like to close by returning to a question of deep concern to colleges and universities—the responsibility of the Federal Government for sustaining the scientific strength of universities. The prevailing relationship between the Federal Government and universities in research remains, after about 30 years of support primarily that of Government as purchaser of a commodity produced by universities. This is a narrow and dangerous approach.

May I comment just briefly on a look at universities as a national resource. It is obvious that university research adds to man's fund of knowledge. Further it is obvious, but nonetheless true, that research in universities provides unique learning opportunities. The most important thing that graduate students learn is how to learn. They do this by being apprenticed to professors who are themselves still learning. The process is at least as important as the facts gained, and in this important sense research and education are indistinguishable. The students who are educated in our universities are precious national resources. They leave in large numbers to work in Government, industry, and business, taking with them more know-how about the process of inquiry than those already on the job can ever glean from reading publications.

For these reasons, the national interest in sustaining strong universities has important dimensions that extend beyond the interests of the individual Federal agencies, and beyond the interest of the National Science Foundation in supporting basic research—important though that is.

In spite of this national interest, there is unfortunately no such thing as a Federal policy toward research in universities. Each Federal agency, with a proper concern for carrying out the tasks given to it by Congress, sets its own objectives, priorities and terms. If this committee could take even some first steps toward establishment of the principle that the Federal Government invests in universities in the national interest, as well as buying research from them, an important public service would be rendered.

In this connection, establishment of the proposed scientific and technological advisory function in the White House could contribute to a change in the philosophy of the relationship between the Federal Government and the research function of universities. For this reason, colleges and universities and the academic scientific and engineering community, hope that this important legislation will be enacted.

Mr. Chairman, we appreciate your interest and many initiatives in the area of science and technology, particularly in our universities and your courtesy in giving us the opportunity to present views to the committee. I will welcome and try to answer any questions which the committee may have.

Senator KENNEDY. Thank you very much. That was a very helpful statement and interesting. I was very interested in your definition of

the learning process and the role of the university and the effect on the learning process of the relationship between the researcher and the student. I myself feel that it is an extremely important feature of learning and understanding and I think you said it very well and eloquently. I was glad to hear it.

We will hear from the other members of the panel and then come back with some questions.

Dr. Wenzlau?

STATEMENT OF DR. THOMAS E. WENZLAU, PRESIDENT OF OHIO WESLEYAN UNIVERSITY, DELAWARE, OHIO

Dr. WENZLAU. Thank you, Mr. Chairman.

Mr. Chairman and Senator Laxalt, I come with a concern shared by Dr. Hereford. The evidence in our view is quite conclusive that while the National Science Foundation is responding strongly to crises being generated by immediate and pressing science-based problems, it is all but ignoring an appropriate and legislated responsibility to sustain the processes by which solutions for future problems are produced.

When the NSF was created in 1950 the Congress charged the National Science Foundation to "develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences." In 1972, Congress reiterated this dual responsibility in Public Law 92–372 which "authorizes and directs" NSF to in part "initiate and support basic scientific research potential and science education at all levels." Both acts of Congress recognize, implicitly if not explicitly, the inner-related nature of science, education and scientific research. In the long run neither can proceed effectively or efficiently without the other. Together they provide the essential knowledge and manpower to deal effectively with specific scientific problems. NSF having been assigned the dual responsibility, must be made to possess the foresight and wisdom to maintain an effective and essential balance between science education and scientific research.

In spite of the specific role that the undergraduate colleges play in this critical chain of events, the decisionmakers who prepare NSF budgets for scientific education and basic research reject or ignore that role. The recommended cut in spending for science education programs to a level nearly 13 percent below the original estimated expenditures in fiscal 1976 continues a devastating downward trend. New funds requested are down even more—26 percent, the difference being the "deferral" of use of fiscal 1976 funds until fiscal 1977. It is clear that the administration having been deprived of the impoundment technique by appropriate congressional action has devised deferrals as a most effective successor. Whatever its legality in fact it has become a device for the administration to subvert the express legislative intent of Congress. While deferral of 1976 funds does not necessarily reduce 1977 expenditures, a disturbing precedent may have been established. Furthermore, smaller amounts of new dollars needed in fiscal 1977 as a result of the deferral may well establish a false impression of funds needed in future years. The fact that NSF deferred $30.8 million from the Science Foundation programs in fiscal 1973, $9.5 million from the education programs in fiscal 1974, and now $10 million in fiscal 1976

has something to do with the precipitous decline in education funding you see in our appendix B.

I would like to call particular attention to the chart in that appendix which illustrates the widening gap between education expenditures and basic research expenditures. It shows that real dollar expenditures have fallen annually since 1968 and that the real dollar expenditures proposed for the next year are only 20 percent of that 1968 level. Inevitably these real cuts will reduce our scientifically trained manpower.

The second tendency which is frustrating and costly to colleges and universities is the on-again, off-again attitude regarding certain NSF programs. While we agree that NSF administrators must be responsive to changing conditions, institutions which share with NSF the responsibility to meet national scientific objectives must be able to plan and develop over the long range. They must be able to anticipate the existence of a program on more than a year-by-year basis. Being encouraged to make a substantial resource and manpower commitment to a new program and then having the funding significantly reduced is demoralizing, inefficient and unproductive. The uncertain and uneven funding of the comprehensive rule program this past epitomizes NSF imposed waste of very scarce college and university resources.

To meet these objectives, I have three specific suggestions:

First of all, we commend this subcommittee and your counterparts in the House for recognizing that the National Science Foundation has a clear responsibility to provide support for a strong process as well as meeting short-range crises in science education by directing the establishment of both science education innovation and science education support programs. Their inner related nature must be recognized but each should be supported at a level which insures high quality and such action by the Congress is both necessary and desirable.

Second, NSF should accept responsibility for sustaining these process-related undertakings by colleges and universities. Support for such programs should not be limited to seed money. Initial startup funds must be followed by sustaining support where evaluation justifies the continued existence of a program. Science education is both critical and expensive. Neither Congress nor NSF realistically can expect institutions, undergraduate or graduate, to assume the full burden of continuing support. It is a shared responsibility with shared benefits; the costs should be shared as well.

Third, Congress should direct NSF to establish a relatively fixed funding guideline recognizing the relationship between education and research. In the mid-1960's NSF funds flowing to education equaled those allocated to research. As recently as 1971 when our concern was directed to an appropriate undergirding of longrun scientific accomplishment, the portion of the NSF budget going to science education was one half the amount directed toward scientific research projects. As a result of new priorities from NSF, which we believe to demonstrate a clear disregard for longer term objectives, the support of the traditional science education programs recommended for 1977 has dropped to 10.8 percent of the funds required for basic research. There is funding relationship between science education and basic

scientific research. If basic research is to continue in the future at the pace implied in the 1977 budget, request funds for science education must be significantly greater than 11 percent of the research expenditures requested for fiscal 1977.

The continuing downtrend in this ratio must be reversed. The long-term goal for expenditures in the future should be to fund science education improvement expenditures at approximately one-third of the level of basic research dollars spent. We feel this relationship is necessary if an adequate number of scientifically educated people are to be available to carry out future basic research at a level satisfactory to our Nation. Continued rapid expansion in both basic and applied research cannot be accomplished with fewer and fewer resources devoted to educating people to accomplish that research. It is also naive to think that educating research scientists can be accomplished in the short term. Present decisions will affect our scientific capacity in the next decade. Congress must exhibit the wisdom and the courage to make those hard choices that NSF elects not to make.

As a partial answer to the inefficiencies generated by NSF's too frequent stop-and-go posture we urge Congress to adopt a biennial authorization procedure for the NSF budget to replace the present every year approach.

Senator KENNEDY. We ought to be doing that in all areas. We ought to get the Congress to go that route. It is just horrendous, the way we proceed 1 year at a time and then complain because of poor administration of expenditures. Whether it is a mayor or president of a university or somebody who is trying to run any of these programs it is very difficult to operate just from year to year. It is just absolutely ridiculous.

But I hear what you are saying. I hope we will improve.

Dr. WENZLAU. Several specific programs embodied in the legislation need special comment.

From the perspective of the type of institution I represent, one of the most important steps ever taken to improve undergraduate science education is embodied in the new program Congress initiated last year—CAUSE—comprehensive assistance to undergraduate science education. CAUSE encourages undergraduate colleges to compete for funds to upgrade science education by custom designing a program to meet the specific needs of the particular institution. Its broad scope of support—for faculty improvement, for curriculum improvement, and for related equipment and facilities—presents an extremely realistic and attractive mechanism for meeting the present needs of many undergraduate institutions. It has had a positive impact on morale in our colleges and greatly increased interest in science curricula. Even though CAUSE is new and the proposal guidelines have been available only a matter of months, more than 750 proposals have been submitted to NSF. With the level of funding of fiscal 1976 at $10 million, only 40 to 50 awards appear likely. With this information in hand we urge the Congress to increase the funding for fiscal 1977 to at least $15 million.

We applaud and strongly support another closely related NSF program—faculty-oriented rule—which we believe meets a sustaining educational need and should be funded under the science education support title. Faculty-oriented rule encourages local campus innovation by making small grants to individuals or small groups of individuals.

Announced for the first time this year, NSF has received 168 proposals for the modest $0.8 million in the budget. We recommend increasing the funding level for fiscal 1977 to $1.5 million to meet the demonstrated needs of this program.

We applaud congressional support of the small but high-gain science faculty fellowships program. After several successful years, the SFF program was suspended by NSF for 2 years. It was then reinstated in fiscal 1974, 1975, and 1976 as a direct result of the initiatives taken by Congress. NSF has planned to replace SFF with a different program called faculty research participation. In this program, grants are initially made on the basis of proposals submitted by industry and government research centers. These, in turn, offer research opportunities to college faculty through a kind of subcontract. Faculty must apply directly to the grantee center. While perhaps justifiable on different grounds, this program of faculty research participation is not an effective substitute for the tried and proven science faculty fellowships. Furthermore, the interest of industries and centers has not been very high. In fiscal 1975 they submitted only 119 proposals of which 66 were approved. Participant interest has been strong, 1,600 applications for 145 awards. The program has identified a need but not the means to meet it.

The science faculty fellowships program meets an increasingly important need in higher education. Faculty mobility has decreased dramatically with the leveling off of college student population. With turnover vastly reduced, new techniques for keeping faculties up to date and amenable to change must be devised. Furthermore, science faculty members need to be able to teach undergraduate courses of inter- and trans-disciplinary nature outside their original specialization. The faculty fellowship programs meet these needs squarely. It is designed for those scientists who have been heavily engaged in undergraduate teaching.

They may improve and augment their scientific knowledge and science teaching skills in a self-designed program of study. Flexibility is important: some science teachers need the stimulus of participation in active research; others require study at a graduate science center to acquire confidence in a different or related subject matter.

Finally, the intense competition for these grants and the peer panel evaluation process insures maximum return for each tax dollar assessed.

We therefore strongly recommend that the science faculty fellowships be continued and the support level be earmarked at $2.5 million. The number of proposals has been nearly eight times the number of grants awarded. Even funded at the $2.5 million level, the number of available faculty fellowships would be far below the number needed. We believe the faculty fellowships would be far below the number needed. We believe the faculty research participation should be funded another year at the $1.3 million level and then be evaluated to determine its effectiveness in meeting objectives set for that program.

There are several comments remaining in my prepared statement and——

Senator KENNEDY. It will be incorporated into the record in full.

[The prepared statement of Dr. Wenzlau follows:]

Statement by

Dr. Thomas E. Wenzlau, President

Ohio Wesleyan University

Delaware, Ohio

On Behalf of

The Associated Colleges of the Midwest
and
The Great Lakes Colleges Association

Before the

Special Subcommittee on the National Science Foundation

Committee on Labor and Public Welfare

United States Senate

457 Russell Senate Office Building

March 3, 1976

Senator Kennedy and Members of the Subcommittee:

Thank you for the opportunity to appear here to testify on the National Science Foundation fiscal 1977 budget request from the particular perspective of a president of an undergraduate college. As a spokesman for twenty-five independent colleges and universities*, I come this morning with an increasingly important concern. The evidence is conclusive: The National Science Foundation is responding strongly to crises being generated by immediate and pressing science-based problems but is all but ignoring an appropriate and legislated responsibility to sustain the process by which solutions to future problems are produced.

In 1950, Congress charged the National Science Foundation to "develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences." In 1972, Congress reiterated this dual responsibility in Public Law 92-372, which "authorizes and directs" NSF to (in part) "initiate and support basic scientific research potential and science education at all levels" (my italics). Both acts

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* The Associated Colleges of the Midwest member colleges are: Beloit College, Carleton College, Coe College, Colorado College, Cornell College, Grinnell College, Knox College, Lake Forest College, Lawrence University, Macalester College, Monmouth College, Ripon College, St. Olaf College

The Great Lakes Colleges Association member colleges are: Albion College, Antioch College, Denison University, DePauw University, Earlham College, Hope College, Kalamazoo College, Kenyon College, Oberlin College, Ohio Wesleyan University, Wabash College, The College of Wooster

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of Congress recognize, implicitly if not explicitly, the inner related nature of science education and scientific research. In the long run neither can proceed effectively or efficiently without the other. Together they provide the essential knowledge and manpower to deal effectively with specific scientific problems -- be they space technology in 1957 or an energy crisis in 1975. NSF, having been assigned the dual responsibility, must be made to possess the foresight and wisdom to maintain an effective and essential balance between science education and scientific research.

Three important aspects of this relationship require emphasis. First, it is absolutely essential that this nation have a scientifically literate population. We live in a science oriented world. In a democracy, the political support essential to provide for a meaningful scientific capability demands that the public understands science. Good science education must take place in primary and secondary schools.

Second, we must have a large proportion of college and university undergraduates well educated in the foundations and opportunities in science. These persons are the source for the primary and secondary school science teachers who teach that basic public understanding that I mentioned above, and also many of these young people move immediately into manpower positions in scientific industry and commerce.

Third, the most obvious direct link between education and research is the graduate school. But the graduate school draws its students from the undergraduate college. These persons, after still more science education, emerge as the professional scientists who conduct basic research which extends the limits of our knowledge and do applied research to solve specific problems.

In spite of the specific role that the undergraduate colleges play in this critical chain of events, the decision makers who prepare NSF budgets for scientific education and basic research reject or ignore that role. The recommended cut in spending for science education programs to a level nearly 13 per cent below the original estimated expenditures in fiscal 1976 continues a devastating downward trend. (See Appendix A.) New funds requested are down even more -- 26 per cent, the difference being the "deferral" of use of fiscal 1976 funds until fiscal 1977. It is clear that the administration having been deprived of the impoundment technique by appropriate Congressional action has devised deferrals as a most effective successor. Whatever its legality, in fact it has become a device for the administration to subvert the express legislative intent of Congress. While deferral of 1976 funds does not necessarily reduce 1977 expenditures, a disturbing precedent may have been established. Furthermore, smaller amounts of new dollars needed in fiscal 1977 as a result of the deferral may well establish a false impression of funds needed in future years. The fact that NSF

deferred $30.8 million from the Science Education programs in fiscal 1973, $9.5 million from the Education programs in fiscal 1974 and now $10 million in fiscal 1976 has something to do with the precipitious decline in education funding you see in our Appendix B.

Current dollar expenditures for science education have decreased every year since 1968 and expenditures proposed for 1977 are less than one-third the fiscal 1968 total for the traditional NSF Education programs. Real dollar expenditures have fallen annually since 1968 and proposed real expenditures are only about 20 per cent of the 1968 level. These cuts will inevitably reduce our scientifically trained manpower.

Nevertheless, fewer scientists are expected to carry out significantly expanding basic research programs. The fiscal 1977 Basic Research budget (see definition with Appendix B) is up 22 per cent over last year and up 56 per cent in three years. Even in real terms, the dollar expenditure for research is expanding -- up 62 per cent since 1968. (Our calculations are based on the 1967 dollar and Consumer Price Index figures. See Appendix B.) Our shortsighted failure to invest in a sizeable cadre of young people well-educated in basic science will subvert, in a relatively short period of time, the very research efforts that NSF seeks to mount.

The second tendency which is frustrating and costly to colleges and universities is the on-again, off-again attitude regarding certain NSF

programs. While we agree that NSF administrators must be responsive to changing conditions, institutions which share with NSF the responsibility to meet national scientific objectives must be able to plan and develop over the long range. They must be able to anticipate the existence of a program on more than a year by year basis. Being encouraged to make a substantial resource and manpower commitment to a new program and then having the funding significantly reduced is demoralizing, inefficient and unproductive. The uncertain and uneven funding of the Comprehensive RULE program this past epitomizes NSF imposed waste of very scarce college and university resources.

To meet these objectives, I have three specific suggestions:

First of all, we commend this Subcommittee and your counterparts in the House for recognizing that NSF has a clear responsibility to provide support for a strong process as well as meeting short range crises in science education by directing the establishment of both Science Education Innovation and Science Education Support programs. Their inner related nature must be recognized but each should be supported at a level which insures high quality.

Second, NSF should accept responsibility for sustaining these process-related undertakings by colleges and universities. Support for such programs should not be limited to "seed money." Initial start up funds must be followed by sustaining support where evaluation justifies the

continued existence of a program. Science education is both critical and expensive. Neither Congress nor NSF realistically can expect institutions, undergraduate or graduate, to assume the full burden of continuing support. It is a shared responsibility with shared benefits; the costs should be shared as well.

Third, Congress should direct NSF to establish some relatively fixed funding guideline recognizing the relationship between education and research. Such a guideline will insure a continuing and adequate manpower and knowledge base in science so that we can deal rapidly and effectively with our next and yet to be defined crisis. This guideline should apply to Science Education Innovation and Support and to the Scientific Research Project Support sectors of the NSF budget. In the mid-1960's NSF funds flowing to education equalled those allocated to research. As recently as 1971, when our concern was directed to an appropriate undergirding of long-run scientific accomplishment, the portion of the NSF budget going to science education was one-half the amount directed toward scientific research projects. As a result of new priorities from NSF, which we believe to demonstrate a clear disregard for long-term objectives, the support of the traditional science education programs recommended for 1977 has dropped to 10.8 per cent of the funds for basic research. (See Appendix B.) There is funding relationship between science education and basic scientific research. If basic research is to continue in the future at the pace implied in the 1977 budget request,

funds for science education must be significantly greater than 11 per cent of the research expenditures requested for fiscal 1977.

The continuing downtrend in this ratio must be reversed. The long term goal for future funding should be to fund science education improvement expenditures at approximately one-third of the level of basic research dollars spent. We feel this relationship is necessary if an adequate number of scientifically educated people are to be available to carry out future basic research at a level satisfactory to our nation. Continued rapid expansion in both basic and applied research cannot be accomplished with fewer and fewer resources devoted to educating people to accomplish that research. It is also naive to think that educating research scientists can be accomplished in the short term. Present decisions will effect our scientific capacity in the next decade. Congress must exhibit the wisdom and the courage to make those hard choices that NSF elects not to make.

As a partial answer to the inefficiencies generated by NSF's too frequent stop-and-go posture we urge Congress to adopt a biennial authorization procedure for the NSF budget to replace the present every-year approach. Appropriations for NSF would remain an annual process. Biennial authorization would permit Congress to conduct oversight hearings during the off-year which would evaluate the broader-policy aspects of the NSF, replacing the necessarily detailed concerns at typical authorization hearings. Even now, programs introduced by NSF require at least two years trial for effective evaluation. There appear to be many gains and few, if

any, costs related to adopting a biennial authorizing procedure so long as Congress continues its oversight responsibilities.

Several specific programs embodied in this legislation need special comment.

From the perspective of the type of institution I represent, one of the most important steps ever taken to improve undergraduate science education is embodied in the new program Congress initiated last year -- CAUSE (Comprehensive Assistance to Undergraduate Science Education). CAUSE encourages undergraduate colleges to compete for funds to upgrade science education by custom-designing a program to meet the specific needs of the particular institution. Its broad scope of support -- for faculty improvement, for curriculum improvement, and for related equipment and facilities -- presents an extremely realistic and attractive mechanism for meeting the present needs of many undergraduate colleges. CAUSE has had a positive impact on morale in our colleges and greatly increased interest in science curricula. Even though CAUSE is new and the proposal guidelines have been available only a matter of months, more than 750 proposals have been submitted to NSF. With the level of funding of fiscal 1976 at $10 million, only 40 to 50 awards appear likely. With this information in hand, we urge the Congress to increase the funding for fiscal 1977 to $15 million.

We strongly support another closely related NSF program -- Faculty-Oriented RULE which we believe meets a sustaining educational need and should be funded under the Science Education Support title. Faculty-Oriented RULE

encourages local campus innovation by making small grants to individuals or small groups of individuals. Announced for the first time this year, NSF has received 168 proposals for the modest $.8 million in the budget. We recommend increasing the funding level for fiscal 1977 to $1.5 million to meet the demonstrated needs of this program.

We applaud Congressional support of the small but high-gain Science Faculty Fellowships program. After several successful years, the SFF program was suspended by NSF for two years. It was then reinstituted in fiscal 1974, 1975 and 1976 as a direct result of the initiatives taken by Congress. NSF had planned to replace SFF with a different program called Faculty Research Participation. In this program, grants are initially made on the basis of proposals submitted by industry and government research centers. These, in turn, offer research opportunities to college faculty through a kind of sub-contract. Faculty must apply directly to the grantee center. While perhaps justifiable on different grounds, this program of Faculty Research Participation is not an effective substitute for the tried and proven Science Faculty Fellowships. Furthermore, the interest of industries and centers has not been very high. In fiscal 1975 they submitted only 119 proposals of which 66 were approved. Participant interest has been strong, 1600 applications for 145 awards. The program has identified a need but not the means to meet it.

The Science Faculty Fellowships program meets an increasingly important need in higher education. Faculty mobility has decreased dramatically

with the leveling off of college student population. With turnover vastly reduced, new techniques for keeping faculties up to date and amenable to change must be devised. Furthermore, science faculty members need to be able to teach undergraduate courses of inter- and trans-disciplinary nature outside their original specialization. The Faculty Fellowship program meets these needs squarely. It is designed for those scientists who have been heavily engaged in undergraduate teaching. They may improve and augment their scientific knowledge and science teaching skills in a self-designed program of study. Flexibility is important: some science teachers need the stimulus of participation in active research; others require study at a graduate science center to acquire confidence in a different or related subject matter. Finally, the intense competition for these grants and the peer panel evaluation process insures maximum return for each tax dollar assessed.

We therefore strongly recommend that the Science Faculty Fellowships be continued and the support level be earmarked at $2.5 million. The number of proposals has been nearly eight times the number of grants awarded. Even funded at the $2.5 million level, the number of available Faculty Fellowships would be far below the number needed. We believe the Faculty Research Participation should be funded another year at the $1.3 million level and then be evaluated to determine its effectiveness in meeting objectives set for that program.

The NSF budget request for the three student oriented programs (Student Science Training Program, Undergraduate Research Participation and Student-Originated Studies) is a distressingly low $5.6 million. This is difficult to understand since all the positive arguments for support of these programs remain in force. For example: Undergraduate Research Participation (URP) offers the opportunity for an undergraduate research experience. The URP format brings together the mature faculty researcher with talented and motivated undergraduate scientists exemplifying the learning experience doing scientific research. This experience enables the student to decide if he should pursue the long and expensive training of a research scientist. It is clearly in the national interest for such decisions to be made wisely and as early as possible. We urge that the funding authorization be increased to $3.0 million for SSTP, $5.0 million for URP and to $2.0 million for SOS.

Although the drastic reducation in funding for Instructional Improvement Implementation contained in the NSF's budget -- a decrease from $12.3 million in fiscal 1975 to $1.5 million in fiscal 1977 -- has little direct impact on the undergraduate colleges and universities I represent, we urge Congressional reconsideration. The potentially negative impact of reduced faculty turnover at colleges and universities is equally valid for primary and secondary school facilities. It seems to us myopic to eliminate Summer Institutes for teachers and curriculum enrichment projects at the very time when external circumstances dictate an increasing role for such programs in the improvement of science education.

Recent and apparently justified criticism of NSF procedures should not be allowed to diminish our appreciation of the agency's dramatic achievements in upgrading science education in this country. We believe Congress should demand more accountability and more responsibility from the NSF administrators. But we urge that you do not restrain the development of new educational approaches for school children. We in higher education benefit from receiving these well-prepared students as they enter our institutions. In our individual lives as parents we also endorse these programs.

We conclude our comments on specific programs by noting the NSF budget proposes still another 10 per cent decrease in funding for Instructional Scientific Equipment. The proposed $2.7 million is only 60 per cent of the dollars allocated to this program in fiscal 1975 and in real terms an even smaller commitment. ISEP meets a well-defined and growing need. We urge Congress to restore dollar expenditures to $8.0 million, still below the high of $8.9 in fiscal 1964.

We believe that the Congress has guided NSF most wisely and most appropriately in resetting its priorities among the programs. We deeply appreciate the willingness of members of Congress to hear our needs and to provide a forum which sometimes we cannot find within NSF on these matters of policy.

Appendix A

ANALYSIS OF FY 1975 - 1977 NATIONAL SCIENCE FOUNDATION

SCIENCE EDUCATION BUDGET

(To Accompany Attached Chart)

Reading the National Science Foundation Education programs' budget this year calls for understanding some recent history. The Fiscal 1976 authorizations set floors of $39.8 million for Science Education Innovation; $35.3 million for Science Education Support and $16.4 million for Graduate Student Support with various floors and ceilings also included for specific programs. However, the Fiscal 1976 appropriations counteracted the legislation with a ceiling on Science Education programs (interpreted to include both Support and Innovation) of $50 million and a ceiling of $15.0 million for Graduate Student Support. The Appropriations Committees further provided that specific education programs affected by the trimmed appropriations should be reduced proportionately. Congress directed NSF to establish the CAUSE, RIAS and Science for Citizens programs, and they forbade funds to be spent on implementation of elementary and secondary curricula until those programs and NSF procedures regarding them were evaluated. They also directed that more funds be spent on programs for Women in Science.

President Ford has indicated deferrals for Fiscal 1976 National Science Foundation programs of a total of $10.0 million, all of which amount comes out of the Science Education program. Although Congress has not yet rejected or approved these deferrals, the total Science Education programs budget for Fiscal 1977 including the Fellowship and Traineeship programs equals $65.0 million, a far and plaintive cry from the education budgets of Fiscal 1971 when these programs and the now defunct Institutional Grants program totalled $133.2 million.

This budget analysis shows where the Fiscal 1976 proposed deferrals are to be made unless Congress acts to disapprove them. If they are disallowed, Congress must add an equivalent $10.0 million even to meet the modest education budget proffered by NSF.

Readers may be interested to know that the old Science Faculty Fellowships program is included with Energy-Related Postdoctoral Fellowships for both Fiscal 1976 and 1977 under the National Needs Fellowships heading. Programs severely cut from Fiscal 1975 levels include Restructuring the Undergraduate Learning Environment, Elementary and Secondary Materials, Alternatives in Higher Education and Technical Innovation in Science.

Midwestern Colleges Office
January 1976

ANALYSIS OF FY 1975 - FY 1977 NATIONAL SCIENCE FOUNDATION EDUCATION BUDGET

(In Millions of Dollars)

	ACTUAL FY 1975 EXPENDITURES	FY 1976 BUDGET			FY 1977 BUDGET		
		Current NSF Plan (With Deferrals)	Estimated Expenditures (Without Deferrals)	FY 1976 Deferrals	NSF FY 1977 Budget Request	New Money Requested	Change Between FY 1975 Expenditures and FY 1977 Budget Request
Fellowships and Traineeships							
I. Fellowship Program E-I-5							
1) Graduate Fellowships in Science and Engineering E-I-5	9.5	11.4	11.4	-0-	11.4	11.4	+1.9
2) National Needs Fellowships (Energy-Related Postdoctoral and Science Faculty Fellowships)	2.9	2.7	2.7	-0-	2.6	2.6	- .3
II. Traineeship Program E-I-8							
3) Minority Institutions Traineeships	-0-	-0-	-0-	-0-	.9	.9	+ .9
4) National Needs Graduate Traineeships E-I-8	2.4	2.2	2.2	-0-	1.5	1.5	- .9
Science Manpower Improvement Program							
III. Student Oriented Programs E-I-10	5.8	5.6	5.4	-0-	5.6	5.6	- .2
5) Student Science Training Program E-I-10	1.7	2.0	1.8	-0-	2.0	2.0	+ .3
6) Undergraduate Research Participation E-I-10	2.9	2.6	2.6	-0-	2.6	2.6	- .3
7) Student Originated Studies E-I-10	1.2	1.0	1.0	-0-	1.0	1.0	- .2
IV. Women in Science Program E-I-12	.4	1.0	1.0	-0-	1.0	1.0	+ .6
Science Education Resources Improvement Program							
V. Improvement of Pre-College Instruction E-II-5	14.8	1.0	3.0	1.0	2.5	1.5	-12.3
8) Instructional Improvement Program E-II-5	12.3	-0-	-0-	-0-	1.5	1.5	-10.8
9) Pre-Service Teacher Education Program E-II-5	1.5	.5	1.5	1.0	1.0	-0-	- .5
10) State, Regional or Urban Systems of Science Education E-II-5	1.0	.5	1.5	-0-	-0-	-0-	- 1.0
VI. Comprehensive Assistance to Undergraduate Science Education E-II-7	-0-	10.0	10.0	-0-	10.0	10.0	+10.0
11) Two-Year Institutions	-0-	2.3	2.3	-0-	2.3	2.3	+ 2.3
12) Four-Year Institutions	-0-	7.7	7.7	-0-	7.7	7.7	+ 7.7
VII. Instructional Scientific Equipment Program E-II-9	4.5	3.0	3.0	-0-	2.7	2.7	-1.8
VIII. Minority Institutions Science Improvement Program E-II-11	5.0	4.8	5.5	-0-	5.0	5.0	-0-
IX. Research Initiation and Support E-II-13	-0-	4.0	3.3	-0-	4.0	4.0	+4.0
X. Science Faculty Resources Development E-II-15	4.3	2.8	3.8	1.0	2.7	1.7	-1.6
13) Faculty Research Participation E-II-15	1.0	1.3	1.3	-0-	.9	.9	- .1
14) College Faculty Short Courses E-II-15	1.2	1.0	1.0	-0-	.8	.8	- .4
15) Faculty-Oriented Improvement (RULE)	2.1	.5	1.5	1.0	1.0	-0-	-1.1
16) Comprehensive (RULE) E-II-15					-0-	-0-	-0-

(continued on following page)

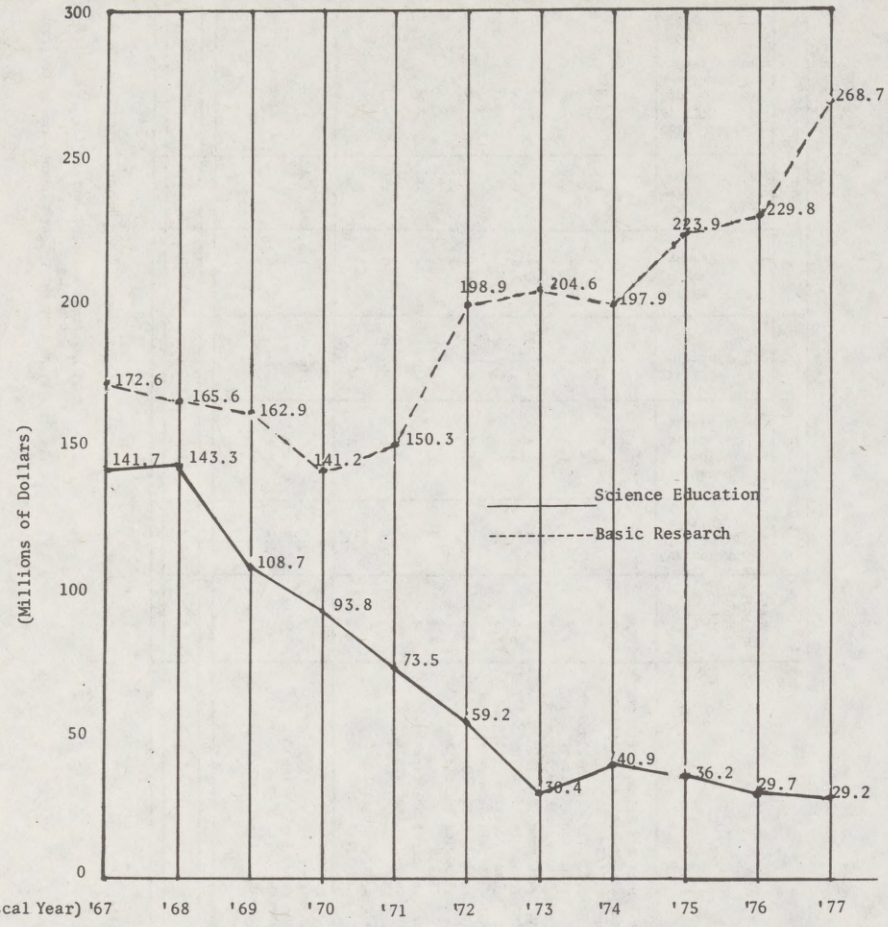
	ACTUAL FY 1975 EXPENDITURES	FY 1975 BUDGET			FY 1977 BUDGET		
		Current NSF Plan (With Deferrals)	Estimated Expenditures (Without Deferrals)	FY 1976 Deferrals	NSF FY 1977 Budget Request	New Money Requested	Change Between FY 1975 Expenditures And FY 1977 Budget Request
Science Education Development and Research Program							
XI. Pre-College Materials Development, Testing and Evaluation E-III-5	7.4	3.5	5.5	3.0	4.0	1.0	-3.4
17) Elementary School Materials Development, Testing and Evaluation E-III-5	2.4	1.4	1.7	.7	1.7	1.0	- .7
18) Secondary School Materials Development, Testing and Evaluation E-III-5	5.0	2.1	3.8	2.3	2.3	-0-	-1.5
XII. Technological Innovation in Education E-III-8	6.0	2.9	6.0	1.1	2.6	1.5	-3.4
XIII. Alternatives in Higher Education E-III-10	7.3	4.3	7.6	3.9	4.1	.2	-3.2
19) Instructional Materials Development and Alternative Degrees E-III-10	4.9	3.0	5.9	3.9	4.1	.2	- .8
20) Science and Engineering Technician Education E-III-10	2.0	1.3	1.7	-0-	-0-	-0-	-2.0
21) Visiting Foreign Energy Scholars E-III-10	.4	-0-	-0-	-0-	-0-	-0-	- .4
XIV. Continuing Education for Scientists and Engineers E-III-13	1.1	1.0	1.0	-0-	1.0	1.0	- .1
XV. Special Studies and Experimentation in Science Education E-III-15	1.2	1.7	1.2	-0-	-0-	-0-	-1.2
Science and Society Program							
XVI. Public Understanding of Science E-IV-4	1.7	2.0	2.0	-0-	2.1	2.1	+ .4
XVII. Ethical and Human Value Implications of Science and Technology E-IV-6	-0-	1.0	.4	-0-	1.0	1.0	+1.0
XVIII. Science for Citizens E-IV-8	-0-	-0-	-0-	-0-	.3	.3	+ .3
TOTAL	74.3	64.9	75.0	10.0	65.0	55.0	-9.3

Midwestern Colleges Office
January, 1976

Sources: 1) The Budget of the United States Government FY 1977
2) NSF Press Release, January 21, 1976, NSF PR76-6
3) FY 1977 NSF Budget Estimate to the Congress

Appendix B

NATIONAL SCIENCE FOUNDATION
Support of Science Education & Basic Research*, FY 1967-1977
In FY '67 Dollars



*Science Education does not include Graduate Student Support; Technological Innovation in Education and Public Understanding of Science.

Basic Research includes only Mathematical & Physical Sciences & Engineering; Astronomical, Atmospheric, Earth & Ocean Sciences, and Biological, Behavioral & Social Sciences.

Sources: NSF Annual Report-FY 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974.
FY 1977 NAtional Science Foundation Budget Estimate to Congress.
Consumer Price Index for Urban Wage Earners & Clerical Workers (1967 = 100), U.S. Department of Labor, Bureau of Labor Statistics.

Midwestern Colleges Office -2/76

SUPPORT OF SCIENCE EDUCATION & BASIC RESEARCH[1]

NATIONAL SCIENCE FOUNDATION
FY 1967 - 1977 In FY '67 Dollars
(In Millions of Dollars)

Fiscal Year	Calendar Year CPI[2]	A. Fiscal Year CPI Average[3]	B. CPI FY '67 Base=100	C. NSF Budget Expenditure for Science Education	D. Amount Needed to Equal $141.7 M Expended in FY '67 for Educ.	E. Purchasing Power of NSF Education Support in FY '67 Dollars	F. NSF Budget Expenditure for Basic Research	G. Amount Needed to Equal $172.6 M Exp. in FY '67 Bas.Res.	H. Purchasing Power of NSF Basic Research Support in FY '67 Dollars
'67	97.2-100	98.6	100	141.7	141.7	141.7	172.6	172.6	172.6
'68	100.0-104.2	102.1	1.03	147.6	145.9	143.3	170.6	177.8	165.6
'69	104.2-109.8	107.0	1.08	117.4	153.0	108.7	176.0	186.4	162.9
'70	109.8-116.3	113.0	1.14	107.0	161.5	93.8	161.0	196.7	141.2
'71	116.3-121.3	118.8	1.20	88.2	170.0	73.5	180.3	207.1	150.3
'72	121.3-125.3	123.3	1.25	74.0	177.1	59.2	248.6	215.8	198.9
'73	125.3-133.1	129.2	1.31	39.9	145.7	30.4	268.0	226.1	204.6
'74	133.1-147.7	140.4	1.42	58.1	201.2	40.9	281.0	245.1	197.9
'75	147.7-151.2	149.4	1.51	54.7	213.9	36.2	338.1	260.6	223.9
'76	151.2-158.2	154.7	1.56	46.4[5]	221.0	29.7	358.6	269.3	229.8
'77	158.2-165.2	161.7[4]	1.63	47.7[6]	230.9	29.2	438.1	281.3	268.7

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[1] Science Education does not include Graduate Student Support, Technological Innovation in Education and Public Understanding of Science. Basic Research includes only Mathematical & Physical Sciences & Engineering; Astronomical, Atmospheric, Earth & Ocean Sciences, and Biological, Behavioral & Social Sciences.

[2] CPI = Consumer Price Index (U.S. Department of Labor)

[3] Calculated by averaging 2 adjacent calendar years

[4] Projection based on 7% inflation through July 1977

[5] Estimated expenditures with deferrals deducted

[6] Request with deferred funds

Sources: NSF ANnual Reports-FY 1967, 1968, 1968, 1970, 1971, 1972, 1973, 1974
FY 1977 NSF Budget Estimate to Congress
Consumer Price Index for Urban Wage Earners & Clerical Workers (1967=100), U.S. Dept. of Labor, Bur. of Labor Statistics

Explanation of Columns: The average CPI between two calendar years is computed in Column A. Column B represents the average in Column A which is then converted to FY '67 Base = 100 figures. Column C shows the NSF actual expenditures each year while Column D shows what NSF would have requested had they even wanted to stay even with FY '67 expenditures. Column E indicates the purchasing power of NSF Science Education program expenditures in FY '67 dollars. Column F shows the NSF actual expenditures while Column G shows what NSF would have requested had they wanted to stay even with FY '67 expenditures. Column H gives the purchasing power of NSF Basic Research program expenditures in FY '67 dollars.

Midwestern Colleges Office-2/76

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ACM - GLCA RECOMMENDATIONS FOR FUNDING

SELECTED NATIONAL SCIENCE FOUNDATION EDUCATION PROGRAMS

FISCAL YEAR 1977 (Millions of Dollars)

Program Name	NSF Request FY 1977	ACM-GLCA Recommendations FY 1977	Program High and Year
Science Faculty Fellowships	1.3	2.5	4.0 (FY 71)
Faculty Research Participation	.9	1.3	1.3 (FY 76)
Secondary School Student Project	2.0	3.0	2.4 (FY 64)
Undergraduate Research Participation	2.6	5.0	6.8 (FY 66)
Student Originated Studies	1.0	2.0	2.0 (FY 72)
Summer Institutes for Elementary and Secondary Teachers	2.5	10.0	24.3 (FY 65)
Instructional Scientific Equipment Program	2.7	8.0	8.9 (FY 64)
College Faculty Workshops	.8	5.0	5.5 (FY 68)
Comprehensive Assistance to Undergraduate Science Education	10.0	15.0	10.0 (FY 76)
Faculty Oriented RULE	.8	2.0	.8 (FY 77)
Course Content Improvement	8.1	10.0	(Pre-College) 13.5 (FY 68) (Undergraduate) 6.8 (FY 67)
Special Studies and Experimentation in Science Education	0	5.0	1.7 (FY 76)
Women & Minorities in Science	1.0	1.5	.6 (FY 74)

Midwestern Colleges Office
February, 1976

Senator KENNEDY. I want to hear from Mr. Silber who will comment now.

STATEMENT OF ROBERT L. SILBER, EXECUTIVE DIRECTOR, NATIONAL SCIENCE TEACHERS ASSOCIATION

Mr. SILBER. Thank you very much.

I have submitted a written statement. What I would like to do now is highlight some of that statement.

The serious task we face today in science education at the precollege level is to educate every young person in the Nation so that he or she will (1) obtain a basic understanding of the fundamentals of science, (2) understand the relationship of science and technology to the problems of society today, and (3) appreciate the alternatives for solving these societal problems. This undertaking is a formidable one.

In the late 1950's and early 1960's, the basic problem faced by science educators was that of preparing greater numbers of scientists and engineers. Through the funding of innovative curriculum development projects, new courses were launched in biology, chemistry, physics, and related sciences. These new curricula were implemented in many schools across the country. Any significant innovation in the area of curriculum deve'opment requires a complementary retraining process for teachers who need to learn about the new approaches and how they are best taught. As a result, the National Science Foundation established programs of summer institutes, academic-year institutes, inservice institutes, and so forth, in order to prepare teachers to teach the new curricula.

The new curricula and the accompanying teacher-training programs had a tremendous impact on precollege science education. Solid, reliable figures on the number of schools using the new curricula and the number of teachers who changed their teaching methods and courses are difficult to obtain.

The world society today faces many problems of great significance. These are not ghosts of problems, but real ones. They deal basically with the peoples of this planet working together to solve dilemmas that face us all. More than ever before our young people need to be able to deal with these problems and in order to do this they must be properly equipped. The students in our classrooms today are from 1 to 12 years away from voting age and from making decisions on critical issues.

We need to respond to four essential needs.

CURRICULUM DEVELOPMENT

The problems facing society—energy, food, population, bioethics, transportation—require a different curriculum approach from that of the 1960's. All children must have a positive and knowledgeable base with which to deal with these problems. Science must be taught in such a way that scientific concepts are clearly related to problem applications.

Another departure from the curricula of the 1960's relates to the interdisciplinary nature of the problems we face. Social science must have an integral role in curriculum development, since that field

can address the social aspects of our problems. Federal funding must be available for the continous research and development needed to revise science curricula to keep it in tune with the needs of the times.

A withdrawal of funding for curriculum development now will cost us the momentum, enthusiasm, and interest of science educators and administrators across the country.

Senator KENNEDY. Let me ask you here. To what extent have the high school teachers been sought out to help develop the new curriculum programs that are needed?

Mr. SILBER. I think they have been involved in every curriculum innovation project, very heavily involved.

Senator KENNEDY. Your counsel then is sought out by the NSF?

Mr. SILBER. Yes.

Senator KENNEDY. Pretty regularly?

Mr. SILBER. Yes.

CURRICULUM IMPLEMENTATION

I think the second major need is that of curriculum implementation. Funds have been completely wiped out for implementing the new curriculum innovations that are available now. Implementation of new ideas, materials, products, approach, and concepts can best be accomplished through cooperative efforts. The local school systems, teachers, supervisors, the State school systems, and the Federal Government should cooperate to bring about innovation.

It makes absolutely no sense to spend time, energy, and money on developing a new product and then letting it collect dust on a shelf for lack of marketing followthrough.

It is essential that curriculum innovations reach the intended audience. Educational change is notoriously slow, but it is not enhanced by withdrawal and inaction tendencies.

The private sector has a major role in this system. For the most part, significant research and development are beyond the financial reach of many companies in the education field. In addition, the risk of departure from the norm is great for companies because of the unknown salability of new products. Research and development funded by public sources allows for experimentation and exploratory implementation. The materials thus developed should be placed in the public domain for futher enrichment and implementation by the private sector. It is an ideal symbiotic relationship.

The third major need——

Senator KENNEDY. Before you go on—there has been some testimony that science teachers have been pressured by NSF to use their curriculum. Is this something you hear about? It is true?

Mr. SILBER. I do not hear that it is true. I think if there is any pressure it may be an interpretation because of trying to insist on change. I do not think it is a pressure for one curriculum over another. It is simply that change is needed and they should be addressing themselves to that.

CONTINUING EDUCATION

I think the third need is continuing education for teachers. It is absolutely essential that teachers continually update and enrich their basic knowledge of science, technology, and methods of teaching.

The NSF programs for accomplishing this in the 1960's were excellent for that time. We now believe that programs should be developed that seek to update teachers in their specific science area, acquaint them with the problems of society, and how these can be brought to students; and instruct them in the newer concepts concerning learning and the learner.

Such programs can be financed cooperatively. The Federal Government needs to infuse such a national effort with basic support which would initiate and develop the program, and which would also supply some funding for support of participating individuals. The local school system must partially support the individual in the program, and the individual must make a contribution. Through such a cooperative system, the Federal Government funding load is reduced, and the program has greater importance and impact since the local system and participating individuals are financially involved.

It is unbelievable, indeed, that at the very time this country is facing a series of its most difficult and long-ranging problems where solving them depends on an enlightened future generation, the funding that provides access to these minds through new curricula and well-trained teachers is either totally unavailable or slashed drastically. NSF needs funds restored to its budget to develop new training programs for science and social science educators across the country.

ASSESSMENT AND EVALUATION

One of the most serious needs and one most difficult to fulfill in education is that of assessing and evaluating a product. How does one determine whether the school product is properly equipped to face his or her new world and whether a good citizen has been developed? Certainly the responsibility is not totally on the schools or educators. The family, environment, media, religious institutions, local and national leadership, and other factors certainly carry great impact. These evaluations and assessments must be better planned and more carefully tendered than in previous years. All programs—curriculum revision, teacher training, materials development, implementation, and so forth—must be accompanied by the best kinds of assessments that can be made. These assessments need to be built into the mechanism and the results produced, serve to point toward new directions.

In conclusion, four great needs exist in science education at the precollege level as we face the next 5 years. These are: Curriculum innovation, curriculum implementation, continuing education for teachers, and assessment and evaluation.

Continuing attention to these areas will produce an enlightened citizenry that will be equipped to face the critical problems of society that are ahead of us. This requires Federal funding of the National Science Foundation at a substantially higher level than has been available in the last few years. The budget proposed for fiscal year 1977 does not come close to being adequate to accomplish the task for us. Such budget cuts and inattention to these described needs only puts this country further behind in its ability to address the learning problems and produces a continuing less than adequately equipped body of citizens to make crucial decisions.

The National Science Foundation provides great leadership in the funding of scientific research. Future scientists and enlightened citizens are products of our educational system. Science and science education are intricately interlocked. If the proper impact of science awareness on society is going to be made, much more attention and increased levels of funding must be placed on the education complement. The National Science Board should give more attention to this segment of the scientific process. One step would be the addition to the National Science Board of members who are better acquainted with the educational process at the precollege level.

The Federal Government represents the only mechanism that can give the thrust, impetus, impact, and financial support to address the problems I have outlined. Local and State school systems, business, industry, and other organizations have a major role, but of a different kind. Their role is one of guidance, cooperation, support, and implementation.

The National Science Foundation should be the agency to play out the role of the Federal Government. NSF needs the financial support to do this properly. The fiscal year 1977 budget falls far short of the support needed.

I recommend that the authorization for support of precollege science education be increased substantially.

I thank you very much for the opportunity to present our views and would be pleased to answer any questions.

Senator KENNEDY. Of course, one of the areas where we can get a greater input and a voice for this educational effort would be on the Science Board itself. There are eight new Board members to be appointed later this year.

Do you know whether or not your organization has submitted any names for the Board?

Mr. SILBER. Yes. This is one position we have held for some time. We have submitted names and we feel there is really a need at that point.

Senator KENNEDY. You do not know how they are doing?

Mr. SILBER. I do not know how they are doing.

Senator KENNEDY. I think it is valuable that at least there is someone soliciting names from you. I think it would be very, very helpful to have representation from high school science leaders on the Board to carry these points going forward.

Let me ask you a couple of questions on behalf of Senator Laxalt, who had to leave.

Dr. Hereford, what is your view of the relationship between the Federal Government and the private sector in the development of curriculums?

Dr. HEREFORD. The private sector? By that I suppose you mean the publishers of materials?

Senator KENNEDY. I would think so, yes.

Dr. HEREFORD. Manufacturers?

Senator KENNEDY. Yes.

Dr. HEREFORD. I should think that it would not, should not differ from the relationship in any other area of industry where industry would bid, so to speak, on the opportunity to carry out the publishing and providing of materials and equipment, if it is laboratory or scientific equipment.

Senator KENNEDY. You think that they ought to be carried out by the best available and most competent source, whether it is in-house or in the private sector?

Dr. HEREFORD. Whether it is within the Federal Government?

Senator KENNEDY. Yes. Should NSF develop curriculums?

Dr. HEREFORD. I certainly think the goal should be to get the very best product, so to speak, and available at the most reasonable price.

Senator KENNEDY. Well, this raises the second question about whether should NSF be involved in the marketing of curriculum for teachers and institutions, and so forth.

Dr. HEREFORD. Senator, I am going to give you my own answer in this particular case without knowledge as to whether it is representative of the three national associations that I speak for.

In my judgment it should not be involved in this.

Senator KENNEDY. What about implementation?

Dr. HEREFORD. It seems to me that in the area of implementation that there is perhaps a funding support that could be provided by the National Science Foundation to enable the qualified individuals to assist in the implementation of the new curricula or new text or new laboratory methods or whatever might be involved.

Senator KENNEDY. All right.

Do the other members of the panel want to mention anything on that?

Dr. WENZLAU. I think, again speaking for myself——

Senator KENNEDY. Yes.

Dr. WENZLAU [continuing]. Not for the institutions that I represent, I would agree with Dr. Hereford. I think that there should be similar as in other areas some implementation possibilities but they should not be situations where the NSF should exert pressure of any sort for adoption of any curricula.

Mr. SILBER. I would like to respond to that because I think it is an important question.

I do not feel that publishers have the financial backing in order to do the proper research and development of new curriculum materials. Not only that, but I do not believe that they would be innovative enough, apart from the normal curriculum that we have, because that is risk taking as far as sale of their products is concerned. So I do not think that is a comfortable position for them to be in.

I think it behooves the Government to support the innovation to the point where the materials are developed and that they are brought to the attention of the school community. Now this is very difficult to do because it is a large school community and communication is not good. Then I think the material should be turned over to the public domain and the publishers can utilize all the materials and publish and distribute and market as they see fit and this actually is what has been taking place.

Senator KENNEDY. All right.

I want to thank you all very much. You have been very helpful. Thank you very, very much.

Mr. SILBER. Thank you.

Dr. HEREFORD. Thank you.

Dr. WENZLAU. Thank you, sir.

[The prepared statement of Mr. Silber follows:]

ROBERT LEE SILBER

Executive Director

NATIONAL SCIENCE TEACHERS ASSOCIATION

Mr. Robert Lee Silber joined the National Science Teachers Association in June, 1973. He has served as the NSTA Executive Director since that time. Prior to joining NSTA, Mr. Silber was associated with the American Chemical Society for 13 years, serving in various positions and, finally, as Director of the Division of Membership Activities. Before joining ACS, Mr. Silber taught high school science for eight years, was Science Department Chairman and taught college chemistry at the University of Evansville. He worked in research in industry for several years prior to his teaching experience.

NSTA is a non-profit educational and scientific membership organization for science educators. Membership includes science teachers at the preschool, elementary, middle school, junior high school, college, and university levels. Science supervisors, consultants, administrators, researchers, and others interested in science education also are members. NSTA has some 20,000 members and an additional 22,000 subscribers to its three journals, Science and Children (elementary), The Science Teacher (secondary), and the Journal of College Science Teaching (college). NSTA convenes four conventions each year, attracting 10,000-12,000 science educators. Convention programs consist of sessions on the latest innovations in science education,

including new curriculum programs, teacher training, equipment and teaching aids, science seminars, and reports from individual teachers and supervisors on local innovations. Exhibits of the latest books, materials, equipment, teaching aids, etc. are an important part of these conventions. NSTA also produces a number of other specific publications designed to help science educators; administers a student program; organizes drive-in conferences; provides awards; and enters into contracts and grants to conduct studies, surveys, produce materials, etc.

Mr. Silber was born July 30, 1928 in Mt. Vernon, Indiana. He completed his undergraduate work in chemistry at the University of Evansville and received an M.S. degree from Southern Illinois University. He has received additional graduate training at Brown University and The Johns Hopkins University.

Mr. Silber has published numerous articles, received the first NIH research (in amino acids) award to a high school teacher, and was the subject of an article in TIME magazine based on his innovations in science education. He was formerly Chairman of the AAAS Cooperative Committee; administered programs in chemical education in Latin America; and has participated in many international conferences on science education.

He has received the TRAIL Award, STAR Award, and recognition from the Royal Institute of Chemistry. He serves on the Editorial Board of Revista Ibero Americana de Educacion Quimica. He is listed in American Men of Science, Who's Who in Education, and is a member of the National Science

Teachers Association, American Chemical Society, American Association for the Advancement of Science, and the Cosmos Club.

Senator KENNEDY. Our next witness is Dr. Jewel Plummer Cobb, a member of the National Science Board. Dr. Cobb was appointed to the Board in 1974; she chairs the Board's Committee on Minorities and Women in Science, and she has played a major role in the development of the NSF's programs to encourage the participation of minorities and women in careers in science.

STATEMENT OF DR. JEWEL PLUMMER COBB, MEMBER, NATIONAL SCIENCE BOARD

Dr. COBB. Mr. Chairman and members of the committee: I am pleased to appear before you today to discuss the programs of the National Science Foundation to increase the participation of minorities and women in science and technology. I also speak to you as Chairman of the National Science Board's Committee on Minorities and Women in Science. Dr. Norman Hackerman, Chairman of the Board, established this Committee in September 1975 to consider education programs to increase the flow of ethnic minorities and women into science.

Title VI of the Civil Rights Act of 1964 forbids discrimination against minorities in Federal programs. Title IX of the Education Amendments Act of 1972 (Public Law 92–318) prohibits discrimination against women at educational institutions. We are in 1976 still far short of achieving this goal. Nowhere is this more apparent than with respect to the participation of minorities and women in science and technology.

The Scientific Manpower Commission Report of 1975 indicates that, of almost 207,500 science and engineering Ph. D.'s in the U.S. labor force, minorities comprised less than 10 percent. The proportion of women with doctorates was higher in 1920 than in any decade since. For example, since 1960 women have earned only 7.3 percent of the chemistry doctorates and 1.8 percent of the engineering degrees. Their representation as Ph. D.'s and as job holders in the scientific work force, from the social sciences, mathematics, and biological fields, is less than 25 percent. Unlike certain European countries, the number of women in scientific professions does not even approach population parity.

The National Science Foundation has in recent years taken some steps to attack the problems of underrepresentation of minorities and women in science. This effort must be continued. We are requesting funds to improve college education in science for minorities through the minority institutions science improvement program.

This program provides support to approximately 200 colleges and universities whose enrollment is predominantly black, Native-American, or Spanish-speaking. Its purpose is to increase the flow of underrepresented minorities into scientific careers through the development of new science curriculums, instructional strategies, and educational procedures; the upgrading of instructional facilities through the purchase of laboratory or teaching equipment; the improvement of faculty competence; and the increased effectiveness of related institutional procedures. In addition, this program plans to support cooperative institutional workshops focusing on the diffusion of curricular materials and instructional strategies developed through its support.

For fiscal year 1977, the Foundation has also requested funds for awards to seven minority institutions for graduate traineeships. The amount requested will provide 3-year support to approximately 38 graduate students for study in the sciences. These programs only support the improvement of scientific and technological training at minority institutions. Their activities and the amounts designated for 1977 only begin to address one aspect of the issue of minority underrepresentation in science.

Another aspect of the problem is the need for experimental educational projects directed toward minority students in other institutions. In past years, NSF has funded a limited number of studies to investigate barriers to minorities in science. This program is currently being evaluated. The evaluation, when complete, will indicate specific areas in which the Foundation can develop programs to minimize barriers to minority participation in science in the most cost-effective manner.

Also, it is important to continue the increased funding of the women in science program. This program's activities to date have done much to identify barriers to careers in science for women and to fund experiments designed to overcome such barriers. The program is currently funding experiments and pilot programs to provide incentives to women to choose scientific careers and to facilitate the return to science and engineering careers among women with earlier scientific training.

Potential women scientists have neither the models nor the information for careers in science and technology. The program attempts to remedy these lacks through visits to high schools by prominent women scientists for lectures, seminars, and informal discussions, and through science career workshops for undergraduate and graduate women science students.

Studies of scientific careers indicate that a critical point in their development is work begun immediately after completion of the doctorate, a point at, or before which, many women are likely to interrupt their careers. The women in science program makes grants to colleges and universities to develop and offer courses, independent study, research participation, or combinations of such activities to women who wish to resume or update their education in scientific or technological fields. These projects lead directly to employment in science and technology-related fields or so admission or readmission to graduate-degree programs in science.

The National Science Board and the NSF staff are working actively in the development of other programs aimed at increasing participation of minorities and women in science. For example, two areas which need additional work are those of motivation and counseling.

We are pleased and grateful for the recognition by our national leadership that this group of women and men representing approximately 59 percent of the population in the United States needs support for scientific and technological education and development. We urge that the committee authorize the entire amount requested for the Foundation now in the administration's 1977 budget so that programs of the type I have described can be supported at an adequate level.

Thank you.

Senator KENNEDY. If you had your own way, I imagine you would go for an increase over there, would you not?

Dr. COBB. Very definitely so, and I would certainly suggest that.

Senator KENNEDY. Do you have a figure that you would recommend?

Dr. COBB. Well, I would suggest that, for the minority component, for which I speak, there ought to be at least a half million dollars added to that budget. I would not at any cost want to diminish the amount of money now being proposed for the women in science program, but rather there be an added amount to augment the minority program.

One also must remember that the funding for the current programs for minority institutions has remained at the same level and, in fact, represents a decrease, even though it is the same number, and that decrease, of course, is reflected in inflationary changes.

So, our programs are in fact clearly diminishing. This is particularly important, and I speak now as an individual rather than as a Board member, when we consider the fact that we do have a population where 59 percent of U.S. citizens fall into the category of women or minorities. This is certainly a significant fact to consider for scientific development of its human resource.

Senator KENNEDY. When you quote the numbers that are involved in the scientific work force I understand it is only about 4 percent minorities, about 5 percent women.

Dr. COBB. Yes, they are quite low.

Senator KENNEDY. That is very helpful, and we appreciate testimony. I want to thank you for coming.

Dr. COBB. Thank you.

Senator KENNEDY. Our next panel will discuss the new programs being developed by the National Science Foundation to provide citizens' groups with access to scientific and technical advice, to encourage scientists to participate in public policy debates, and to improve the participation of nonscientists in the development of policies and priorities for science and technology.

The panel members are: Dr. Alan Nixon, past chairman of the Committee of Scientific Society Presidents, and former president of the American Chemical Society; Dr. James Sullivan, research director of the National Council for the Public Assessment of technology; and Dr. Joel Primack, the author of "Advice and Dissent," an excellent book which examines the role of scientists in public policy.

We have your panel and one other, and we have just about an hour left. We will try to divide that time up equally between your panel and the next panel.

Let us proceed.

STATEMENT OF DR. ALAN C. NIXON, PAST CHAIRMAN, COMMITTEE OF SCIENTIFIC SOCIETY PRESIDENTS, AND FORMER PRESIDENT, AMERICAN CHEMICAL SOCIETY; DR. JAMES B. SULLIVAN, RESEARCH DIRECTOR, NATIONAL COUNCIL FOR THE PUBLIC ASSESSMENT OF TECHNOLOGY AND CODIRECTOR, CENTER FOR SCIENCE IN THE PUBLIC INTEREST; AND DR. JOEL PRIMACK, COAUTHOR OF ADVICE AND DISSENT, A PANEL

Dr. NIXON. Thank you, Senator. Nice to see you again. I appreciate being here.

If I had to sum everything up in one word, I would say: "Cheers." I think this is a great program that is being instituted here, and it is the sort of thing that I have been pushing myself for many years; trying to get my fellow chemists and chemical engineers to get into the action, as far as contributing to public interest in science.

As president of the ACS and chairman of the CSSP, I was able to expand my area of interests. In fact, a recent survey that I did, indicated that more than half of the major engineering and scientific societies do have publ c interest activities, and promote the idea of their members getting involved. But it is a difficult thing to do.

We do have to spend more money than we have in encouraging public interest in science. After all, if we are willing to spend $110 billion on external defense, we should be willing to spend a fair amount of money defend ng ourselves from ourselves, which is often necessary as a result of the application of science and technology, as we have found out to our sorrow. I think the National Science Foundation is a good body to do this, particularly since the present Science Adviser has shown remarkable ability to adopt to new conditions in recent years.

But I do urge that they have an advisory body with a strong representation from the general public to, as I say in my prepared remarks, somewhat moderate the natural acquisitive and exclusionist tendencies of scientists.

If you look back over this century, you find that we have spent far too little money looking at the consequences of what we are doing in science and technology co npared to the amounts of money we spend in doing it. So, I applaud the Congress venture in this area, but I hope that they will remember that it will take substantial contributions over the years. There is no point in starting up a program and then letting it fade out rapidly. This will do more harm than good.

The NSF proposes in their report a budget of about $2½ million for initiation of the nine options that they give, and I would say that the programs were expanded to total effort, it would take about $10 million a year. I do not think this is too much money to spend in this area, particularly since there would be a lot of individuals and organizations involved who would put in considerably more than that in either time or money.

So, the $300,000 that has been proposed to start a program is, I think, very, very minimal and it would mean that those options that are selected would have to be critically cut down.

I will talk about some of the options that NSF has in their report.

First, the registries of scientists and engineers.

I think this is a good idea. I have urged scientific societies to do this themselves. Some are interested, but it costs a lot of money and societies are having cashflow problems. However, I think they would be happy to work with NSF on implementing this option.

There is one thing I would like to point out in this connection. We do have to get scientists and engineers involved. However, most engineers and quite a few scientists work in industry and they are critically inhibited by their managements from speaking out. This was emphasized recently in the case of three General Electric engineers in California, who felt compelled to resign in order to speak out on the

safety of nuclear energy, and it came to a head in a panel discussion I had at the recent AAAS meeting in Boston with Doctor Bueche, vice president in charge of research for GE.

He felt it was perfectly all right for a scientist or engineer to be required to discuss it with his management and failing satisfaction to have to resign in order to inform the public. I do not think that is right. A person should not have to resign. And as a matter of fact, quite a few societies have endorsed guidelines for employment which are designed to prevent the necessity of such requirement.

Although this is ancillary to the NSF budget matter. I do think it is critical in this area of getting scientists and engineers involved, because often the people that know most about some of the problems are those who work in industry.

I think this could be something that the Committee on Labor and Public Welfare should be interested in taking up.

NSF also proposes to produce media programs, which I think is a good way to inform the public. They have a lot of experience in this now, and they should build on their experience. They could also take advantage of programs produced by societies on public interest matters to videotape these, edit them, and get them before the public.

Radio also is, I think, a very effective medium.

The ACS has produced, for many years, a program called "Man and Molecules" which is now carried by about 540 radio stations, and seeks to educate the public about recent advances in chemistry and chemical engineering.

NSF does have three proposals involving State-based centers or regional centers and national clearing houses. I will touch on those in a minute.

Probably the most important part of the NSF proposal is the Scientists and Engineers Associates program. I think this is an important area in which to increase our involvement. Professional societies have used this approach in promoting Congressional Fellows and I think this has turned out to be very successful. The extension of this program by NSF would enable people to work with other legislative bodies, with public interest science organizations, and so forth.

I do point to the fact that there is a considerable reservoir of recently retired scientists and engineers, who could be brought into this program.

The internship program for science and engineering undergraduate and graduate students is one that I think should be adopted and would be relatively easy to do. It should be used properly, though, so that the students are meaningfully employed.

The establishment of forums, conferences, and workshops, is something, of course, that can be done, and NSF knows how to do it, but they should be careful to make sure that the public gets involved in it.

Grants to independent journals and magazines is another excellent option. However, the proposed budget of $50,000 would not go very far.

Another thing that NSF should do is to look at something that they have not proposed and that is to promote the organization of a research foundation, something like the Brookings Institute, which

would play a role in developing basic position papers on matters of public interest in science and would build on what the societies themselves are doing at the present time.

So to summarize: I have looked at the program that NSF has proposed and I have come up with some budget numbers. I feel that I can go along with NSF on their registries of scientists and engineers at $150,000, and the scientists and engineers associates program at about $400,000 and the promotion of forums, conferences and workshops at $150,000.

I would raise the grants to independent journals to $100,000; budget media programs somewhere in the region of $150,000 to $400,000, depending on how fast they can be developed, and the internship program for students at $100,000. That comes up to the order of $1.2 to $1.4 million.

Then I would provide additional funds, probably $50,000 to $100,000 to develop a better proposal on the matter of an information clearinghouse and State and/or regional centers.

I feel that there is a great deal of overlap in the three option proposals, and I think that NSF should look into this much more carefully before they plunge into this area, which seems like an easy way to spend a lot of money without getting our money's worth.

Senator KENNEDY. Thank you very much.

Doctor Sullivan?

Dr. SULLIVAN. Thank you, Mr. Chairman.

I also am glad to see the National Science Foundation entering the science for citizens field and beginning this program. For the past 5 years, I have spent most of my time helping local citizen groups who are concerned over the environmental and social consequences of the new technologies that are slated for their neighborhoods and their States. My coworkers and I have worked with dozens of citizen groups and have commented on literally hundreds of environmental impact statements. Recently we have also begun an intensive research program to better understand how groups participate in the decisionmaking process and what steps Government can take to make that process more open to citizen groups.

What we are learning from all this experience is that, except under extraordinary circumstances, it is virtually impossible for a citizens group to participate in legal and technical Government proceedings. It is as simple as that.

The technical complexity of the issues, and the volume of activity and time required for a citizens' group to participate in one of these hearings has caused many citizen groups now to foreswear the proceeding process and go back to other means such as influencing public opinion through the press.

There have been a number of attempts in the last 10 years or so, since the beginning of the environmental consumer movement to make it easier for citizen groups to get involved. Some of these attempts are reflected in the science for citizens program; others are not. All of these efforts have been, by and large, only experiments. None of them have gone beyond that state. None of them have provided the level of continuing assistance to citizen groups that technical procedures require.

I think the basic problem is one of resources and relevance. The resources question, Dr. Nixon touched on. I believe the science for citizens program begins to redress this inbalance in resources that exists in the voluntary sector. I endorse his budget suggestions.

I would like to speak to the question of relevance. This science for citizens program being developed by NSF has to be praised for holding hearings around the country on what the program should do, and it should be praised for the amount of effort that NSF has put into finding out just who the citizens' groups are and what they want.

I think examination of the draft document that has been produced by NSF reveals certain naivité about citizen groups, and that is to be understood. NSF has yet to involve itself with citizen groups.

I think there are a number of steps that NSF could take that would redress some of the problems I see in this report. These suggestions are the following:

The first is that the technical assistance provided to the groups has to be tailored closely to the user. It goes without saying, that when applying research to industrial needs, or to national needs, the user is the prime instigator of what the research program looks like; it should not be any different with citizen groups.

My experience is that State and local Federal efforts to provide technical assistance to citizen groups have failed when they have not spent enough time talking to citizens to find out what they need. A necessary condition, I think, for this program to succeed is that an advisory committee be set up primarily of citizen groups to help NSF know just what the citizen groups need.

My second suggestion has to do with providing direct funds to citizen groups. This is an issue that the NSF did not discuss in its draft report. It did commission a study by Boasberg, Hewes, Klores, Smith and Kass, a Washington law firm. The study describes models for providing funds directly to citizen groups. They work in other agencies.

The Environmental Protection Agency has such a program that has been well received by citizen groups. The California State energy resource conservation also has a program to provide funds to citizen groups.

That option needs more examination by the National Science Foundation. I think that the draft report should be expanded to include more discussion of that.

My third suggestion has to do with the training of scientists, and I will not say much about that, because I think NSF has done pretty well in that area. I would recommend that the budget be upped slightly to provide more funds for doctoral students as well as mid-career scientists to participate in the program.

Finally, my last suggestion has to do with research on how to make a Science for Citizens program more effective. In conjunction with the citizens advisory council I suggested, the National Science Foundation should prepare an intensive research program to determine just who the citizen groups are that need technical help, which ones want this help, which ones do not, and what kind of technical help can best serve their needs.

I have talked to a large number of citizen organizations and environmental and consumer groups around the country. Many of them

70-027 O - 76 - 20

were very skeptical about the NSF's program. The ones that were skeptical did not come out to testify at NSF's hearings. Only the ones that were in favor of it came out to testify. The groups that were skeptical were very much afraid of Federal funds being spent for citizen action. I think the model cities program has demonstrated that citizens should be careful about where they get their money and to be wary of Federal funds.

So, if I can summarize my remarks in one sentence, I would say that it is crucial that citizens be at the hub of deciding how the NSF science for citizens money is spent and where it goes. The citizens' advisory committee is the first step that I think is a necessity if the program is to be effective.

Thank you.

Senator KENNEDY. Doctor Primack?

Dr. PRIMACK. Thank you, Senator.

In summarizing my testimony, I would like to tell you what my strategy is going to be. I am going to discuss briefly the public interest movement as a whole, and try to explain what I see the role of public interest science—part of it—to be. I would then like to recast the NSF's Science for Citizens program a little bit, summarizing its programs the way I see them and listing a number of guidelines that seem to me would be useful in trying to establish priorities between the different programs.

Then finally, I would like to make some comments on specific program options. Pretty much, my comments on the program options are going to be much in agreement with those of Drs. Nixon and Sullivan, so I will not go into very much detail.

Let me start, then, by talking about the public interest movement.

I do not have to explain to you what the rationale for the public interest movement is. The idea is that it is not enough to expect that the Nation will be able to determine what the public interest is through the clash of private interests. There are too many people who are not represented.

Now, the initial organizing principle for many of the public interest groups has been procedural questions. One of these questions is the question of access, which means getting the Government to give you their internal reports and documents on the basis on which they are making decisions, and getting the Government agencies to listen to you when they make decisions.

Now, to some extent, success has been achieved in increasing the access of various citizens and citizen groups. The difficulty is that once access is obtained, once you get the reports, you have to be able to understand them, and if the reports are on some complicated technical issue, you have to have somebody that can help you understand them. Furthermore, if you have the attention of some Government agency that is making policy in the area, then you have to have something to say, and it may be necessary for you to consult with some real experts.

That brings me to the next part, which is the experts. The problem there is that there are a great many experts in the United States on practically any area of technology you care to mention. On nuclear reactors, for example, a tremendous number of people are working.

The problem is that, as we all know, you do not ask your barber if you need a haircut. Fortunately, in the case of the haircut, you just look in the mirror; you can tell for yourself. The problem is—well, I will cite some examples:

You cannot smell asbestos, and you cannot taste plutonium. You have to depend upon experts.

Now, the basic problem is—as anyone knows who has followed these controversies on reactors or PVC or DDT, or any number of issues—it is hard to find independent experts. By independent experts, I mean people who are not closely allied either in their direct funding or in their general orientation toward large private interests, or toward Government agencies, people who would not see a large part of their role as being to further private interest objectives.

The number of such really independent experts, is pretty small. In fact, it is nowhere near large enough to provide the public with some kind of assurance that it is getting the real dope—that it really is able to understand these problems.

So, I see one of the primary goals of the science for citizens program as being to increase the number of these experts. This means, to some extent, even creating new career opportunities for these kinds of people, because the issues are often so complicated that people like me—I am a physicist, really working in pure physics, who consult occasionally with groups like the Sierra Club—just cannot carry the full burden by ourselves.

Groups like the Sierra Club need full-time professionals. So, we need to increase the number of experts and we need to make it much more possible and practical for citizen groups of all kinds to get hold of these people to find out who the right people are and to get them included in their deliberations of how to influence Federal policy, and to get them to help when they have to go out and read the reports that I referred to and make comments to the relevant Government agencies.

So that is the problem and that is how I see, basically, the science for citizens program fitting in.

Let me suggest four guidelines which I think ought to be used to establish priorities.

First of all, I completely agree with Jim Sullivan in saying that the program has got to be relevant—and by relevant, I mean to the concerns of the citizens.

The second is that, given the fact that the kind of funding that is going to be available for this program for the short term, at least, is going to be very small, it is quite important to choose programs with high leverage, where you get a good deal of impact for a small amount of money.

Next, I think it is important for NSF to fund programs in which NSF can choose grant recipients primarily on considerations of quality and relevance rather than on the basis of political orientation.

Finally, I think the funding should support both new and already established individuals and groups working in the technology and public policy arena. NSF seems to have an orientation more toward supporting new groups, interns, and things of this sort. I think that is tremendously important. But because of the need to develop

positions, career opportunities, for people in this area, I think it is important to fund the kinds of groups that are beginning to establish themselves in universities, for example, and various other places.

Well, those are my guidelines.

Now, the projects considered for support in the NSF program plan fall into three major categories. One is direct support to scientists, engineers, and students.

Another is support for vehicles of communication among public interest scientists and between the members of the wider public having technical education.

Finally, facilitation of communication and interaction between the technical community and the general public on technical issues, for example by regional clearing houses, registries of scientists, and various media programs.

It seems to me that all three things are very important, and all three things deserve funding.

A final option, which NSF did not consider very favorably, is funding the public interest groups themselves, and other nonprofit citizens' organizations, primarily for specific programs, particularly review of environmental impact statements and the like. Perhaps this should be done within an explicitly adversary framework, meaning NSF would not seek out individual groups that are balanced, but instead seek out different groups, one a strong advocate on one side and another group a strong advocate on the other side, capable of presenting their advocacy points of view, each one very effectively, and providing balance in that way.

Time is very short, and I am not going to go through the specific program options that NSF considered. Let me just say, in concluding, that I bascially like NSF's idea of having a rather experimental spirit about this program, doing things on a small scale, but doing a number of different things, and finding out by seeing what works which should be supported on a larger scale in the future.

But I think it is very important that the programs start off on a large enough scale that we will be able to see in a couple of years some impact from these various programs, so we have some basis to decide which ones to continue with.

I would like to conclude by emphasizing the purpose of setting up a program like this is not to harass people who want to innovate in technology and who want to produce new products for our society. The purpose is not to make their lives more difficult. Our purpose is, instead, to develop better means of making public policy decisions on complex technological issues.

Only if we have confidence in our control over technology will our society be willing to experiment with the new technologies that will undoubtedly be necessary to solve the new problems we face.

Senator KENNEDY. Very good. Thank you.

We will make sure to have all the testimony included in their entirety at the conclusion of your remarks.

There are a couple of areas that I would be especially interested in.

To what extent do your professional associations encourage this kind of effort, and what is being done within the professions themselves to try to get the associations to be more active?

Dr. NIXON. Most of the major societies do have programs in public affairs, or whatever they call them and they encourage the members to get into the action.

The ACS, for instance, has a congressional advisor program where we try to match every Member of Congress up with somebody from his district, and we try to give him advice. We do try and provide advice for people that approach us. We do this not only on a 1 to 1 basis, but also of course, through studies which are released to the area.

Senator KENNEDY. Would you say the other professional societies are as active as you are?

Dr. PRIMACK. I can comment a little on that.

I summarized in the early part of my written testimony some of the activities, and also NSF has a little bit on it in their science for citizen program plan books. I have been fairly active myself in the American Physical Society, and also the AAAS.

The efforts are, first of all, largely in their professional meetings. They hold sessions with discussion of public issues, so that the members will know something about them. They put out publications; one of the most prominent is Science magazine, where there is increasing discussion, fairly high-level discussion, of public issues concerning technology.

There very recently has been a new trend to actually undertake very significant studies on very controversial areas.

The American Physical Society got funding from NSF and the AEC, right before the AEC became ERDA, to do studies of reactor safety and of a number of areas concerning energy conservation. These studies have tremendously raised the level of discussions, since they were among the first independent studies where the people involved knew enough about the subject to come to some generally accepted conclusions, but neverthless, were not tied to the industry.

Of course, the American Physical Society and AAAS, and other societies, also sponsor the Congressional Scientist Fellowship program.

To give some indication of the depth of interest among some of the societies, in the continuing of these kinds of activities, I will refer to the dues check-off program of the American Physical Society. The Physical society supports primarily its journals and its other vehicles for furthering pure physics and applied physics, but not these kinds of public policy programs. They were somewhat reluctant to use member dues to pay for programs like this.

So they allowed members to contribute funds for such programs at the same time they paid their dues, and the response from the membership has really been overwhelming. I think it was something like half of all the members contributed an average of $5 or $10 on top of their dues. This is without any real solicitation at all.

Senator KENNEDY. I want to get a quick reaction from you on the extent the NSF has worked with public policy and interest groups in the past.

Have they reached out to you in the past?

Dr. NIXON. In the Chemical Society, they have partly supported some of the studies we have done on the environment, for instance, and a present study on the role of chemistry in medicine.

Senator KENNEDY. Generally, do you give them fairly good grades in terms of working with public interest of scientific groups?

Dr. NIXON. This is not that sort of public interest.

Senator KENNEDY. No, it is somewhat different.

We will just get at least 20 seconds from each of you on that subject, if we could.

Dr. PRIMACK. Let me put in 20 seconds.

NSF has done fairly well on individual projects. The difficulty is that everything is seen as a special case, and one has to start from scratch each time, on why you need to have outside studies, and one of the purposes of establishing the program whose job it is to develop independent expertise would be that you would not have to make the case every single time.

Dr. SULLIVAN. I think they have only made minor efforts to get themselves involved with public interest science groups. There are not that many public interest science groups. NSF is beginning now.

More citizen input is what I see the big need for, on-going citizen input into the design of the program. I think NSF will do OK if they listen to citizens.

Senator KENNEDY. Very good.

I think you mentioned, Dr. Nixon, that with regard to the professional organizations, at least, there is a feeling within them that they have access to the NSF?

Dr. NIXON. Yes. Guy Stever has been quite interested in the last few years in getting input from the societies.

Senator KENNEDY. I must say, in comparison to what I have heard as Chairman of the Administrative Practices Committee, looking into the regulatory agencies, they seldom have meaningful or continuing contact with that kind of group.

We have rather interesting legislation before the Judiciary Committee to encourage public participation in the proceedings of Federal agencies. It allows compensation of fees for attorneys and other expert witnesses before the regulatory agencies.

I think this will be useful and helpful. We will set up some criteria to define limits to that funding and to insure that the presentations contribute to the proceeding. It is not going to be as open as perhaps some of you would like to see, but I think it will be a meaningful step forward.

Dr. SULLIVAN. I think that is crucial, especially in light of the recent Supreme Court decision.

Senator KENNEDY. Also, we need to get competitive impact statements from Federal agencies, as well as the environmental impact statements. We are working on legislation to accomplish this. All of these activities are going to require agencies to reach out to groups like those you are representing.

Thank you very much.

Dr. NIXON. Thank you.

[The prepared statements of Dr. Nixon, Dr. Sullivan, and Dr. Primack follow:]

FEDERAL SUPPORT FOR PUBLIC INTEREST SCIENCE: NSF'S SCIENCE FOR CITIZENS PROGRAM

Testimony by

Joel Primack

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before The NSF Subcommittee,

U.S. Senate Committee on

Labor and Public Welfare

March 3, 1976

As technology grows both in its complexity and in its effects on our lives, it becomes increasingly important that the citizen have ready means of access to diverse sources of competent scientific information and advice. At the same time, however, the nation's reservoir of independent technical experts -- "public interest scientists" -- capable of providing such advice is not growing in proportion to the number and difficulty of the technological problems our society faces. The National Science Foundation's new Science for Citizens program can be seen as a response to this two-pronged problem.

In practice, it is often not individuals but organizations, particularly "public interest" groups, that seek technical help in order to understand and influence technological issues. It will be useful, therefore, to review briefly the history and rationale of the public interest movement in order better to understand the role of public interest science.

Public Interest Groups

A principal function of government is to choose among a variety of possible policies those which best represent the public interest. But how is the public interest to be determined? A generation ago, the conventional answer was that the public interest arose out of the clash of private interests -- by which was meant organized private interests: corporations, labor organizations, property owners, ethnic groups, and so on. The difficulty is that, in many cases, there exist large groups of people --often virtually the entire population-- who may not be much affected as individuals by particular decisions, but whose collective stake in the outcome is nevertheless quite significant. Public interest groups claim to represent these sorts of

inclusive (as opposed to private, or exclusive) interests in the political arena. Although such groups have existed in America for many years, there has been a dramatic growth in the number and political impact of these groups during the past decade.

Although these groups have been rather diverse -- representing civil liberties, environmental, consumer, and other interests -- a feature common to many of them is a strong concern with procedural issues. Thus, for example, in the controversies over the Storm King pumped storage electric generating plant or the Calvert Cliffs nuclear plant, the issue was primarily one of forcing the respective federal agencies (the FPC and AEC) adequately to consider environmental impacts of, or alternatives to, the proposed plants. Significantly, both cases were regarded as signal victories for environmentalists even though the two opposed power plants were eventually approved to be built. Indeed, one of the great legislative successes of the environmental movement during this period was the passage of the National Environmental Policy Act, whose principal impact on policy-making has been through its requirement of environmental impact reviews.

The need for improvement in administrative procedures, rights of public access, and the like, is still great. But now the focus of the public interest movement is beginning to shift increasingly away from such procedural issues. Once public access has been achieved, substantive issues then come to the fore.

In the past, the cutting edge of the public interest movement has been public interest law. Now, increasingly, the efforts of public interest lawyers will need to be supplemented by those of their scientific colleagues if our technological decision making process is to remain open, democratic, and pluralistic.

Public Interest Science

Traditionally, public interest science has been an activity carried on by scientists who have taken time off from their usual pursuits in order to bring what they consider to be important technical information to the attention of government officials and the general public. A well known example is Linus Pauling's warnings in the early 1950's about the biological hazards of radioactive fallout, which provided much of the initial impetus toward the Atmospheric Test - Ban Treaty.

Such public service activities by scientists are probably more common and diverse today than ever before. Scientists speak before civic groups on current technology for solar heating of homes and other buildings, or consult for a city council on the gasoline-consumption implications of the planned installation of a number of stop signs. A small group of scientists from local federal and commercial laboratories join to organize the Colorado Committee for Environmental Information, and one of their first activities is to warn the citizens of Denver of the potential danger from a large stockpile of obsolete nerve gas bombs stored under the approach path to Denver's airport. Several engineers from the Rand Corporation join with a few university scientists to assist the Sierra Club in its review of the AEC's draft report on the safety of nuclear reactors. And so on.

It is essential that such "amateur" public interest science continue. Until recently the scientific community delegated its public responsibilities mostly to official government science advisors. This was a mistake. Even the most competent and relevant advice can be ignored in the political crunch when decisions are made. The unfettered spirit and fresh perceptions of outsiders will always be required to keep the system honest.

But neither is a system in which public interest science is practiced only by volunteers satisfactory. Nothing less than a full-blown crisis may be required to motivate a dedicated scientist to drop his usual work -- but by that time it may be rather late to initiate corrective steps. The problems that our society faces in dealing with technology have grown too complex for public interest science to continue entirely on an ad hoc basis.

In recent years, a number of more or less organized public interest science activities have been instituted. The AAAS in 1969 dedicated itself to work primarily on "contemporary problems concerning the mutual relations of science, technology, and social change." The AAAS journal, Science, and their annual meetings have been devoted increasingly to such issues, and AAAS has also published a number of related reports and books. In 1970, AAAS sponsored a Herbicide Assessment Commission, which investigated and helped to bring an end to defoliation in Vietnam; and AAAS has recently joined with the American Physical Society and several other professional societies to sponsor the Congressional Science Fellowships program. In 1974-75 the Physical Society, with support from NSF and AEC, organized a number of major studies on energy, concentrating on issues in reactor safety and on opportunities for energy conservation; and other professional societies have prepared similar public studies useful both to scientists and laymen. Such mechanisms for organizing the public advisory activities of scientists represent the beginnings of the institutionalization of public interest science.

There are even beginning to be career opportunities in public interest science. The Sierra Club, the Massachusetts Audubon Society, and other traditional environmental groups have hired young scientists. The environmental public interest law firms, the Natural Resources Defense Council and the Environmental Defense Fund, between them have

more than a dozen full time staff scientists. And technology policy research groups having a strong public interest science flavor have recently been organized at universities; examples include Princeton's Center for Environmental Studies and the University of California at Berkeley's Energy and Resources Group.

Public interest science is thus lively and growing rapidly -- but it has now reached a critical size. In the past, financial support for such activities has come from scientists themselves (through voluntary contributions solicited along with regular membership dues in the American Physical Society, for example), from membership-based public interest groups, from universities, and from private foundations. It is essential to the independence of public interest science that such diversity of funding be preserved. But now I think it is appropriate that the federal government begin to support part of this activity. This is what the Science for Citizens program proposes to do.

Science for Citizens: Priorities

It is clear that the total amount of federal money that will be available to support public interest science will be fairly small, so it will be necessary to establish priorities among the various programs that might be considered. To this end, I would like to suggest four general guidelines:

(1) programs chosen for support should be likely to have a significant relevance to public policy;

(2) high leverage programs --those where a small amount of money can go a long way-- should receive much of the early funding;

(3) it is desirable to fund types of programs in which NSF can choose grant recipients on the basis of considerations of quality and relevance rather than political orientation;

(4) funding should support a mixture of new and already

established public interest scientists and groups, since there is clearly a need for both, and NSF should be prepared to support certain programs for two or more years where appropriate.

The projects considered for support in the NSF's Science for Citizens Program Plan fall into three major categories:

(a) direct support to scientists, engineers, and students;

(b) support for vehicles of communication among public interest scientists, and between them and members of a wider public having moderate technical education: forums, conferences, workshops, and journals;

(c) facilitation of communication and interaction between the technical community and the general public on technological issues of public policy: national or regional clearinghouses, registries of scientists willing to do public interest work, and various media programs.

Another option which was not considered favorably in the NSF document, but which I think is nevertheless worthy of discussion, is

(d) direct support to public interest groups and other non-profit citizens organizations for specific projects -- for example, studies of particular issues, reviews of environmental impact statements, and the like -- perhaps within an explicitly adversarial framework.

A final suggestion mentioned in the Program Plan, that of establishing state-based centers to administer programs of all the sorts just mentioned, is one to which I would give low priority. The larger the number of administrative units, the larger is the fraction of the total funds going to various sorts of overhead. There is furthermore a lower limit to the size of many types of projects below which they cease to have much chance of effectiveness. I have had a little experience with a local National Endowment for the Humanities grant to promote discussions of the future of my home county, and doubt whether such programs really have a great deal of effectiveness; in any case, the Science for Citizens budget

is likely to be very much smaller than that of the National Endowment. Thus the state-based centers are downrated on the basis of criterion (2), leverage.

Fellowships, Internships, and Project Grants

Direct support can be awarded to scientists, engineers, and students on either an individual or a project basis. Fellowships and internships, enabling their recipients to work with public interest groups, state legislatures, media organizations and the like, would be an excellent vehicle for enabling newcomers to public interest science to find an appropriate niche and perhaps start or modify their careers. Support should also be available for worthwhile projects conducted by already established individuals and groups.

Both fellowship and project grants can be chosen to meet all the guidelines that I proposed; indeed, high quality people will naturally choose to work in locations and projects of high relevance and leverage. It seems likely that there will be no shortage of qualified applicants, considering the number of applications regularly received by the Congressional Scientist Fellowship Program, for example; the increased interest of scientists in undertaking public interest work; and the growing number of science policy groups on campuses. Recipients should be chosen on the basis of technical competence (i.e., ability to produce information and analyses which will pass peer review); policy competence (ability to formulate a problem and present conclusions in a way which will raise the level of the public debate in an important policy area); and independence, both financial indepencence (established by some sort of full disclosure) and intellectual independence (ability to

approach the issues with a broader -- or at least different -- perspective than that of technical groups sponsored by interested parties). Another criterion is cost effectiveness. In general, the smaller the group and the higher the fraction of time the persons involved are prepared to devote to the project, the greater the output. Groups have more inertia than individuals; before the NSF funds a new group, it should consider carefully whether it will be of high enough quality to have a reasonable chance for long-term viability.

Presumably the NSF will want to set up selection panels for various types of Science for Citizens grants, as it does in other areas. It is obviously important that these panels neither be dominated by people who are ignorant of or unsympathetic to the purposes of the program, nor be captured by groups identified with particular political causes. Panels should include established discipline-oriented researchers (the more basic the better, to minimize connections with vested interests); qualified technical people working in the policy area (Congressional Science Fellows, academic technology-policy types, public interest scientists, etc.); and representatives of the potential client groups, including the general public.

Forums, Conferences, Workshops, and Journals

High priority should also be given to support for various vehicles of communication among independent scientists working on technology policy, and between them and the technically educated community. This is another area where a small expenditure can have a high leverage, particularly since present efforts are relatively meagre or under-funded.

I will mention one example of such a project with which I have

had some connection, just to illustrate the rich possibilities in this area. I organized a symposium on nuclear reactor safety in collaboration with Hans Bethe at the American Physical Society meeting in Washington last April. The focus of attention was the AEC's Reactor Safety Study (the "Rasmussen Report") and the APS's own reactor safety study, to which I alluded earlier; speakers included Norman Rasmussen, Herbert J.C. Kouts (Director of Research for the Nuclear Regulatory Commission); and two participants in the APS study. I think all who participated or attended agreed that the symposium was very helpful in clarifying areas of agreement and disagreement, and thus raising the level of discourse in a crucial and controversial area. The talks were then revised in light of the discussion and published together as a special section of the September 1975 issue of the Bulletin of the Atomic Scientists.

The major costs for such a symposium are the travel expenses of the speakers; in this case these were small, and borne by the Physical Society's Forum on Physics and Society. I am certain that many useful symposia, conferences, workshops, and the like would be organized if funds were more readily available. Criteria for choice of projects to support should include relevance of the issue, fairness and balance of the program, openness and convenience of attendance for all those who might be expected to benefit, and adequacy of plans for dissemination to a wider audience.

Rapid publication of such conferences in a well-edited form by a widely circulated journal is in many cases the most effective means of dissemination; indeed, such journals can themselves act as sponsors of the conferences. Grants to journals at the technology-

policy interface will be especially useful if they support editorial projects which the journals would not otherwise have the resources to undertake. But even generalized grants to such journals can be justified, since these publications perform the essential function of creating a coherent technical literature open to all competent investigators. The need for such journals will grow as the Science for Citizens program adds its stimulus to work in this field; already the journals represent a bottleneck which discourages needed analyses from being done because there is not an obvious place to publish them. Here, considerations of leverage would suggest that much of the funding, at least initially, go to already established and widely circulated magazines such as Environment or the Bulletin of the Atomic Scientists.

Clearinghouses, Registries, and Media Programs

Facilitation of interaction between the technical community and the general public on technological issues of public policy is clearly an essential function of the Science for Citizens program, but it is also likely to be hard to do well. Since costs of many media programs can be very large, it will be particularly necessary in this area to choose initial projects carefully.

The success both of specialized groups such as Resources for the Future and the 1973-75 Ford Foundation Energy Policy Project, and of generalized groups like the Center for Science in the Public Interest, shows that science for citizens clearinghouses can be both useful and viable. However, for the reasons I mentioned before in connection with state-based centers, nationally active groups are likely to be more effective than regional ones. Of course, in some cases the nature of the problem itself will dictate a regional orientation; for example, clearinghouses might usefully be organized

on problems of the outer continental shelf or on technical issues involved in water, resources, and land use policy in the Western Great Plains or the Southwest.

Science for Citizens clearinghouses are likely to be the most effective units to organize specialized rosters of qualified public spirited experts, and to match experts with potential clients. Mere lists, no matter how cleverly organized, tend to be less used -- and less useful -- than a knowledgeable person at the other end of the telephone line. Before any massive roster-compiling is undertaken, previous experiments in this field should be carefully studied -- for example, The Institute of Ecology's roster of ecologists, and the Biophysical Society's roster and "editorial board" system.

Organizing and staffing Science for Citizens clearinghouses is likely to require considerable effort and ingenuity. Here, again, it may be most effective to start by funding existing centers, or enlisting their help in organizing new ones. The choice of location for such centers is also quite important; obvious criteria include ease of access both to experts and to clients, and this might often be maximized by siting the clearinghouse at a large university in a metropolitan area.

Among the various public education programs which might be considered, some could very well be administered by a Science for Citizens clearinghouse or even a SFC grant recipient. These could include preparation of series of two or five minute radio "spots" on topical issues (an excellent project of this sort has for some years been conducted by Clarles Levy of the University of California; his "spots" are regularly broadcast on various stations including the CBS network affiliates in San Francisco and Los Angeles) or of longer radio or television programs in various formats. Leverage will

obviously be maximized if distribution of such programs is as broad as possible.

Other media programs which may have high payoff for relatively low cost include year-long fellowships for journalists specializing in or interested in the science and public policy area (a model is Harvard's Nieman fellowships; indeed, several of the Nieman Fellows in recent years have been science writers), and support for special college and graduate programs to train science writers and broadcasters, including summer internships for students (my campus, the University of California at Santa Cruz, last year initiated a good program of this sort). It must also be remembered that public education is not the exclusive province of the news media: high schools, junior colleges, and four-year colleges also can be effective. Thus weekend workshops or summer institutes to bring teachers in these institutions up to date on technical aspects of policy issues can be very useful (I have recently participated in two weekend projects of this sort organized at Stanford University with assistance from a Lilly Foundation grant). By reaching teachers from a number of institutions, who will in turn teach many students or engage in other public activities, such a program can have fairly high leverage.

Direct Support to Public Interest Groups

The NSF is naturally leery of providing direct support to public interest groups or other admittedly partisan organizations, and there are indeed some good reasons why it should perhaps not do so. For example, the potential for offending powerful constituencies will here reinforce the endemic timidity of bureaucrats, and they may tend to fund primarily the most innocuous or uncontroversial groups -- or, even

worse, the most solidly entrenched. Nevertheless, I still think that direct support to partisan groups should be considered.

The reason is that technical issues in public policy are sometimes inextricably intertwined with political issues or value choices, and the only unbiased scientists available may know next to nothing about the problem. The controversies over nuclear fallout, the anti-ballistic missile system, and persistent pesticides have provided examples of this situation. Cases like these are thus inherently adversarial, and it may be illusory to try to find entirely neutral experts, however independent they may be. In such cases, the best solution may be to fund two or more admittedly partisan groups, chosen of course on the basis of the quality of their proposed projects.

Our society has come to depend on adversarial mechanisms for the resolution of conflicts, and it is hardly inappropriate that this should sometimes include controversies involving complex technological issues--for example, in administrative rulemaking hearings. It is evidently essential that if such conflicts are to be resolved fairly, all sides must have access to competent expertise. A Science for Citizens program that would be responsive to this need might include, among other things, provision for small (say, less than $5,000), rapidly processed grants to groups participating in such hearings, or in the review of an environmental impact statement. As a participant in such review efforts for the Sierra Club, I was dismayed that we did not even have the resources to bring our volunteer experts together for a single face-to-face meeting.

Conclusions

Many of the programs and projects considered under the new Science for Citizens program seem clearly useful and worthy of federal support. A minimal program should include at least one program in each of the first three categories -- direct support for public interest scientists, support for communication mechanisms within the technical community, and support for mechanisms leading to increased public interaction and understanding. I would hope that funding can be made available for more than merely a minimal program. The idea of undertaking such programs in an experimental spirit seems to me a good one; the more such experiments that are tried, the higher the probability of developing successful ones.

I think it may be useful, in concluding, to reemphasize that the purpose of public interest science -- and of technology assessment more generally -- is not to harass or suppress technology. Our aim instead is to develop better means of making public policy decisions on complex technological issues, consistent with our democratic, pluralistic system of government.

The nation can never return to the halcyon days of its industrial youth, when technological laissez-faire was fostered. In the future we must learn to choose more carefully the technological paths we wish to pursue and to make adequate provisions for the people whose interests or jobs are affected by the choices. Public interest science and increased public participation in technology assessment can allow decisions to be made with more confidence and thoughtfulness, and it certainly should raise the level of public debate about the desirability and risks of new technologies. Only if we have confidence in our control over technology will our society be willing to experiment with the new technologies that will undoubtedly be necessary to solve many of the problems we face.

Acknowledgment and References

In preparing this testimony I have benefitted from conversations with Frank von Hippel. For more information on public interest science, see Joel Primack and Frank von Hippel, Advice and Dissent: Scientists in the Political Arena (Basic Books, 1974), and Martin Perl, et. al., "Public interest science--an overview", Physics Today, June 1974, pp. 23-31.

SCIENCE FOR CITIZENS

Federal Support for Public Interest Science

Testimony Before The Subcommittee On The National Science Foundation

Of The U.S. Senate Committee On Labor And Public Welfare

Dr. Alan C. Nixon

Chemical Consultant

Wells Fargo Building

Berkeley, California

March 3, 1976

I am a chemical consultant and I have spent most of my working years in chemical industry. I am a past President of the American Chemical Society and current Past Chairman of the Committee of Scientific Society Presidents and current Chairman of the California Section of the American Chemical Society. I am very happy to have this opportunity to appear before you to comment on the program "Science For Citizens." I wish to state that my overall view is one of enthusiastic support for the concept of such a program. In my many years of involvement in the American Chemical Society I have consistently urged my fellow chemists and chemical engineers to become more active in public policy issues involving science and technology. More recently as chairman of the CSSP I had the opportunity to express similar convictions to a large majority of the scientists in this country and through my activities as laison to the Association for Cooperation in Engineering I was able to attempt to influence the majority of engineers in this country. A recent survey that I did of all of the scientific and engineering societies

whose presidents are members of either CSSP or ACE indicated that somewhat more than half of the societies officially take advantage of opportunities to give testimony before Congressional Committeess and have active programs in public affairs. However, one of the real needs in this country is to provide a mechanism for encouraging more individual scientists and engineers to get into the action. I think money spent by the Congress in this endeavour will certainly be money well spent. Afterall, if we are willing to spend 110 billion dollars defending us from the Russians we should be willing to spend a substantial percentage of this amount defending us from ourselves. It might be argued that the National Science Foundation is not the ideal agency to do this job but since we do not have a Department of Science and Technology it is probably the best agency that we have, particularly since the NSF under the able leadership of the President's Science Advisor has shown a remarkable ability to adapt to changing circumstances and to react effectively to new opportunities. However it is important that this program, "Science For Citizens," have an advisory body which does include strong representation from the general public to somewhat moderate the natural acquisitive and exclusionist tendencies of scientists.

In general I would say, in looking back over the history of federal involvement in research and development during this century, the prevailing tendency has been to spend far too little money questioning the wisdom and long range effects of what we are doing in science and technology compared to the money spent in actually doing it. The Science For Citizens program is certainly a worthwhile attempt to try and redress this balance. However, it must be recognized by Congress that such an effort to stimulate more activity in this area will require substantial financial

contributions over a number of years. The development of information systems, the creation of public education programs and the establishment of a credible system for getting more scientists and engineers involved is not easy. It will not result in instant success and there is no magic wand that can be waved to bring it about. An abortive attempt could easily do more harm than good. According to the draft report of the National Science Foundation on Science For Citizens, February 1976, the estimated amount of money required to initiate the nine options selected by NSF would run to about two and a half million dollars while complete development of all of them might run up to around 10 million dollars a year. To my mind this is not an unreasonable amount of money to pay for the sort of results that we might expect, particularly since the matching effort, in terms of time and money by individuals and organizations would certainly come to considerably more than this. However, if the budget element for this program were to be only $300,000 it would severely delay the initiation of the total program and make it necessary to critically select those segments to be funded in fiscal '77.

CONSIDERATIONS OF OPTIONS

I will comment on the various options given in the NSF report in the order in which they listed them.

1. Registries of Scientists and Engineers

Since I have been endorsing the idea of having professional societies do this themselves for several years I think this is an excellent start in the effort to locate people who are willing and able to assist public interest groups more directly contribute on questions of national import. I know some societies have looked with favor on the idea but have been

held back by costs. Most professional societies at the present time are having cash flow problems, attempting to meet rising costs but at the same time not increase their membership fees and subscription rates drastically. However, it should be pointed out that there is a major problem in getting many qualified people to volunteer for this effort. As you know most engineers work for industrial organizations while a substantial and rising proportion of scientists do likewise. Industrial managements are extremely reluctant to have technical employees speak out on technical matters except through the management structure. This was emphasized at the recent meeting of the American Association for the Advancement of Science in Boston on a panel on "Ethics and Corporate Scientists." I expressed the point of view that scientists who work in industry have an ethical responsibility to reveal information that they have which they feel should be divulged for the protection of the public. As related in the New York Times for Sunday February 22 this view was challenged by Dr. Arthur Bueche, vice-president for research at General Electric Company who emphasized that a corporate scientist primarily "owes loyality to his employer." Dr. Bueche felt that if a scientist or engineer wished to speak out his proper course was to discuss it with his management and, failing satisfaction, resign if he felt he had to go further. I do not think that Dr. Bueche is right, it should not be necessary for an industrial scientist or engineer to resign in order to contribute to public policy or safety. But a mechanism must be created in order to protect such individuals. There are enough instances that have been brought to the public attention to make this clear: most recently by the resignation of three General Electric engineers in California who felt compelled to speak out on the safety of nuclear energy.

As a matter of fact the relationship between employed scientists and engineers and their employers is still based on the old English common law of the master/servant status. Many professional societies have recognized that this is not satisfactory and in my recent survey of CSSP and ACE organizations I found that 23 of them endorsed guidelines for employment which recommend the establishment of employment conditions that would discourage arbitrary firing or discrimination as a result of activity such as being willing to speak out on public interest science matters. However, since these guidelines are purely voluntary and most societies do not have any mechanisms whatsoever to implement them they are not very effective. Only the American Chemical Society has made a serious effort to implement the guidelines and has found that it is a very difficult thing to do. Therefore I recommend that if we expect to tap this extremely important reservoir of information for public interest science, we should enact into law the most important provisions of the guidelines for employment thus establishing what has been called a "Bill of Rights for Professional Employees."

2. Media Programs to Increase Public Understanding

I think that media programs are an excellent way to increase the public's understanding of science and technology policy issues and without question should be used. However, I believe that this should be done by adding on to the present programs that NSF is supporting at the present time, such as the NOVA series, making sure in the development of the scripts for these programs that opportunities to emphasize public issues in science and technology be sought. Some experiments could be done in the development of TV scripts in the next year and have them evaluated by panels of media experts.

Another relatively inexpensive thing that NSF could do would be to take advantage of programs produced by others, such as professional societies symposia and panel discussions on public interest matters in science and engineering. These would be video taped and edited for distribution to television stations, schools and adult centers. A current example of this is a program sponsored by the California Section of the American Chemical Society on March the fifth presenting a panel of experts discussing the problems of nuclear safety with reference to the "Nuclear Initiative" which will be voted on in California this June.

Another relatively inexpensive but powerful medium is radio. The format of using experts on public interest topics on "call-in" programs provides an excellent vehicle. Another mechanism is the production of specific discussion programs that are presently available through the professional societies. For instance the ACS produces a "Man and Molecules" program which is carried by more than 540 radio stations around the world.

3. State-Based Centers To Support Public Programs in Science and Technology

On the face of it this seems like an excellent idea but it is one that may be very difficult to implement. So that I feel it should have a lower priority than some of the other items on the list. Certainly if the estimate of $345,000 is correct NSF will not be able to do this in the next fiscal year. I would recommend that this option be further studied with the idea of establishing it first of all in only one state, selecting a state, such as New York or California, where the state government has already established a mechanism for informing the state legislatures on science and technology matters with respect to contemplated legislation.

Such states also would be more inclined to provide matching funds for such centers (this would not include New York at the present time of course).

4. Scientists and Engineers Associates Program

I feel this is a most desirable program to be incorporated in the SFC overall program since it will make experts available to all sorts of public interest groups that might have difficulty recruiting them otherwise. Obviously not very much can be done in the first year under the budget limitations. One extension of the program proposed by NSF would be to increase the availability of short term personnel by working through the professional societies. They could help identify recently retired individuals who would be interested in spending a month or two working intensively on an in-depth piece of scientific public interest work. Also it might be possible to recruit rather large numbers of scientists and engineers who would be willing to arrange to do part time work on a rather continuing basis either by arranging for time off or by working on their own time with their out of pocket expenses covered.

5. Internship Program for Science and Engineering Undergraduate Students

This is an option that would be relatively easy to implement. It could be grafted on to present work-study programs that many educational institutions are adopting. There are many other examples of successful flexible programs. Because of rather dismal employment prospects in the future the academic community is eager to innovate. Care would have to be taken to ensure that the students were given an opportunity to contribute in the area of science and technology rather than being utilized simply as envelope stuffers.

6. Establishment of a National Clearinghouse with Regional Branches

Establishment of such a clearinghouse would meet a very obvious need. According to the NSF estimates the budget for such a clearinghouse even with only one branch would be clearly impossible in the first year. I would recommend that planning for this operation go forward during the year with particular concern for coordinating with other sources of information in the government and elsewhere and to determine what would be the best way of supplying information at the least cost. One possibility initially would be to take advantage of some of the existing suppliers of information to scientists and engineers by feeding information to the professional societies who have wide circulation news type magazines. It might also be possible for NSF itself in this area at a low subscription rate to put out a weekly newspaper type publication. This is obviously an option which would have to be developed with good planning. This aspect of the matter could very well occupy the next year.

7. Establishment of Regional Centers

This option obviously overlaps number 6 and would be subject to the same sort of constraints regarding careful planning because of the high cost of establishing such centers and the difficulty of insuring that they would be a success. I recommend that most of the activity during the first year go towards planning the establishment of such a service and that considerable detailed attention be paid to the operation of centers that have already been set up by states or by foundations to determine the best way to set them up. I'm more attracted to the idea of the Regional Issues Centers described as a suboption, although even here it is not clear that there has to be a separate center established rather than working through already established institutions such as universities,

museums and foundations. The NSF could assist in the setting up of conferences, workshops and special studies in various regions as particular problems come to the fore, such as the offshore oil drilling problem on the east coast, the nuclear safety problem which is particularly prominent in California in the present time and so forth. Information about such meetings should be advertised through the newspapers, technical magazines, and specialized media in the areas where the activities would occur.

8. Forums, Conferences and Workshops

This option obviously could be implemented very rapidly with the NSF itself serving as the center of implementation either directly or through other existing institutions such as public interest science groups, universities, professional societies or foundations. I certainly agree with the conclusion of the NSF report that the conferences and workshops to be conducted under this option would need to be well planned so that the time of those attending and the resources invested would not be wasted. One of the essential needs here is that the outcome of such conferences and workshops be reported in an interesting concise form to the news media so that some of the considerations entertained and the conclusions arrived at by the conferences would have impact upon a larger group of people than those attending the conference. In this regard we cannot entirely depend on the present batch of science writers; there are not enough of them and they do not have the time to cover every conference of this type. I recommend that an attempt be made to recruit a corp of retired scientists and engineers who have some talent for writing who could be assigned to cover these conferences.

9. Grants to Independent Journals

This is an excellent option which I know has been exercized in part by the NSF in years past. I would say that this should continue to be done on a selective basis. Editors should be encouraged to apply for specific grants to publish an article or a series of articles dealing with a topic involving public interest science or to report meetings that have been held by organizations in this area. Care must be taken to select magazines or journals that have either wide circulation or are highly influential. However, not very much could be done with the proposed budget of 50 thousand dollars.

Related to the development of media programs would be support for the establishment of what might be called research foundations for science and engineering which would play a role similar to that of the Brookings Institute in the field of economics. These would be independent think-tank type institutions and could be established to cover various branches of science and engineering. One such proposal has been considered by the American Chemical Society which received some favorable support but was shelved because of financial considerations. The ACS itself through its Committee on Chemistry and Public Affairs has been very active in producing reports that deal with the chemical aspects of many problems and issues that relate to the public interest. (Other societies have done similar studies in their own disciplines). These include "the Environment, the Chemical Basis for Action," and "Chemistry and the Economy" which have already been issued, the first with a supplement and with a second edition now being prepared. Two others in preparation are "Chemistry in Medicine" and "Energy and the Environment from a Chemical Viewpoint." These are valuable reports and have indeed

been supported, in part, by the National Science Foundation. They have been widely distributed to legislators, colleges and universities, industrial organizations and public interest groups (their effectiveness could be greatly increased if they were rewritten by talented science writers and put out in paperback form for general sale). They have the great advantage that since large numbers of volunteers are involved and the report is finally edited and produced by the professional society the reports have a degree of objectivity which is probably difficult to obtain in any other way. However because of the fact that most of the information is supplied and writing is done by volunteers the timetable for production is necessarily long (and usually slips). Establishment of research foundations under the aegis of one or a consortium of scientific or engineering societies (or CSSP and ACE) should provide comparible objectivity but a shorter response time.

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CONCLUSION

The Science For Citizens program will be most effective if it generates independent input and involves people who are both knowledgeable and concerned. This in turn should raise the level of public understanding and appreciation.

I feel that the NSF did a commendable job of seeking out opinions and getting input from both citizens and scientists in most aspects of their proposed program. Accordingly, I recommend that the following options of their program be funded at the indicated levels ($ K).

* Registries of Scientists and Engineers	150
* Scientists and Engineers Associates Program	400
* Promotion of Forums, Conferences and Workshops	150
* Grants for Independent Journals	100
* Media Programs	150-400
* Internship Program for Students	100

In lower priority I would put the matter of clearinghouses and centers not because they may not be important but because I do not feel that all the problems have been resolved and the various alternatives identified. So I would recommend that sufficient funds be provided so that a thorough job of planning can be done with respect to the establishment of a central clearinghouse, with regional branches and the establishment of regional centers or state-based centers. This will require a critical examination of available models and the development of a number of optional methods of operation and funding. Such plans should then be referred to the professional societies, public interest groups and interested individuals for evaluation; to be followed by the development of final plans.

REFERENCES

(1). A Brief Survey of Professional and Public Affairs Programs of Scientific and Engineering Societies. A.C. Nixon and A.W. Ritchie, CSSP - 1155 16th Street, NW Washington, DC 20036.

(2). Scientists Discuss Dual Loyalty on Job. N.Y. Times, Sunday February 22, 1976.

(3). Professional Society Guidelines to Employment. Wescon Professional Program. San Francisco, September 16-19, 1975, p 30/3.

(4). A Bill of Rights For Professional Employees. C & E News, January 20, 1975, p 39.

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S C S P S
COMMITTEE OF SCIENTIFIC SOCIETY PRESIDENTS

1975

1155 Sixteenth Street, N.W.
Washington, D.C. 20036
(202) 872-4452

January 19, 1976

TO: Members of the Committee of Scientific Society Presidents and Association for Cooperation in Engineering

FROM: A. C. Nixon

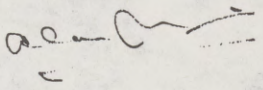
SUBJECT: Report on Survey of Professional and ~~and~~ Public Affairs Activities

The question of how much various societies were doing in the area of public affairs and professional relations was a matter that came up at several meetings of the CSSP and ACE and I promised to conduct a simple survey to get preliminary comparative information in these areas.

The questionnaire, addressed to all constituent societies of CSSP and ACE, that was sent out last April was the result of this, perhaps incautious, promise. During last year responses came in from almost all societies and with the help of my colleague, A. W. Ritchie, the attached report has been prepared.

Although not as complete as I would have liked, I think the results are interesting and on the whole encouraging. I hope you will find the report interesting and that it will lead to a more extensive examination of these important areas.

ACN:ev



Except as otherwise noted, the views expressed are those of the individuals involved and do not necessarily represent the official position of their respective organizations.

THE NEW YORK TIMES, SUNDAY, FEBRUARY 22, 1976

Scientists Discuss Dual Loyalty on Job

By JOHN NOBLE WILFORD
Special to The New York Times

BOSTON, Feb. 21—Scientists who work in industry have an ethical responsibility to speak out on any research they are doing that could prove detrimental to the public, and scientific societies should take steps to protect the jobs of members who feel compelled "to blow the whistle" on their employers, Dr. Alan C. Nixon, a former president of the American Chemical Society, says.

He spoke here this week at the annual meeting of the American Association for the Advancement of Science at an all-day meeting on ethics and the corporate scientist.

But Dr. Nixon's viewpoint was challenged by Dr. Arthur Bueche, vice president for research of the General Electric Company, who emphasized that the corporate scientist "owes loyalty to his employer" and cautioned that it is "often difficult to distinguish between those who are blowing the whistle and those who are just crying wolf."

Dr. Bueche said that the primary ethical responsibilities of a corporate scientist or engineer were to perform "significant, relevant professional work," to protect trade secrets and to design and produce products that were "safe and effective."

Three G.E. Resignations

If in the course of such work a scientist discovers what he believes are problems, Dr. Bueche added, he should first discuss the problem with associates and his management — and "be willing to resign" if he chooses to to make a public attack.

This happened earlier this month when three General Electric engineers in California resigned from one of the company's nuclear divisions because they had reached the conclusion that nuclear energy represented a profound threat to mankind.

Their action focused renewed attention on a problem of increasing concern within the scientific community: how to separate what a scientist says as a concerned citizen from what he says as a scientist reporting scientific facts.

"We can tell them apart, but the rest of the populace can't," Dr. Bueche said, adding that it can be "dangerous to the entire technical community" when a scientist "combines the role of activist and professional investigator."

But Dr. Nixon stated:

"I believe the scientist has a responsibility to bring to the attention of the American public any problems in his field of science. Pollution is largely the result of chemistry, but our profession has not been very active in bringing this to the attention of the public. This came much later, usually the result of being caught by a government agency."

Dr. Nixon, a former industrial chemist, headed the American Chemical Society and, more recently, has been chairman of the Committee of Scientific Society Presidents. In that capacity, he has sought to encourage scientific societies to establish codes of ethics for corporate scientists, to investigate any cases of potentially harmful research brought to their attention by members.

Dr. Nixon said that the American Chemical Society had investigated 120 such cases in recent years and "has expelled members who did something found to be unethical."

But he conceded that it remained "very difficult for a corporate scientist to speak out—often if he does, he is either fired or transferred to a less desirable assignment."

Dr. Dorothy S. Zinberg, a lecturer in sociology at Harvard University, suggested that the subject of ethics was often difficult for scientists because "they thrive on problem-solving but not on problems that are less amenable to scientific methods and which produce, at best, uncertain results."

Dr. Zinberg recommended that science students be introduced early in their training to "an array of case studies" that would "span the subtle issues of personal honesty to flagrant cases of bribery, collusion and inhumanity."

"It is important," Dr. Zinberg said, "that before they are caught up in their careers an attempt be made to explore with them the dilemmas of contemporary industrial science."

Dr. Zinberg, a former industrial chemist herself, is a member of the American Association for the Advancement of Science's committee on scientific freedom and responsibility. The association's annual meeting, which convened on Wednesday, is scheduled to end Tuesday.

Riegle Hurt in Collision

SAGINAW, Mich., Feb. 20 (AP) — Representative Donald W. Riegle Jr., Democrat of Michigan, suffered minor cuts Friday when his car collided with a pickup truck near Saginaw, the police reported. Mr. Reigle's driver, Paul Pratt, 23 years old, of East Lansing, received a traffic ticket after the car slid on a patch of ice and struck the truck. The Congressman and Mr. Pratt were the only two injured. Neither was hospitalized.

I have discussed this matter with numerous people in both engineering and scientific societies and also some legal and legislative types and I have drawn up what I think are the most important provisions which might be put into such a law:

1. Conditions of employment shall be fully described in writing to a prospective employee.

2. Legal obligations of the employee to the employer must be clearly set forth in an employment agreement.

3. Employment shall be based solely on competence and ability to perform assigned responsibilities without regard to factors of age, race, religion, political affiliation, or sex.

4. Exempt employees may not be regularly scheduled to work more than 40 hours per week unless recompensed at the rate of 1.5 times normal salary for hours in excess of 40/week.

5. Exempt employees must be provided with opportunities and facilities for working more than 40 hours per week if they so desire.

6. An employer must keep exempt employees informed of their judged level of job performance by means of confidential written annual records which must be attested to by the employee with copies provided.

7. The judgment of an exempt employee's performance should involve input from his professional peers by means of confidential questionnaires.

8. Employers should allow exempt employees opportunities to maintain professional expertise through attendance at professional meetings equivalent to at least 1 week/year and courses of study and leaves of absence for professional study equivalent to 2 weeks/year.

9. Employee-inventors shall participate to the extent of at least 10% in the income generated by their inventions. Patents obtained by an employee resulting from inventions developed on his own time, outside his assigned field of work shall be the property of the employee.

10. Employees practicing in professional fields where advancement is dependent upon publication shall not be inhibited from so doing except through contractual arrangements.

11. The right of professional employees to participate in the activities of their professional societies shall be recognized.

12. Employees shall receive notice of intended termination one month plus two weeks for each year of service before such termination shall take place except that severance pay may be offered in lieu of notice beyond one month.

13. Terminated employees shall be provided reasonable assistance in finding another position.

14. Employees terminated due to budget cuts or a reduction in force shall have first priority in rehiring for two years beyond their termination date. Employees terminated with a minimum of ten years' service shall have fully vested pension rights.

15. Employees with a minimum of ten years' service may not be terminated except for fully documented cause confirmed by two levels of management above his immediate supervisor, confirmable by employee's peers.

16. Health and insurance plans shall be continued for a terminated employee beyond termination for a minimum of one month plus one week for each year of service.

17. Upon termination, proportional vacation rights shall be exercised by the employee either in time or money.

18. Upon termination, the employee shall be given custody of hes central personnel file. Records remaining with the employer will consist simply of the name and address of the terminated employee and the period of service. Upon termination an employee shall be delivered a document by the employer defining hes residual rights in inventions, patents pending, and possible publications.

FUTURE POSSIBILITIES

Obviously the list of points that I have delineated above will not be agreed to by everyone, however they do stand as a suitable starting point. The existence of such standards for employment would make it more difficult and more expensive for employers to terminate professional employees and would have a tendency to stabilize employment. It would also accomplish the important objective of protecting the "whistle blower" and other public spirited employees. There are a number of instances of individuals who have "stuck their neck out" in order to call attention to unsafe or unsavory situations either with respect to their specific employment or to employment conditions generally. Two cases that come to mind are those of the "three BART engineers"[6] who were fired when they told their management that the Westinghouse train control system would not work (performance of BART to date has competely verified their judgment) and that of Louis McIntire who was

conciliators. If such efforts are in vain and the employee feels that it can be resolved by taking the matter to court, the Society has established a Legal Aid Loan Program through which applicants can get low interest bearing loans of up to $10,000 and the Society has stated that in landmark cases it is prepared to bear the burden of the cost or at an appropriate time to enter the case in an amicus curiae basis.

However, in spite of all these measures, it is recognized that compliance with the Guidelines is voluntary on the part of the employer and that it could possibly work to the detriment of the more concerned employer who is willing to abide by them vis-a-vis a more ruthless competitor who has no such tender feelings. It has come to be recognized by many that the fairest way to deal with this problem would be to have the guidelines, or at least a basic core, mandated by law. The argument for this is expressed in the following quotation:[4]

Comment

A bill of rights for professional employees

You write a letter to the editor of a newspaper—your employer doesn't like it and fires you. Can he do that? He sure can! What can you do about it? Nothing!

Most chemists are surprised to learn that they have practically no job rights. Most can be fired for the most trivial reasons—or none at all. [Exceptions to this are those who have adequate personal contracts with their employers, are fired in violation of the various antidiscrimination laws (race, color, sex, age, religion, national origin), or are covered by a strong collective bargaining agreement.]

The ACS Guidelines for Employers is intended to alleviate this situation. They set out fair and reasonable minimum standards to counsel employers in their treatment of their chemist and chemical engineer employees. (The new "Professional Employment Guidelines" also will include a code of conduct for employees based on the Chemists' Creed.) They suggest that the employer explain fully to prospective employees exactly and in writing what conditions of employment will prevail, particularly legal obligations, salary policy, advancement, nondiscrimination, and termination conditions. They also spell out desirable standards regarding evaluation and disclosure of merit (should be in writing and involve peer judgment), permit and encourage means for professional development, professional society involvement, and social responsibilities.

With respect to termination conditions (unhappily all too often invoked in recent years), the guidelines recommend at least four weeks' notice, severance pay (two weeks per year of service), internal transfer opportunities, fully vested pension (after 10 years of service), and nondismissal after 10 years' service (except for documented cause), rehire privilege, and assistance in securing a new job.

Although these guidelines set up desirable conditions, they have no teeth. Compliance by employers is voluntary, depending upon the efficacy of persuasion to get employers to go along with them. Oftimes, an employer suggests that he would like to endorse the guidelines but cannot because his competition does not. The employer is free to pick and choose among the various guidelines, selecting those that are to his advantage to follow but not necessarily those that are most beneficial from the employees' standpoint.

This does not mean that the guidelines are useless. They can be used by an individual employee to measure the performance of his own employer, which is useful in deciding whether or not to change jobs or to ask ACS for assistance in protesting his treatment by his employer. They also can be used as a yardstick (meter stick?) against which employers' actions in mass layoffs can be measured, but noncompliance, at worst, can result in a citation in C&EN. And even here, since cooperation by employers is voluntary, it is difficult to get access to all the data pertaining to the layoff. It requires considerable effort by the national and local section committees on professional relations to dig out the facts.

In cases of such frustration we often are tempted to say, "There ought to be a law"—and in this case I think we are right. A law stating the principles embodied in our guidelines would provide professional employees with a firm basis for job security—it would ensure that employers would have to treat the employees fairly and would set out a mechanism to ensure compliance. This could be done either by amendment of the National Labor Relations Act or by a new act.

The process whereby legislation might be enacted could be complicated but there is a philosophical basis for singling out professional employees for special treatment since this has been done already in the National Labor Relations Act and in the Fair Labor Standards Act (employees exempt from this law are not entitled to payment for overtime). It might have to be drawn so it applied to all exempt employees (thereby including mainly managerial types), but this is not necessarily a problem. An ancillary problem that could be treated in this or accompanying legislation would be to provide a medium for providing job and retraining opportunities for professional (or exempt) personnel during times of increasing unemployment which will be funded by a tax on professional (or exempt) payrolls.

ACS is moving in this direction. Both the board of directors and the Committee on Chemistry and Public Affairs have endorsed the development of a model for legislation in this area. It is being discussed by both the Committee of Scientific Society Presidents and by the engineering presidents who constitute the Association for Cooperation in Engineering. What do you think?

Alan C. Nixon
1973 ACS president

C&EN News 1/20, 1975 p 35.

Testimony of James B. Sullivan, PhD.
Co Director, Center for Science in the Public Interest
Research Director, National Council for Public Assessment of Technology

Before the National Science Foundation Subcommittee
U.S. Senate Committee on Labor and Public Welfare

March 3, 1976

I am glad to see the National Science Foundation beginning the Science for Citizens program. For the past five years I have spent most of my time working to help local citizen groups who are concerned over the environment and social consequences of new technologies slated for the neighborhoods and states. I and my co-workers at the Center for Science in the Public Interest have provided expert testimony to citizen groups in dozens of pollution and energy cases, and we have provided comments on literally hundreds of environmental impact statements. Recently, with the National Council for the Public Assessment of Technology, we have developed an extensive research program to better understand how citizen groups can participate more meaningfully in technical decision making processes.

What we are learning from this experience is that, except under extraordinary circumstances, citizen based organizations are essentially excluded from participation by the large volume and technical complexity of the issues involved.

Quite a few experiments have been begun recently to redress this exclusion and to provide information and access to local groups: 1) registries of concerned scientists by TIE, BSA, CSPI, PIEC; 2) local committees of scientists who devote part time to aid citizen groups, SIPI, VITA; 3) permanent organizations of scientists who devote full time to science policy issues of interest to citizen groups CSPI, VITA, FAS, SIPI.

Some of these experiments have succeeded in making citizen participation possible; others have not been so successful. All of the experiments, however, are just that: experiments; none provide the level of continuing assistance to citizen groups that our rapid pace of technological development requires.

The imbalance is extreme between how the average citizen influences decisions about new technology and how the developers of the technology influence those decisions. The experiments begun to redress that imbalance have fallen short in resources and in relevance to sitizen needs. The problem of relevance of the Science for Citizens Program is going to be a most crucial one and deserves special attention.

There are several aspects of this problem that I wish to focus on:

(1) To be useful, technical assistance has to be tailored to the user. Just as this is true in applying research to industrial or national needs, it applies to citizen's needs. The NSF draft program recognizes that organized public interest groups are one sector of the public that are in particular need of aid. But what do they need? The program outlines ideas to provide them with technical information but is silent on how to discover what kind of information the groups need or who will supply it. Our experience with academic institutions and with studying various public participation mechanisms is that decisions on what public interest groups need is best left to the groups themselves, not to a second party.

Take the example of the short run need of these groups for ready access to experts who can provide quick information or who can critique documents involved in a controversial issue: a nuclear engineer to advise on waste disposal technology or an economist to serve as an expert witness on a cost-benefit study of a new dam. Programs outside the public interest movement that have been set up to provide technical information have not begun to address this need. Yet public interest groups are painfully aware of it.

Obviously the way to ensure relevance of the Science for Citizens Program for organized citizen groups is to allow those groups to help design the program. I suggest that a citizen's advisory panel, made up primarily of representatives from public interest groups, should be established by NSF to help guide the Science for Citizens Program.

(2) NSF should provide funds directly to citizen groups for expert assistance. Several attenpts have now been made to establish registries of scientists who are willing to work with citizen groups. The NSF proposes such a registry now. Notable among past experiences of registries are those of the Institute of Ecology, the Center for Science in the Public Interest, and the Biophysical Society of America. The major difficulty that each of these groups has had has been in involving scientists in policy decisions who had no experience in policy areas. The majority of corporate and government decisions have included technical information developed by specialists, experts whose disciplines encompass the narrow field in question and who have experience in policy making areas. Citizen groups on the other hand often can only recruit graduate students or scientists outside their major field, the so-called academic fringe.

The Science for Citizen Program should provide funds to make it possible for citizens to obtain the services of recognized experts. Such a program within NSF would also encourage the academic community to recognize the value of serving the public interest community just as it now values serving the corporate and governmental community.

There are several models that such a program could follow. Among these are the EPA's methods of funding groups to comment on planning documents; funding intervenors such as is practised by the Federal Trade Commission and the California State Energy Resources Conservation and Development Commission; an analogous science system comparable to the national laboratories which are run by private enterprise but funded by the government.

(3) Training of scientists -- both those starting their careers and those in mid-career -- in policy areas.

For a great number of reasons, scientists are not accustomed to serving the information needs of a public constituency. Unlike lawyers or doctors, their major concern is not service, but a creative process of discovery. Scientists like to "follow their noses" in research and this process does not fit well into a controversial situation where specific facts and statistics can quickly acquire a good deal of political value. The few scientists who are involved in getting a bill through the legislature or in serving as an expert witness, or as an advisor government official have experience that cannot be learned from academic study.

The Science for Citizens Program should develop a Public Interest Fellows program similar to the Congressional Fellows program of the AAAS and other professional societies. Competitions could be held to pick good candidates; selection should be made by a panel the majority of which are members of public interest groups to be aided. Once an individual is selected the choise of activity for the duration of the stipend would be at his or her discretion.

(4) Finally, there is the need for research on how to make the Science for Citizen Program more effective for public interest organizations. How do groups use technical information and how is the information used politically? What methods can be developed to assure that decisions are possible and not merely the whim of some special interest or other?

There is very little experience in this area. So I suggest that the NSF conduct a program to develop case histories of citizen involvement and technical decision making. These cases could be prepared by the citizen groups themselves.

To summarize, I would stress the need to provide relevant technical assistance to voluntary citizen groups and to allow those groups a significant role in determining the precise form that technical assistance should take.

Senator KENNEDY. Our next panel consists of witnesses who have been very active in the effort to improve opportunities in science for minorities and women.

Our subcommittee has been particularly interested in developing ways to strengthen the NSF's programs in these areas, and we have especially appreciated the advice that groups like these have given us.

The panel members are: Dr. Alonzo Atencio, president for the Society of Advancement of Chicanos and Native Americans in Science; Dr. William Jackson, National Organization for the Professional Advancement of Black Chemists and Chemical Engineers; and Dr. Shirley Mahaley Malcom, of the Office for Opportunities in Science of the American Association for the Advancement of Science.

We will recess for about 4 minutes, and then we will get started again. We will make sure you get your full half-hour.

[Whereupon a short recess was taken.]

Senator KENNEDY. Dr. Jackson, do you want to start?

STATEMENT OF DR. WILLIAM JACKSON, NATIONAL ORGANIZATION FOR THE PERSONAL ADVANCEMENT OF BLACK CHEMISTS AND CHEMICAL ENGINEERS, ACCOMPANIED BY DR. ALONZO ATENCIO, PRESIDENT, SOCIETY FOR ADVANCEMENT OF CHICANOS AND NATIVE AMERICANS IN SCIENCE, AND DR. SHIRLEY MAHALEY MALCOM, SPECIALIST, OFFICE OF OPPORTUNITIES IN SCIENCE, AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE, A PANEL ON MINORITIES AND WOMEN IN SCIENCE

Dr. JACKSON. Thank you. My name is William M. Jackson. I am treasurer of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers.

I would like to thank the chairman for the opportunity to testify on the National Science Foundation authorization bill.

I would like to insert my prepared testimony into the record and summarize a few of the highlights.

We support the present NSF minority program and think that what they are doing is very useful. However, and there is always a catch, we do not think it is enough.

When I was given the charge of testifying before you, I contacted quite a few of my colleagues around the country and we discussed various proposals that NSF could institute that would be useful for minorities. We had discussed this point in several of our national meetings. I come before you today with what we think would be a very useful and very innovative program. We ask you to charge NSF to authorize the establishment of minority centers for Graduate Education in Science and Engineering.

Now, we not only ask you to ask NSF to authorize this program, but we would like the Senator and this committee to spearhead a drive in the Congress to insure that money is appropriated for the program.

If we get that far——

Senator KENNEDY. You are not asking very much. I think we better go back to your full statement.

Dr. JACKSON. If we get that far, maybe we will get something done.

We think that these minority centers should be established in six regions of the country. I will now give you a few reasons why we think this program will significantly impact the problem.

The purpose of the program would be to increase the number of minorities in science and engineering.

I have heard here today that we do not really need to increase the number of scientists and engineers, but that is a reflection of what one of my colleagues calls "monochromatic assumption." The assumption is that since the number of whites in science and engineering are saturated no new programs are needed to increase the number of minorities in science and engineering.

Senator KENNEDY. Is that what "monochromatic" means?

Dr. JACKSON. Yes. Monochromatic means one color.

We think that the regional centers will serve as positive role models for members of the local communities. This is one of the advantages of regional centers. The center will serve as an alternate option for minority graduate students. They can go to these regional centers, or to the majority institutions. Some of them will and some of them will not. They will serve as centers for advanced education for minority students coming from smaller minority colleges or junior colleges in their areas. Frequently you have a college that is very good at giving students all of the positive influences they need, but does not have enough of a call for the advanced courses in science and engineering to institute these courses. These centers could serve as a place for those students. There they could come and take those advance courses in the summer.

The establishment of these centers would highlight the problem of underrepresentation of minorities in science and engineering which I think is very important.

You know, we have had Congress highlight the importance of several problems in the minority community over the last 20 years, and the minority community has responded. More students have entered the social sciences in the late 1950's and early 1960's, and business in the late 1960's and early 1970's in response to a perceived need in these areas.

I think the commitment by Congress to these centers would elicit a response from the students in the minority community to go into these fields.

I think that I have gone far enough. I had better put a bottom line on it, though, and the bottom line is how much it is going to cost.

I heard somebody say they were asking for an increase in the authorization of half a million dollars. I do not think these centers could be created for half a million dollars. I think that the kind of program that I am envisioning—and I can give you detailed budgetary estimates on it—would be $36 million a year for six institutions for a period of 10 years.

Now, you can probably get very good estimates from the National Science Foundation on what these centers would really cost for each department, because they have operated programs like this before. I have been told that the Office of Management and Budget has a good estimate of what it will cost.

The kind of commitment that we are talking about in establishing this program, would go a long way in solving the problem that we are addressing ourselves to today.

Senator KENNEDY. Very good. Thank you. Doctor Atencio?

Dr. ATENCIO. My name is Alonzo Atencio, and I welcome the opportunity to testify before this Committee on the National Science Foundation appropriation.

I want to begin by saying that I support entirely what Doctor Jackson just presented on the centers of excellence. The establishment of centers for special emphasis, similar so those centers of excellence established in the past, would have a big impact on the Chicano and native American communities.

I will forego the prepared statement and I will concentrate on the recommendations I made in it.

To review briefly, the Chicano and native Americans have unique problems in the Southwest. First they are found in largely rural areas where education seldom reaches and the secondary education offered does not prepare, or stimulate students to go into science.

A center of excellence program, at a place like the University of New Mexico, where we have over 3,000 Chicano students, and about 1,000 American native students, as well as a physical plant to implement such a program, would be an excellent site for the development of a center of excellence of this type.

Since over 80 percent of the Chicano and native American students who graduate from high school seldom go to college, the establishment of such a center would permit us to reach out to the high schools.

We had a program, for high school students and it had a big impact on Chicano and native American high school students. This was a science exposure course in which students from small towns and reservations would be enrolled in science courses and while they worked in laboratories, they would learn to get a feel for the physical plant—the big university.

Medical school is an awesome experience for anybody coming into it, especially a young student coming in from a rural area.

My second recommendation is that the National Science Foundation enlist the aid and advice of Chicanos and native American scientists and other minorities, and include them in their policy advisory boards.

I cite this because of my experience in a minority medical science program sponsored by the National Institute of Health. This is an excellent program helping minority students and faculty at many institutions. The input from blacks and Chicanos, and native Americans as consultants and committee members has been invaluable to the NIH.

Many of us go on site visits with top level academic—administrators from majority academic institutions. It is revealing indeed to witness an understaffed, ill-equipped minority inst tution. When both minority and majority site visitors experience this first-hand, it is a two way learning experience. An experience which is very important because most of these people are in positions to formulate policy and therefore help minority students by supporting science programs.

The third recommendation I would like to make is that the NSF establish a program to support minority faculty research, and allow for release time for them to pursue research.

There are very few of us. There are only about 80 Chicanos who are Ph. D's in the country, and 14 native Americans. Those of us at majority institutions we are usually assigned many extracurricular non-research activities. So a program that would divert research money to minority faculty allowing release time for them to pursue their own careers and stimulate graduate students, would be a very important element in continuing to build and increase the student pool in science.

My last recommendation is that the NSF should lend its prestige to encourage the upgrading of science education for minorities.

I heard testimony this morning that the NSF is trying to encourage science and mathematical education for the general public. I think it goes hand in hand, that the minorities should also be included in this particular endeavor.

Again, I thank you for the opportunity to present to you this concern on behalf of the Chicanos and native American minority.

Senator KENNEDY. Let me ask you this: would the centers of excellence be limited to minorities only?

Dr. ATENCIO. Not necessarily. I can use an example.

They accept students, put them to work in laboratories alongside a science professor or a medical professor.

I guess, you would say that the student participants are largely minority students, however.

Senator KENNEDY. Not exclusively?

Dr. ATENCIO. Not exclusively, no.

Senator KENNEDY. Because I would imagine, if it was exclusive, there would be some questions of legality. Yet if you do not make it somewhat exclusive, you wonder whether it would serve its purpose.

Dr. ATENCIO. I would agree that would create some problems.

Dr. JACKSON. I think that is one thing I would like to comment on.

It is not exclusively—and I think it is important that it would not be exclusive—because I think it is important for the majority of the population to have access to an institution that was a minority institution of excellence. I think that, in fact, white students going to a minority center of excellence could learn from that experience, just like we learn when we go to a white institution, from that experience.

So, I know it would not be exclusive.

Senator KENNEDY. Fine. Doctor Malcom?

Dr. MALCOM. Thank you, Senator.

I am Shirly Mahaley Malcom, an ethologist and ecologist, presently employed as a specialist on minorities' and women's affairs at the Office of Opportunities in Science of the American Association for the Advancement of Science.

I want to thank the chairperson of the subcommittee for inviting me and the AAAS Office of Opportunities in Science to testify.

I will simply extract from my testimony and you have a copy.

Senator KENNEDY. All of the testimony will be printed in the record at the conclusion of your remarks.

Dr. MALCOM. Continuing on, the Office of Opportunities in Science was created 3 years ago to increase the numbers and the visibility of women and minorities in the sciences. Last year, handicapped scientists were added to our constituency. The Office carried on three kinds of functions.

First, we are advocates for those groups underrepresented in science.

Second, we provide a clearinghouse and respond, as able, to questions about the status and numbers of women, minorities and handicapped in science.

Third, we initiate studies and action programs that will serve these ends, and are especially interested in the provision of better science education—at all levels—for women, minorities, and the handicapped.

Though the Office and I myself are very much interested also in National Science Foundation efforts to increase the number of minority scientists, I will restrict my suggestions to women under the assumptions that my colleagues here will cover the minority needs most ably. I speak out today out of the accumulated experience of the Office of Opportunities in Science and from my personal experience as a woman scientist.

Women have not been—are not included in the mainstream of science and technology in this country. This is attested to by their lower status in the major science degree granting institutions, their exclusion in terms of meaningful numbers from peer review, consulting and advisory bodies, their absence in the leadership of major industrial labs. This is not an overstatement; examples abound from all corners of academia, Government, and private sectors.

In the way of illustration, one need look only so far as to the composition of the decisionmaking and advisory bodies that help to shape national science policy. The two recently appointed science advisory groups to the President have only one woman member, a social scientist. If asked to name noted scientists of our generation, few, if any, women immediately spring to mind. The one or two who are likely to be named are named over and over again, and are the brightest stars. Must a woman scientist be a superstar before she is admitted to the team of mainstream science at policy and decisionmaking levels?

There are several problems that women in science face, including the problem of small numbers and barriers to participation, as well as the problem of visibility. The woman scientist is too often the invisible, anonymous worker of whom little mention is made.

There are some women in science, more in some fields—especially the social sciences—than others. We are concerned about increasing the numbers of women in those fields where we are most poorly represented—the 2 to 4 percent. We are concerned about the scientific and technological priorities that impact on the future of this Nation.

We are glad to see this year what we interpret as a new level of concern within the NSF about the problems of women in science. We have noted the various programs and projects directed toward these concerns. I hasten to point out to the subcommittee that the National Science Foundation is no worse than any other institution that supports science and employs scientists. Indeed, its level of concern and activity is much higher than that found in many universities and private research and development institutions. The situation found in the National Science Foundation simply reflects what we find in the whole national scientific scene, but we deplore that situation and hope for vigorous NSF leadership in changing the scene.

I want to talk briefly about three different aspects of the whole plan for NSF action and policy directives toward increasing the numbers and participation of women in science.

The first is action; that is, continued and increased financial support of programs and projects. Then inclusion, and the third is leadership.

First, in terms of action, programs have been undertaken within the Science Education Directorate of the Foundation, and we applaud these efforts.

Most of the new effort in the Science Education Directorate will take place at the college and graduate level. The NSF must also be reminded that, as now in the case of the minorities, the processes which cut most women out of science begin at the precollege levels. Foundation programs must therefore also impact in major ways upon elementary and secondary science education and must support efforts at those levels both philosophically and financially.

Much, much more needs to be done at an earlier point in the student's education, for most developing scientists have chosen their future careers by the time they finish high school. The NSF, with its primary mission the support of basic research, perhaps naturally emphasizes higher education. I can not underline too strongly, however, the need for many effective programs at the precollege level, if we are serious in our intent to recruit more women and minorities to science.

These processes are even worse for minority women, who are affected by forces related to both their race and gender.

In addition to the exploratory and experimental programs, the Foundation must develop ways of implementing successful strategies that will remediate the past failures. In the areas where we already know some things that work, the NSF should be developing incentives to get them used.

For instance, half a dozen researchers and teachers reported last week at our annual AAAS meeting some exciting work on women and mathematics. The successful techniques used to do this need to be broadcast widely. If the Foundation seriously means to increase the number of young women going into science, it can not stop after the experiments have been tried.

We need also to make sure that minority women are included in whatever programs are undertaken by the Foundation to increase the numbers of women in science. In the past, the concerns and needs of minority women have not been adequately addressed by either programs for women or programs for minorities. A few get included in each type of effort, but most fall in the cracks between the funded programs. Minority women must not be excluded, either accidentally or incidentally, from programs, as has happened in the past with some of the NSF programs.

I believe that quality science education must be made available to women, minorities and the handicapped. Indeed, I believe that quality science education must be made available to everyone. The shape of this Nation to come will depend increasingly on a scientifically and technologically literate citizenry. Improving the quality of science education for the underrepresented and underutilized elements of the population will not only allow them to choose science as a career, but will also increase the overall level of scientific literacy in the population.

In designing programs at the AAAS to improve the science education and counseling of women and minorities, we have been convinced that what is good for them is good for all youth. The opposite is not always true. But strategies that succeed in interesting the excluded in science are, we believe, capable of interesting others. We can therefore justify expenditure of a larger portion of the general science education authorization.

There have been some marvelous improvements in science education over the past 15 years, and NSF deserves high praise for many of them. But science education has conspicuously failed with the groups represented on this panel. That failure can be remedied only by a greater share of the current science education efforts.

Special programs are absolutely necessary in terms of inclusion if we are to increase the number of women going into science, but responsibility for the problems of visibility and numbers must permeate all the programs and directorates of the Foundation if women are truly to be included in the mainstream of science. It is all too easy when one has funded special efforts for others in an institution to say:

"Oh, yes, women in science; they're taken care of in that special program out on Wisconsin Avenue . . ."

Somehow, that knowledge is often accompanied by a relief from responsibility. That must not be allowed to happen at the NSF.

It is easiest to include the concerns of women when starting a new program. Any new programs that are undertaken in the NSF must be structured from their initiation, to include unincluded groups—women, minorities, and the handicapped. The inherent difficulty in changing a structure once it is started or set up should guide the NSF toward a more flexible and representative structure to any new program that is implemented. The new science for citizens program is a splendid opportunity for the NSF to make real efforts for the inclusion of women and minorities.

Senator KENNEDY. I am going to be able to give you just another minute or so.

Dr. MALCOM. OK. In terms of the whole idea of inclusion of women, there should be a real intent to include women in all aspects, especially in terms of things like review. In the words of the last year's conference report:

"If the peer review system is really to work, it must be broadly representative of the science community."

This is one very important aspect, and also in terms of where is the leadership to come, the advocates of women in science; the National Science Foundation has the chance, in terms of its highest leadership, to spearhead the drive toward the increase of women's participation and visibility and numbers.

The additional organization for programs for women in science—authorization for programs for women in science—made possible by the subcommittee is, of course, very important, but just as important to the process are the actions that require no additional funds, no new authorizations and appropriations. These are examples of leadership, evidences of determination, the many, many decisions which Foundation officials make every day.

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Special programs are absolutely necessary at all levels, but the problem in science for women, minorities and the handicapped will not be solved until their concerns are the conscious concern of every officer in the Foundation and ultimately of every educator and research director in the scientific community.

Senator KENNEDY. Very good. That is a very competent and comprehensive statement. I think it will be very useful for us for both the record and for our own information.

I think our real problem is not going to be so much with this committee, but it is going to be with the Appropriations Committee. So I think that is what we are going to have to get targeted on.

I think your groups can be helpful in expressing the sense of urgency about these programs. We will want to work closely with you as that process moves along so we can get the kind of funding that is necessary to do the job.

It is going to be difficult at best, but I think your groups and the people that you represent should really focus on this. We are going to be glad to help you, and we will try to press that forward.

I want to thank you very much for your statements and your comments. They have been very useful and helpful.

At this point I order printed in the record the prepared statements of Dr. Jackson, Dr. Atencio, Dr. Malcom and all statements of those who could not attend and any other relevant material submitted.

[The information referred to follows:]

TESTIMONY FOR THE SENATE SUBCOMMITTEE ON
THE NATIONAL SCIENCE FOUNDATION BUDGET

March 3, 1976

Mr. Chairman and members of the Committee, my name is William M. Jackson and I am Treasurer of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers. As their representative, I would like to thank you for the opportunity to testify on the FY 1977 authorization for the National Science Foundation. While we are an organization for chemists and chemical engineers, I feel confident that we are representative enough to speak for black scientists in general.

In last year's hearing on the N.S.F. authorization, it was repeatedly emphasized by this Committee and by witnesses appearing before this Committee that minority representation in science was unacceptably small. In this Committee's report to the Senate on the FY 1976 authorization, evidence was presented that disclosed that in the Fall of 1973 minorities represented only 2.6%* of all of the graduate students enrolled in the field of engineering or the sciences. Further, the total number of Ph.D.'s awarded to blacks in engineering and the sciences in the 13-year period from fiscal 1958 to fiscal 1971 was 924. This represents only 0.8% of the total number of doctorates awarded in these fields during this period.

*Excludes Asian-Americans

I could go on and on with these statistics, but numbers alone would not paint a true picture of the impact of the small numbers of minorities in science and engineering upon the health of the minority community. It is clear that the United States is moving in a direction where scientific and technical skills are a major resource of the community. The most successful new ventures depend upon "State of the Art Technology." Xerox, IBM, Poloroid, A.T.&T., etc. are just a few examples of large companies which depend upon this technology for their viability and growth. In the Senator's home state there is a famous highway called the "Electronic Beltway" (Rt. 128) which is populated with a large number of companies that grew out of the application of "State of the Art" technology. True economic development in any American community requires that they have complete access to the most advanced technology. To deny the minority community full representation in science and engineering will doom them to second class participation in the future development of America. Consider that if the minority community which is approximately 20% of the United States population, was properly represented in science and engineering, they would have received in fiscal 1975 alone $12 billion in R&D expenditures. Considering that this activity is only a small portion of the Gross National Product attributable to technology, it is no wonder that minority groups can be considered economically disadvantaged.

There are additional social consequences to the underrepresentation of minorities in science and technology. The

most damaging of all may be the perception of the white community of the abilities of minorities. Scientists and engineers are perceived by the majority of people to be highly intelligent and motivated people. The fact that there are few minorities in these fields has led some members of white communities to conclude that minorities do not have the genetic potential for achievement in these fields. All minority scientists at one time or another have been confronted with statements such as "Black scientists are capable only of routine work." One of the most esteemed black scientists, Percy Lavon Julian, was discouraged by the leading chemist of his day from pursuing graduate education. What a loss to science and the United States if this man had been discouraged.

Mr. Chairman, all of what I have recounted so far is well known to you and the members of your Committee. The principal question I am sure that all of you have is what can be done by N.S.F. to rectify the present unjust situation. When I knew that I would testify before you, I made an effort to contact a cross-section of my minority colleagues around the country and we discussed this point. We would like to give our support to the present programs that are now going on in N.S.F. However, we would like to request that the Chairman of this Committee instruct the National Science Foundation to initiate a "Minority Center of Excellence Program." We would also like to request that the Senators of this Committee spearhead a drive to see that in addition to the authorization of this program, the Congress appropriate the money for this new program. In

the rest of this statement I would like to outline the historical precedent for such an action, the goals such a program could achieve, and try to answer some of the objections that may be raised about this program.

The historical precedent extends over more than 100 years. It is commonly recognized among the members of the academic community that the Morrell Act of 1860 was the most important factor in the development of higher education for the masses of the Americans. This Act sustained the university system in this country which permitted the build-up of traditions of research in places like the Universities of Washington, Iowa, Minnesota, Illinois, Michigan, etc. It was 32 years later in 1892 before any black colleges were designated as land grant colleges. Even then, few of them received an equitable share of the appropriations. The inequities that existed in the system were glaringly apparent to me last Spring when I lectured at Oklahoma State University and Langston University. Both of the schools are land grant institutions, but Langston has received over the years only a miniscule share of these appropriations. The results of this criminal (rather than benign) neglect are the differences in physical plant, staff and facilities. As an aside, I recently learned that the Office of Education in their testimony last week for the continuing authorization of the Higher Education Act, called for the repeal of the second Morrell Act of 1890. Somehow, we are always spending time to maintain what has been achieved, while trying to expand our opportunities.

In more recent times, there is historical precedent in the actions that we are calling for in programs that were instituted by NASA, DOD and N.S.F. All of these agencies have given money to academic institutions in response to what was perceived as a national crisis. NASA set up space research centers around the country. I myself did research in the Space Sciences Building at the University of Pittsburgh. The Department of Defense and the National Science Foundation had programs to create centers of excellence at universities other than those that were already considered outstanding. I am sure each of these agencies can testify about the success of these programs. I think the major criticism that was leveled -- and one of the major objections to the center of excellence programs -- was that it was increasing the number of scientists and engineers too rapidly. The scientific and academic communities were justifiably concerned about the prospects of employment for these scientists. We members of the minority community do not share this concern for minority scientists. All of the traditional sources of employment for scientists have continually complained of their inability to find suitable minority scientists and engineers. In other words, the market exists.

Now that it has been established that historical precedents exist for the proposed action, let me outline what we think will be the principal benefits of this program. If I had to choose one word to describe the benefits we contemplate, it would be "options." The establishment of "minority centers of excellence" will expand the options of the minority community.

It would create a place where minority students might choose to complete their education, thus allowing some of these students to obtain their undergraduate degrees at the traditionally minority or majority colleges near them. It would create an additional option for minority faculty since they would no longer have to choose between the pursuit of an academic research career and the education of their fellow minority members. I know that several government agencies, including N.S.F., have programs to aid those college faculty members who want to do research. But research in a college is not the same as research in a university where one can have graduate students and post-doctoral research associates.

It will create options for those faculty members who go to white institutions and, because they have a lot of talent, are coerced into non-academic positions such as associate dean for minority students. I have heard many a white chairman of a department complain that it makes no sense to hire minority faculty because if they are good they will end up in administration and out of teaching.

It will create options for small minority colleges and community colleges in the area of these "Centers of Excellence." They could structure the programs of their students so that the academic year could be used for teaching the basic courses, while the summers were devoted to advanced courses in the students' chosen field at the regional Center for Excellence. Their faculty might be employed for the summer at these centers to teach some of these advanced courses. But now, instead of

having a class of only one or two students, they would probably have 10 to 20 students.

Finally, these regional centers would create options for the minority community by putting in their midst the latest and most sophisticated technology. Since the faculty at these centers would live in the minority community, they would be a resource of highly trained scientists for the local schools. The faculty would serve as effective role models for aspiring young minority students. It is often said that minorities are not interested in science and engineering, but surveys of the attitudes of high school students belie this assertion. The percentage of black students who express an interest in a technical career is identical to those of white students. Black students tend to drop along the wayside, since they have not been counseled properly on the academic preparation they will need to accomplish their goals. Local role models would help to alleviate this problem. Local role models would show students that they have other viable options other than the medical, dental, legal or religious professions.

Senator, let me at this point try to intercept some of the potential criticisms of the proposed program. The most obvious one would be that white institutions be charged to accomplish the goals that I have outlined. After all, they have the facilities and staff. All they would have to do would be to institute the programs. Again, I will resort to the word "options." Setting up the programs I have described at white institutions would deny the minority community the option of

having their own institutions. This is an option which the white community already enjoys. It would deny the white community the option of attending a "Center of Excellence" run by members of the minority community. I think this is an option that you need. There is nothing like first-hand experience to tear down stereotypes that are built between people.

If these programs are established in the white institution they will not have the cultural ties with the minority community. The staff would not be able to serve as role models for the youth in the community, since few of the staff would be minorities. Students and faculty brought in for summer programs are often viewed with suspicion and hostility on the campuses of majority institutions. This would of necessity decrease the efficiency of the program.

Finally, there is a great deal of evidence that minority institutions are very effective in preparing minority students for professional careers. Even today, 20 years after school integration, the majority of the black professional graduates attend black institutions some time during their academic tenure. This is an example of how the black faculty at these institutions serve as role models in inspiring students to obtain advanced degrees. The students who go on are an example of how institutions or groups of people tend to replicate themselves. It is unlikely that this replication would occur in these programs were instituted in predominately white institutions.

There are those who would declare that what is proposed is too expensive. The program that is envisoned would cost a

minimum of about $36 million a year divided among six minority institutions. It has been my experience that it takes about $200,000 per year per faculty member to run a first-rate research program. Thus, in the six institutions 30 faculty members in three departments could be funded at this level. The funding would be continued for a 10-year period after which time the program should be self-sustaining, since the principal investigators would all be successfully competing in the usual marketplace. The $36 million cost of this program is small compared to the total figure of $453 million in government funds that the top six U. S. universities received in FY 1973.

In conclusion, we, the minority members of this society call upon Congress to invest in the minority youth of this country. It is time we showed them that they have a viable option which will put them in the mainstream of this society. The potential rewards of this program certainly outweigh the modest cost of $36 million per year -- a cost that is little more than the cost of one F/14 fighter plane.

CURRICULUM VITAE

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BIRTH: September 24, 1936
BIRTHPLACE: Birmingham, Alabama

EDUCATION

Ph.D.; Catholic University of America, Washington, D.C., June 1961

B.A.; Morehouse College, Atlanta, Georgia, June 1956

Ford Foundation Scholar; Morehouse College, Atlanta, Georgia, 1952-56

PROFESSIONAL EXPERIENCE

August 1974-present--Professor of Chemistry, Howard University, Chemistry Department, Washington, D.C.

January-June 1974--Adjunct Research Professor, Howard University, Chemistry Department, Washington, D.C.

September 1970-August 1974--Senior Chemist, Goddard Space Flight Center, National Aeronautic Space Administration, Greenbelt, Maryland

September 1969-70--Visiting Associate Professor, University of Pittsburgh, Department of Physics, Pittsburgh, Pennsylvania

1964-67--Staff Chemist, Goddard Space Flight Center, National Aeronautic Space Administration, Greenbelt, Maryland

1963-64--Postdoctoral Research Associate, National Academy of Sciences, National Research Council, National Bureau of Standards, Washington, D.C.

1961-63--Research Scientist, Martin-Marietta Company, Baltimore, Maryland

1960-61--Chemist, National Bureau of Standards, Washington, D.C.

Summer 1957--Summer Student Trainee, Diamond Ordnance Fuze Laboratory, Washington, D.C.

MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Chemical Society
American Physical Society
American Association for the Advancement of Science
Society of Sigma Xi
American Optical Society of America
National Organization of Black Chemists and Chemical Engineers

DISTINGUISHED APPOINTMENTS AND AWARDS

Treasurer, National Organization of Black Chemists and Chemical Engineers, 1973-present

Member, United States National Committee for the International Commission for Optics, 1975-78

Treasurer, Board of Directors of Southwest House, 1972-74

International Astronomical Union Commission 15, 1974-present

PUBLICATIONS

1. "A New Method for the Determination of Primary Quantum Yields in the VUV Photodissociation of C_2N_2", M.J. Sabety-Dzvonik, R.J. Cody and W.M. Jackson, Percy Julian Award Symposium, Vol.1 in press.

2. "The Photochemical Formation of Cometary Radicals", W.M. Jackson, J. Photochem. (1974), in press.

3. "Laboratory Observations of the Photochemistry of Cometary Parent Molecules", W.M. Jackson, Invited Paper to appear in Proceedings of International Astronomical Union Cometary Symposium, special NASA publication (1974), in press.

4. "Radio Detection of H_2O in Comet Bradfield, W.M. Jackson, T. Clark and B. Donn, to appear in Proceedings of International Astronomical Union Cometary Symposium, special NASA publication (1974, in press.

5. "Laser Photoluminescence Spectroscopy of Photodissociation Fragments", W.M. Jackson and R.J. Cody, J. Chem. Phys., 61, 4183 (1974).

6. "Laser Measurements of the Radiative Lifetime of the $B^2\Sigma^+$ State of CN", W.M. Jackson, J. Chem. Phys., 61, 4177 (1974).

7. "Laser Induced Fluorescence of CN Radicals", W.M. Jackson, Bericht. Buns. Gesellsch. Physik. Chem., 78, p. 190 (1974).

8. "Temperature Dependence of the Dissociative Ionization of CO_2", W.M. Jackson, R.T. Brackmann and W.L. Fite, International J. Mass Spec. and Ion Phys., 13, 237 (1974).

9. "Angular Distributions and Polarization Fraction of Helium Resonance Radiation", M.J. Mumma, M. Misakian, W.M. Jackson and J.L. Faris, Phys. Rev. Sec. A, 9, 203 (1974).

10. "Laser Induced Fluorescence of CN", W.M. Jackson, J. Chem. Phys., 59, 960 (1973).

11. "Angular Dependence of Metastable Fragments Produced by Electron Impact on CO_2", M.J. Mumma, W.M. Jackson and J.L. Faris, presented at VIII ICPEAC, (1973).

12. "Photochemistry in the Atmosphere of Comets:, W.M. Jackson, invited paper, Proceedings of VI International Conference on Photochemistry, Molec. Photochem., 4, 135 (1972).

13. "Mass and Phase Spectrometry of a Water Vapor Jet", J. Fricke, W.M. Jackson, W.L. Faris, J. Chem. Phys., 56, 5 (1972).

14. "The Quenching of the B^{2+} State of the CN Radical", W.M. Jackson and J.L. Faris, J. Chem. Phys., 56, 95 (1972).

15. "Search for Microwave H_2O Emission in Comet Bennett", T.A. Clark, B. Donn, W.M. Jackson, W.T. Sullivan III, N. Vanderberg, Astron. J., 76, 614 (1969i) (1971).

16. "Absorbing Ice Model of Interstellar Grains", K.S. Krishna Swamy, W.M. Jackson and B. Donn, Proceedings of 2nd International Astronomical Union Conference on Interstellar Dust, Astron. Nakr., 293 (1971).

17. "Mass and Phase Spectrometry of Heated SF_6 and CO_2", R.T. Brakmann, W.L. Fite and W.M. Jackson, Advances in Mass Spectrometry, Institute of Petroleum, 5, 125 (1970).

18. "Photochemical Effects in the Production of Cometary Radicals and Ions", W.M. Jackson and B. Donn, Icarus, 8, 270 (1968).

19. "Photolysis of Gaseous Benzene at 1470 A", W.M. Jackson, J.L. Faris, B. Donn, J. Phys. Chem., 71, 3346 (1967).

20. "Reactions of Ethylidiene in the Vacuum Ultraviolet Photolysis of Ethylene", E. Tschuikow-Roux, J.R. McNesby, W.M. Jackson, J.L. Faris, B. Donn, J. Phys. Chem., 71, 1531 (1967).

21. "Vacuum Ultraviolet Photolysis of Ethane Films", W.M. Jackson, J. Faris, N.J. Buccos, J. Chem. Phys., 45, 4145 (1966).

22. "Collisional Processes in the Inner Coma", W.M. Jackson, B. Donn, Mem. Soc. Roy. Sci. Liege, 5th Ser., 12, 133 (1965).

23. "Xenon-Photosensitized Formation of Metastable Nitrogen", W.M. Jackson, M.D. Scheer, Science, 148, 1718 (1965).

24. "High Temperature Degradation of Phenol Formaldehyde Polycondensates", W.M. Jackson, R.T. Conley, J. App. Polym. Sci., 8, 2163 (1964).

25. "On the Isomerization of Isobutyl Radical", J.R. McNesby, W.M. Jackson, J. Chem. Phys., 38, 692 (1963).

26. "Thermal Reactions of the Isobutyl Radicals", W.M. Jackson, J.R. McNesby, B. de B. Darwent, J. Chem. Phys., 37, 2256 (1962).

27. "Reaction of Methyl -d_3 Radicals With Isobutane, Isobutane -2-d, and Propane", W.M. Jackson, J.R. McNesby, B. de B. Darwent, J. Chem. Phys., 37, 1610 (1962).

28. "Thermal Isomerization of Isopropyl-1,1,1-d_3 Radicals", W.M. Jackson, J.R. McNesby, J. Chem. Phys., 36, 2272 (1962).

29. "Photolysis of Acetone - d_6 in the Presence of Propane, 2,d_2. Decomposition of the n-Propyl Radical", W.M. Jackson, J.R. McNesby, J. Amer. Chem. Soc., 83, 4891 (1961).

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STATEMENT BY

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FOR THE

SOCIETY FOR ADVANCEMENT OF CHICANOS AND NATIVE AMERICANS IN SCIENCE

BEFORE THE

SPECIAL SUBCOMMITTEE ON THE NATIONAL SCIENCE FOUNDATION

OF THE

COMMITTEE ON LABOR AND PUBLIC WELFARE

UNITED STATES SENATE

March 3, 1976

Mr. Chairman and members of the Committee, thank you for the opportunity to appear before the subcommittee on the authorization for the National Science Foundation for fiscal year 1977.

My name is Alonzo C. Atencio, by profession I am a Biochemist on the faculty of the University of New Mexico School of Medicine. Today, however, I wish to present testimony on behalf of the Chicano and Native American community. I present this testimony as President of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS).

SACNAS, advocates meaningful interaction between science and society in general. We believe that no modern society can function without meaningful dialogue between society and its scientific community. The involvement of the Native American and Chicano communities in scientific education, research and administration has been meager. Currently, there exists many individual efforts addressed to this problem. It is the intention of this organization to unify and expand this effort.

To this affect our activities in the past have included: testifying before State Boards of Education in an effort to create more awareness for the need of upgrading science and math education for Mexican-American and Native American youth in high and junior high schools; working as consultants to federal agencies and academic institutions; participating in evaluation of colleges and universities as site visit team members on behalf of the National Institute of Health, NIH; and working with policy advisory committees and councils within the HEW. I cite these activities because these are some of the areas where the NSF has been reluctant to invite SACNAS members to participate.

70-027 O - 76 - 24

Interaction between NIH policy advisory committees and SACNAS members has been rewarding to both. As is often the case, members for these committees are chosen from top level academic administrators and scientists, who, though sincere and sympathetic, often do not have a real feeling for the plight of minority scientists or minority institutions. The sharing of experiences along with first hand observation of the actual situation at these institutions is the obvious lack of research equipment and heavy teaching loads on faculty. The NSF-MISIP program has served as catalyst to some of these minority institutions already. However, the situation with minority faculty and students at majority universities and colleges is much different than at minority schools.

Since Chicanos and Native Americans do not have institutions of their own, they are found in small numbers at doctorate granting majority institutions. I should add, they are more than likely found in junior and community colleges or vocational schools. There are possibly two exceptions where a significant number of Chicanos and Native Americans are found in large clusters at Ph.D. granting institutions: The University of New Mexico at Albuquerque, and New Mexico State University at Las Cruces. The University of New Mexico, for instance, has over 3,000 Chicanos and 1,000 Native American undergraduate students. Unfortunately, very few of these students are science or math oriented majors. The reasons for this are many and varied, but underlying all of them is the lack of encouragement, counseling and preparation.

The few of us who have persisted and survived the educational process on to our doctorate have done so under rather unusual circumstances. My

own circuitous route can be used as an example:

I graduated from a high school where science curricula, encouragement and participation by students was almost non-existent. Though a curiosity to know more about the world around me existed within me - college was out of the question. My father worked as a laborer and at the time I graduated from high school, he earned less than $2,000.00 per year to support a family of eight children. Being the oldest, my own task was set forth to work and help him meet living expenses. Three years after graduation, I enlisted in the U.S. Navy and four years later enrolled at the University of Colorado in Boulder. This venture would not have been possible had it not been for the G.I. Bill. I hasten to add that this privilege cost me four years of the most productive part of my life and was paid for by the many young men left in the battle fields of Korea.

I earned a B.S. in Chemistry in 1958 and enrolled in graduate school in 1960. While working full time for $360/mo. as a Research Technician and attending school part time, I earned a Master's Degree in 1964 - my Ph.D. in 1967 and finished my scientific training with a two year post-doctoral stint in the Department of Chemistry at Northwestern in Evanston, Illinois. My work for the Master's thesis was worthy of an invitation for presentation at an international symposium in Gleneagels, Scotland in 1963. I bring this out to demonstrate that we are able to do innovative, meaningful research even under such stressful conditions. So at the age of 38, I earned my Ph.D. and by the age of 40, I had finished my postdoctoral training. Most of my majority peers have earned their doctorate by the ripe old age of 26 and have been supported by training grants so that their whole energy was focused on their career

pursuit rather than earning a living, and supporting a family while getting their education.

I recount this experience to emphasize the need for turning on more young Chicanos and Native Americans to science careers and reduce the enormous waste of talent and creativity. Those who argue that we do not have this ability are myopic and in all probability use the stereotypical arguments created and perpetuated by naive social scientists generalizing on the southwestern Chicano and Indian cultures.

I recommend that the N.S.F. could help us in correcting the imbalance of minority representation in sciences by 1) the establishment of centers for special emphasis similar to those centers of excellence established in the past; 2) that the N.S.F. enlist the aid and advice of Chicanos and Native American scientists and other minorities and include them in a decision making capacity on their Policy Advisory Boards and; 3) That it establish a program to support minority faculty research to allow for release time to pursue research; 4) The N.S.F. lend its prestige to encourage the upgrading of science education for minorities. All of these recommendations can be interwoven to create a special effort necessary to correct past educational neglect.

Science, as viewed at the university level is strongly dependent on outside sources of funding for its successful implementation. Research is an essential activity in the development of not only excellence in research but in the development of top educational institutions as well. These centers of excellence foster creative productivity which in turn molds the future scientists and university professors. This is an activity so

essential to maintain our advances in knowledge, in technology and in the conquest of disease.

Members of the N.S.F., N.A.S., N.I.H. and other scientific professional societies and groups are well aware of the effect centers of excellence have had on scientific thought and progress.

I, again thank you for this opportunity to present to you our concerns in the education of minority scientists.

STATEMENT OF DR. SHIRLEY MAHALEY MALCOM, OFFICE OF OPPORTUNITIES IN SCIENCE, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. PREPARED FOR DELIVERY BEFORE THE SPECIAL SUBCOMMITTEE ON THE NATIONAL SCIENCE FOUNDATION OF THE COMMITTEE ON LABOR AND PUBLIC WELFARE, U.S. SENATE, 3 MARCH 1976.

I am Shirley Mahaley Malcom, an ethologist and ecologist, presently employed as a specialist on minorities' and women's affairs at the Office of Opportunities in Science of the American Association for the Advancement of Science. I want to thank the Chairperson of the Subcommittee for inviting the AAAS Office of Opportunities in Science to testify. The Office of Opportunities in Science was created three years ago to increase the numbers and the visibility of women and minorities in the sciences. Last year handicapped scientists were added to our constituency. The Office carries on three kinds of functions. First, we are advocates for those groups underrepresented in science. Second, we provide a clearinghouse and respond as we are able, to questions about the status and numbers of women, minorities and handicapped in science. Third, we initiate studies and action programs that will serve these ends, and are especially interested in the provision of better science education--at all levels--for women, minorities and the handicapped. Though the Office and I myself are very much interested also in National Science Foundation efforts to increase the number of minority scientists, I will restrict my suggestions to women under the assumption that my colleagues here will cover the minority needs most ably. I speak this morning out of the accumulated experience of the Office of Opportunities in Science and from my personal experience as a woman scientist.

Introduction

Women have not been included in the mainstream of science and technology in this country. This is attested to by their lower status in the major science degree granting institutions, their exclusion in terms of meaningful numbers from peer review, consulting and advisory bodies, their absence in the leadership of major industrial labs. This is not an overstatement; examples abound from all corners of academia, government and private sectors. In the way of illustration, one need look only so far as to the composition of the decision-making and advisory bodies that help to shape national science policy. The two recently appointed science advisory groups to the President have only one woman member, a social scientist. Look at the rosters of science consultants used by the government. Look at the private sector and at the heads of major research and development centers. The picture is the same; few women are to be found. If asked to name noted scientists of our generation, few, if any, women immediately spring to mind. The one or two who are likely to be named are named over and over again and are the brightest stars. Must a woman scientist be a "superstar" before she is admitted to the team of mainstream science at policy and decision-making levels?

There are several problems that women in science face, including the problem of small numbers and barriers to participation, as well as the problem of visibility. The woman scientist is too often the invisible, anonymous worker of whom little mention is made. There <u>are</u> some women in

science, though more in some fields (especially the social sciences), than others. We are concerned about increasing the numbers of women in those fields where we are most poorly represented. We are concerned about the scientific and technological priorities that impact on the future of this nation.

Although women constitute a majority of the population and around 40% of the work force (work for pay population) we represent a small portion (8-9% of all science PhDs) of the male dominated, i.e., white male dominated, world of science (women representing only 4-8% of PhD level chemists, 2-4% of PhD level physicists and geoscientists, less than 1% of engineering PhDs). There is a need for intervention into the process by which scientists are made that is supportive of a redirection of women into science. The current trends of supply and demand and the predicted trends do not alter what needs to be done. NSF must be concerned, in fact we all must be concerned, that the valuable talent of the underutilized women and minorities, be included and involved in shaping the scientific and technological future of this country.

We are glad to see this year what we interpret as a new level of concern within the NSF about the problems of women in science. We have noted the various programs and projects directed toward these concerns. I hasten to point out to the Subcommittee that the National Science Foundation is no worse than any other institution that supports science and employs scientists. Indeed its level of concern and activity is much higher than that found in many universities and private research and development institutions. The situation found in the National Science Foundation simply reflects what we find in the whole national scientific scene, but we deplore that situation and hope for vigorous NSF leadership in changing the scene.

We suggest the following as a format for future NSF action and policy directed toward increasing the numbers and participation of women in science.

Action. There should be continued and increased financial support of programs and projects aimed at (a) overcoming barriers, (b) research of special problems, (c) experimental efforts, (d) financing education, formal and informal training, and (e) assessment of the progress being made toward the inclusion of women in the mainstream of science.

Inclusion. There must be inclusion of women scientists and their concerns at every level, in every office and program in the Foundation. They must be consciously included on peer review and advisory bodies, in staff appointments, in the hiring of personnel, in the awarding of grants, etc.

Leadership. The highest levels of the NSF, the Director and the Board, must assume a leadership role in advocating the full participation of women in the world of science.

Action

Programs have been undertaken within the Science Education Directorate of the Foundation that have been aimed at exploring the barriers to the full participation of women in science and increasing the numbers of women in science. We applaud these efforts and particularly thank this Subcommittee for its role in increasing the authorization for those programs. We also appreciate the efforts of that sub-committee of the National Science Board whose concern for women and minorities have led them to a promotion of other programs which will affect the numbers of women and minorities in science. The new programs outlined earlier this week by Dr. Averch can play a significant role in effecting some real change. We need these "special effort" projects if we are to reverse the trends of the past.

Most of the new effort of the Science Education Directorate will take place at the college and graduate level. The NSF must also be reminded that, as in the case of minorities, the processes which cut most women out of science begin at the precollege levels. Foundation programs must therefore also impact in major ways upon elementary and secondary science education and must support efforts at those levels both philosophically and financially. Much, much more needs to be done at an earlier point in the student's education, for most developing scientists have chosen their future careers by the time they finish high school. The NSF, with its primary mission the support of basic research, perhaps naturally emphasizes higher education. I cannot underline too strongly, however, the need for many effective programs at the pre-college level if we are serious in our intent to recruit more women and minorities to science.

As one moves from one level to the next--from pre-college to college to graduate level--more women are left behind, left out of the pool of potential scientists, so that the output reflects processes that serve to select women out. These processes are even worse for minority women who are affected by forces related to both their race and gender. We know that something is happening at each level to discourage women. We need to know more exactly what those forces are so they can be counteracted. We need to know the effect of counseling, mathematics curricula, role models, etc. on the process of producing women scientists. We need to know whether "science anxiety" courses, changes in the image of science and scientists, bias-free counseling and other such experimental projects can shape the attitude of young women about science and the possible choice of science as a career.

In addition to the exploratory and experimental programs, the Foundation must develop ways of implementing successful strategies that will remediate the past failures. In the areas where we already know some things that work, the NSF should be developing incentives to get them used. For instance, half a dozen researchers and teachers reported last week at our annual AAAS meeting some exciting work on women and mathematics. The successful techniques need to be broadcast widely. If the Foundation seriously means to increase the number of young women going in to science, it cannot stop after the experiments have been tried.

We need also to make sure that minority women are included in whatever programs are undertaken by the Foundation to increase the numbers of women in science. In the past, the concerns and needs of minority women have not been adequately addressed by either programs for women or programs for minorities. A few get included in each type of effort, but most fall in the cracks between the funded programs. Minority women must not be excluded either accidentally or incidentally from programs, as has happened in the past with some of the NSF programs.

The recent efforts of the NSF Division of Experimental Projects and Programs leads us to feel there is determination in that Directorate to meet the needs of these groups. The recent NSF support of the Conference of Minority Women Scientists and the forth-coming conference of Women in Basic Scientific Research, both organized by our office at the American Association for the Advancement of Science are statements of this interest. We are impressed by the commitment of the people with whom we have worked.

I believe that quality science education must be made available to women, minorities and the handicapped. Indeed, I believe that quality science education must be made available to everyone. The shape of this nation to come will depend increasingly on a scientifically and technologically literate citizenry. Improving the quality of science education for the underrepresented and under-utilized segments of the population will not only allow them to choose science as a career, but will also increase the overall level of scientific literacy in the population, a goal which I believe this Subcommittee shares.

In designing programs at the AAAS to improve the science education and counseling of women and minorities, we have been convinced that what is good for them is good for all youth. The opposite is not always true. But strategies that succeed in interesting the excluded in science are, we believe, capable of interesting others. We can therefore justify expenditure of a larger portion of the general science education authorization. There have been some marvelous improvements in science education over the past fifteen years, and NSF deserves high praise for many of them. But science education has conspicuously failed with the groups represented on this panel. That failure can be remedied only by a greater share of the current science education efforts.

Inclusion

Special programs are absolutely necessary if we are to increase the number of women going into science, but responsibility for the problems of visibility and numbers must permeate all the programs and directorates of the Foundation if women are truly to be included in the mainstream of science. It is all too easy when one has funded special efforts for others in an institution to say, "Oh yes, women in science; they're taken care of in that special program out on Wisconsin Avenue. . . " Somehow that knowledge is often accompanied by a relief from responsibility. That must not be allowed to happen at the NSF.

The recently organized NSF Women's Council can be of great help in getting other directorates to share in the responsibility. The Foundation is to be commended for creating that body; we hope it will be adequately staffed and supported by the Director's office and its members professionally rewarded for their service on it. All too often groups like that are expected to take on the new responsibilities without additional time and support staff. We know also of instances in other institutions where women and/or minorities serve well on such committees only to be penalized later in terms of advancement because the work is not considered of professional significance. If the NSF leadership gives its Women's Council status and visibility, support and clout, the Council can really help the Foundation move toward equal opportunity for women in all directorates.

It is easiest to include the concerns of women when starting a new program. Any new programs that are undertaken in the NSF must be structured from their initiation to include unincluded groups--women, minorities, and the handicapped. The inherent difficulty in changing a structure once it is set up should guide the NSF toward a more flexible and representative structure to any new program that is implemented. The new Science for Citizens program is a splendid opportunity for the NSF to make real efforts for the inclusion of women and minorities. Women and the concerns of women must be integral parts of this new program. Since a majority of citizens <u>are</u> women we cannot see how the NSF can fail to seek major input from women as to the direction and implementation of Science for Citizens. Women and minorities must be included in the staffing and development of this new program right now if it is to truly respond to all "citizens". As testimony to a belief in a scientifically literate and involved citizenry this Subcommittee allocated funds for the new NSF Science for Citizens program and I wish to take this occassion to thank the Subcommittee for this action. It is my hope that the Committee will make sure that input from women and minorities is used in determining the direction of this new program, for it seems not yet to have happened.

Our goal is to integrate women into the mainstream of science. Since the basic business of science as well as NSF is basic scientific research, we must therefore seek to include women at all levels of NSF's support of and interest in basic research. Increasing the numbers and level of women on the staff is an important part of this. Aggressive equal opportunity recruiting as has begun to happen this past year can make a difference over time, but equal opportunity is not just a matter of recruitment and hiring.

The directorates must also encourage and recruit grant applications from women and encourage male grantees to take on women scientists as their colleagues. It will take some time to increase the proportion of applications submitted by women, for they are not found in large numbers in the research institutions, and then they are often on soft money and not entitled to be primary investigators. Policy changes might enable such persons to be primary investigators, but even without policy changes, consistent effort on the part of program directors can in itself have an effect over time on the applicant institutions.

This is an excellent time to think about how women scientists should be used in the peer review process now that the NSF has started to rethink the whole process of review and advisory procedures. We would hope that these procedures, so basic to the conduct of science, include women scientists in a prominent way. If the peer review system is really to work it must be "broadly representative of the science community", in the words of last year's Conference Report. Attitudes of some staff who contend that "we know everyone who is any good" and can then only name one or two women, serve only to perpetuate the status quo. Another damaging assertion that we have heard from a program officer that "the sex of a reviewer makes no difference" indicates a lack of understanding of the issues of opportunity and visibility. Good science can be done by persons of either sex, but decisions on the comparable value of different research proposals, or of research emphasis and direction are deeply affected by the values people hold, and values in our society <u>are</u> often affected by one's race and sex. We need a change of such attitudes and a realization that those most likely to be overlooked are women and minorities.

More women researchers, especially in the "hard" sciences, mathematics and engineering; greater use of women scientists in the review and advisory processes; support of the research of women scientists--these are but some of the ways by which real equality of opportunity in science is achieved.

The views expressed here are not new. The substance of these statements are included in the 1976 NSF Authorization Act. We realize that changes are being made, more in some areas than in others. We wish to underline and reiterate our support of these efforts. But we also wish to emphasize the need to spread such efforts throughout the NSF, we wish to turn every program director into an EEO Officer concerned as to how his or her section is involving women.

Leadership

And that brings me to my final section. The National Science Foundation has the chance to play a major leadership role in increasing both the visibility and numbers of women scientists and other excluded groups. The National Science Board and NSF Directors must become our public, vocal supporters. By their advocacy and example they can affect not only what happens in the Foundation itself, but in the entire scientific community. They can affect the atmosphere and opportunities for women, especially young women at the beginning of their careers, in the educational and research institutions. The National Science Foundation is in a key position to provide national leadership in this area and can do perhaps more than any other institution to improve the status and numbers of women in the greater scientific community. What we seek from the National Science Foundation is moral, political and scientific leadership. Integration of women into the mainstream of science is not only the right and political thing to do, it is also good science.

Conculsions

The additional authorization for programs for women in science, made possible by this Subcommittee, is of course a very important part of NSF's ability to make progress in this area. All women scientists, present and future (and we hope there will be a lot of the latter) are most grateful to the Subcommittee members for that.

Just as important, however, to the progress we all desire are actions that require no additional funds, no new authorization and appropriations. These are the examples of leadership, evidences of determination, the many, many decisions which Foundation officials make every day. Special programs are absolutely necessary at all levels, but the problems in science for women, minorities and the handicapped will not be solved until their concerns are the conscious concern of every officer in the Foundation, and ultimately of every educator and research director in the scientific community.

Statement Submitted

by

Dr. Walter B. Waetjen, President
Cleveland State University, Cleveland, Ohio

to the

Special Subcommittee on National Science Foundation
U.S. Senate Committee on Labor and Public Welfare

This statement is submitted on behalf of the American Association of State Colleges and Universities, the Association of American Colleges, and the National Council on Independent Colleges and Universities

March 3, 1976

I am Dr. Walter B. Waetjen, President of Cleveland State University, Cleveland, Ohio. I am appearing today on behalf of the 320 state colleges and universities which make up the membership of the American Association of State Colleges and Universities, as well as the approximately 1,000 independent and public institutions which constitute the memberships of the American Association of Colleges and the National Council of Independent Colleges and Universities.

I am also the newly-chosen Chairman of the AASCU Committee on Liaison with National Science Foundation programs. In that capacity, I hope that our full committee of college Presidents from all parts of the country will have the opportunity to meet with this subcommittee and its staff later in the year.

Together, our three organizations represent a large part of the higher education community and educate more than fifty percent of all college undergraduates in the United States, as well as a

substantial proportion of graduate students. They enroll considerably more than half of all students attending four-year colleges as opposed to two-year colleges.

We appear today to testify on the Science Education programs, and especially on the proposal of the administration (which appears in the Federal Register on January 28, 1976, p. 4249) to defer $10 million in science education funds until the fiscal year 1977.

What this actually means is a de facto loss of at least $20 million in science education funds for fiscal years 1976 and 1977, at the very time when, if anything, we should be strengthening science education. Further, because of inflation, the proposed 1976 and 1977 budgets actually represent a serious loss in constant dollars available for science education.

To recapitulate the funds available for science education, let me make use of the chart which follows.

SCIENCE EDUCATION PROGRAMS, NATIONAL SCIENCE FOUNDATION

Actual FY 75	Proposed FY 76*	Proposed FY 77
$74.0 million	$64.8 million	$65.0 million

*The administration proposes to defer spending of $10 million appropriated in FY 76 until FY 77 and use it at that time. What this would mean, to repeat, is that there would be $10 million less available in science education funds for the current year than last year's budget. Then, because these $10 million would be added on to the FY 77 budget, only $55 million in new money is actually proposed for FY 77.

This is what we mean by saying that there would actually be a $20 million decrease in science education funds over the two-year period, and in constant dollars a still larger decrease.

In view of its actions in previous years, we know that this Subcommittee is well aware that science education is a relatively small but important part of the total NSF effort.

All of us know that science is a continuum. Unless funds are spent at the pre-college, undergraduate, and graduate levels, not enough talented people will become interested in and trained well enough in the sciences at an early age to make up an adequate future pool of scientific researchers as well as teachers.

We are particularly concerned with maintaining a strong undergraduate sicence education program. In a very real way undergraduate higher education acts as the mother lode from which are derived the teachers of our young at the elementary and secondary levels as well as the source of candidates for graduate programs which produce scientists for the professions and industry. Last year this committee initiated the CAUSE and RIAS programs which appear destined to produce results in assuring that science education in our colleges and universities maintains high standards in the years to come in the face of constantly changing scientific and technological conditions.

Further, we believe that the NSF has very correctly taken on the role, in the new "Science for Citizens" program, of disseminating a better understanding of science and technology to the citizens at large. Unquestionably, our society faces major and increasingly complex problems affected by science and technology for which popular understanding is an absolute necessity. The use of some science education funds for "Science for Citizens" appears to us to be essential.

Many of our institutions are particularly well qualified to participate in the "Science for Citizens" program. Many already conduct adult and continuing education programs, evening and weekend seminars, and other special events which could be used as one basis for this program. Many have on-campus radio stations or arrangements with educational or commercial TV stations and other media, for the presentation of such programs. Many also have scientists and specialists with long experience in citizen's education.

In any case, we do not believe that the $10 million in FY 76 funds should be deferred, or that the budget for FY 1977 should be below the FY 75 level of $75 million in new money--at least. Probably, if other budgetary necessities permit, the FY 77 budget should be higher.

We realize that it is the Appropriations Committees rather than the authorizing committees which will have to act to prevent the proposed deferral of science education funds and keep appropriations at a level at least equal to the FY 1975 figure. But, we hope that this Subcommittee will communicate its concern about these matters to the Appropriations Committees.

Our institutions stand ready to be of any assistance we can to your Subcommittee as your work proceeds. Thank you.

70-027 O - 76 - 25

STATEMENT

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Presented to the
Special Subcommittee on National Science Foundation

United States Senate
March, 1976

Mr. Chairman, we are pleased to have this opportunity to comment on how the National Science Foundation can make the opportunities in science more available to members of minority groups. First allow us to indicate however, what we speak as concerned scientists who have observed over the years that the practice of science at all levels has taken place with a less than adequate participation by members of minority groups. We also speak as organizers of a national conference held earlier this year, a conference designed to address the issues and propose solutions to the problems associated with inadequate representation of minorities in science and medicine. This conference titled "Minorities in Science" was featured as a part of the bicentennial meeting of the American Association for the Advancement of Science held in Boston, February 18-24. For reference a copy of the program is enclosed with this statement. It should be noted that the minority representation was broad inasmuch as it included women, blacks, chicanos, and native americans. The breath of fields of science represented by these individuals was equally large.

May we first introduce ourselves by stating that Dr. Vijaya L. Melnick is an Associate Professor of Biology and Co-Ordinator of the Pre-Medical Science Program at the Federal City College, Washington, D.C., Dr. Franklin D. Hamilton is an Associate Professor of Biomedical Sciences and Director of Summer Research Training at The University of Tennessee-Oak Ridge Graduate School of Biomedical Sciences, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

The record clearly shows that minority representation in the fields of science and engineering is grossly inadequate and does not meet the combined needs of educational, federal and industrial institutions for these ethnic groups. The lack of adequate representation is quite well documented in Dr. Martinez' testimony before this Subcommittee last year, a report by Dr. Adolph Y. Wilburn (careers in Science and Engineering for Black Americans, Adolph Y. Wilburn Science, Vol. 184 page 1148, 1974) and more recently in an article in the New Engineer (Black Engineers: Fewer Than We Thought, New Engineer page 28 January 1976). Given the fact that minority representation in science is disproportionately low, a pertinent question for this committee to consider is how the National Science Foundation can avail its programs and projects toward assuring an increased participation in science by members of minority groups.

As we look back in history, we find that the National Science Foundation was created for the general purpose of strengthening research and education in the sciences in the United States. One activity designed to help bring about this goal has been the award of grants primarily to Universities in support of scientific research. Such awards include those made for small and large research projects, for the construction of laboratories, generally these grants served several means designed to strengthen an institution's scientific endeavors.

Particularly revelent to this statement are two institutional programs initiated by NSF to increase the number of universities capable of conducting distinguished programs of education and research were the University Science Development Programs (USD) started in 1964 and the Departmental

Science Development program (DSD)[3] started in 1967. With the assistance of these two programs NSF had, by 1970, awarded a total of $201.8 million to 85 institution for development of their science facilities[1] alone 27 institutions received awards totaling $26.5 millions through USD and DSD grants. Another program developed by NSF for the purpose of increasing the quality of science education was the Graduate Science facility award initiated in 1959. These fund provided for renovation and construction of academic facilities. Through these awards 179 different institutions received a total of $186 million to develop their science capabilities.

Although each of the three programs mentioned above has been phased out by NSF, the practice of selectively supporting good institutions along with the large support for research and research training provided by The National Institutes of Health led to a substantial increase in the rate of production of PhD trained scientists doing the last decade of the 60's. That number increased from a total of 3460 PhD awarded in The Life and Physical Sciences in 1962 to 8700 awarded in the same areas in 1972.[3] Parenthetically, let us note that it was in the early seventies that concern arose because the job market could not absorb these highly trained individuals, resulting in some unemployment and greater underemployment of new PhD recipients. However, these results demonstrate that the capability is readily available which if properly called upon, can significantly increase the number of professonally trained personnel

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[1]NSF Factbook Alvin Renetzky editor-in-chief, Academic media, Orange, New Jersey, 1971.

[3]Source: National Center for Educational Statistics.

in the sciences. It also shows that the resources of this country can be harnessed to address current manpower needs. In the sixties the need was for an increase in the quality and quantity of research and research training. Unfortunately during this great influx of funds into academia to accomplish this task, minority institutions and minority training were overlooked. Even though there appears to be an ample supply of Ph D's, such is not the case with minority Ph.D's. The need for more minority scientists is overwhelming and because of this it is herewith proposed that this committee ask the National Science Foundation to direct a substantial portion of its effort to developing programs that can train minority students in science for the future needs of society and it should be done promptly.

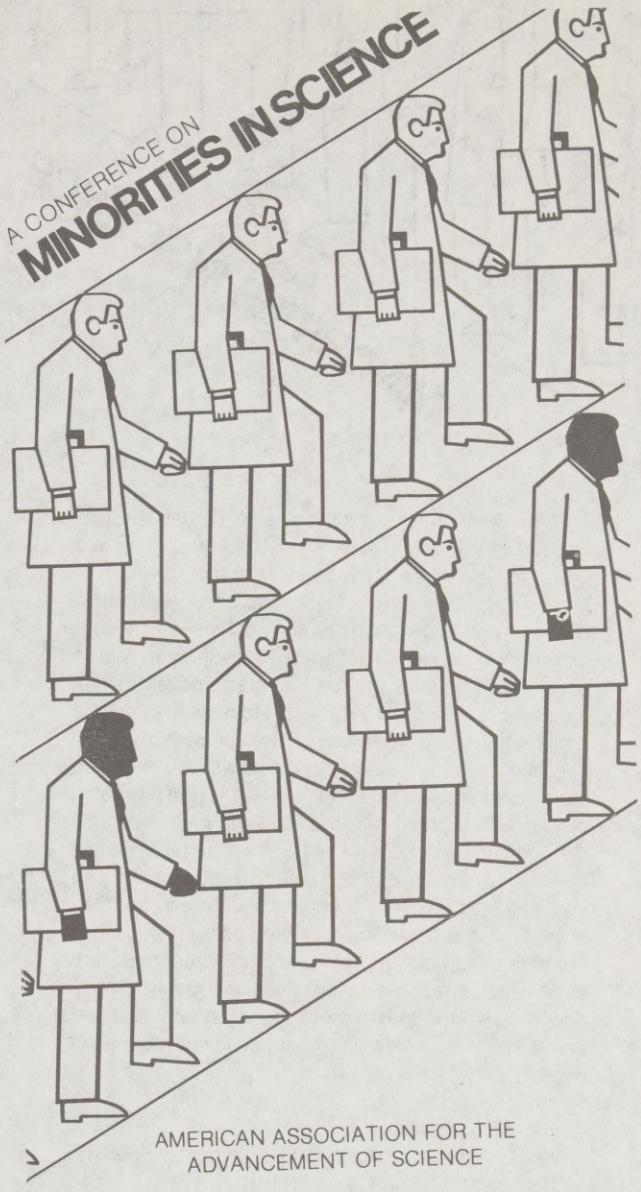
We propose that NSF develop an Institutional grant program for institutions with significant minority population that will have the result of helping Universities with good programs in science develop into excellent science research and training facilities while impacting primarily, but not exclusively, with minorities. We propose that this program be named Centers for Excellence Grant. These awards should assist the recipient institutions improve the quality of their faculity and graduate students in all areas of science including chemistry, mathematics, physics, the life sciences and engineering. These awards should contain funds for renewal and construction of research and research training facilities. These awards should also contain funds for purchase of equipment and supplies and funds for library resources, computer cost and travel. This program should be funded to an extent to allow for the development of 5-6 institutions with significant minority enrollment as centers of excellence in science. It is proposed that such a program eventually reach funding that will provide each of six selected

institutions six million dollars per year for ten years. The long term committee is recommended to preserve the integity of the program. Since we are proposing a small number of these highly developed and very specialized facilities, we also suggest that these funds provide for special summer programs at these highly developed institutions in which students and faculty members from other smaller and less developed institutions can gain the exposure and training these centers could offer. Furthermore, we strongly suggest that officials at NSF seek suggestions and recommendations from minority institutions and minority institutions and minority science organizations in developing this program. More importantly, it is proposed that a nine member advisor group, with no less than seven ethnic minority members, be formed and given charge to form policy for implementation of such a program.

If such a program could be started by the NSF we suggest Mr. Chairman, along with the programs for minority institutions within NIH (i.e. The Minority Biomedical Support Program (MBS) of The Division of Research Resources and The Minority Access to Research careers (MARC) of The National Institute of General Medical Science) could within 10 years alleviate the shortage of minority PhD trained scientist.

In closing Mr. Chairman, may we state why we feel consideration should be given to developing excellent science programs primarily at institutions with significant minority enrollment. It is impressive that the total enrollment at all minority institutions has grown from 158,000 in 1968 to 300,000 in 1975 it is projected to be 600,000 by 1980. In 1975 the 120 minority institutions graduated more than 30,000 students with BS and professional degrees. A current survey by Dr. James Jay (Negroes in Science:

Natural Science Doctorates 1876-1969, James Jay Balamp Press, Detroit 1971) indicated that 75% of all minority PhD recipients in the sciences received their undergraduate training at minority institutions. That year therefore, it is apparent that the most direct way to increase the number of minority students who enter graduate science training programs is to increase the quality and quanitity of science students and science training at minority institutions. We feel that the proposal submitted in this statement will achieve this objective and we urge this committee to give it serious consideration.



AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE

★BICENTENNIAL MEETING★

SHERATON HOTEL
BOSTON, MASSACHUSETTS

FEBRUARY 19-21, 1976



A conference on minorities in science has been organized to critically evaluate those policies, programs and projects that have been directed toward the amelioration of unequal and inadequate representation of minority groups in the biomedical sciences. The conference will consist of a series of seven symposia in which leading speakers from congress, governmental agencies, academic institutions, industry, and private and professional organizations will present their respective points of view. Not only will the selected speakers discuss their direct role, efforts and programs but will also suggest modifications and new directions that will bring a better and more complete participation of minority groups in the biomedical profession. The year of the bicentennial seems a fitting time for such an evaluation and assessment of the success of existing programs and policies that have been directed toward making equal representation a working reality. Everyone interested in these issues is invited to attend and participate in the conference. For additional information write:

Office of Opportunities in Science
American Association for the Advancement of Science
1515 Massachusetts Avenue, N.W.
Washington, D.C. 20036

This project is supported by grant number 1 R13 GM MH 23018-01 awarded by the National Institute of General Medical Science and the National Cancer Institute, NIH, DHEW.

Minorities in Science

THURSDAY, 19 FEBRUARY

9:00 a.m. Presiding: Percy J. Russell

Introduction
Percy J. Russell

Medical College Admissions Test
James L. Angel *(Dir., Med. Coll. Admissions Assessment Prog., Assn. of Amer. Med. Coll., Washington, D.C.)*

The Graduate Record Examination — What Does It Measure?
Robert Altman *(Grad. Record Examination Prog. Dir., Educ. Testing Service, Princeton, N.J.)*

Fluctuations in Minority Applicant Pool for Medical and Graduate School
Ralph Cuzart *(Dean, Meharry Med. Sch., Nashville, Tenn.)*

The Role of Black Institutions in Science Education
Frederick Humphries *(Pres., Tenn. State Univ., Nashville)*

Black Americans in the Sciences
James M. Jay *(Prof. of Biol., Wayne State Univ.)*

Native Americans in the Sciences
Don Jennings *(Exec. Dir., Assn. of Amer. Indian Physicians, Norman, Okla.)*

Spanish-Surname Americans in the Sciences
J.V. Martinez *(Chem. and Atomic Phys. Branch, ERDA, Washington, D.C.)*

Problems of Minorities at Majority Institutions

THURSDAY, 19 FEBRUARY

3:00 p.m. Presiding: Francine B. Essien

Minority Students and the Political Environment: A Historical Perspective
Theodore Brown *(Asst. Dir., Ctr. for Biomed. Educ., City College, CUNY)*

The Role of Sociocultural Factors in Determining Student Participation in Science
Sigfredo Maestas *(Dean of Acad. Affairs, N.M. Highlands Univ., Las Vegas)*

Status and Prospects of Minority Students in Traditional Medical Schools
George I. Lythcott *(Assoc. Vice Chancellor, Ctr. for Health Sciences, Univ. of Wis., Madison)*

The Students' Perspective
Woodrow Myers *(Student, Harvard Univ. Med. Sch.)*

Discussants:
Janet S. Blackwell *(Dir., Intercultural Educ. and Resources Ctr., Cal. State Coll., Hayward)* and Carl Spight *(Chm., Dept. of Phys., Morehouse Coll., Atlanta, Ga.)*

Public Policy and Biomedical and Behavioral Training: Effective Development of Existing Potential

THURSDAY, 19 FEBRUARY

8:30 p.m. Presiding: Vijaya L. Melnick and Cora B. Marrett

Science Policy for Education of Minorities
Joseph W. Watson *(Provost, Third Coll., Univ. of Cal. at San Diego, La Jolla)*

Minority Participation in Mental Health Training Policies
William Denham *(Acting Dir., Div. of Manpower and Training Prog., Natl. Insts. of Mental Health, Rockville, Md.)*

Better Health Sciences Through Minority Participation
Robert Schlegel *(Assoc. Dean for Public Policy and Prof. of Pediatrics, Charles Drew Post Grad. Sch. of Med., Los Angeles)*

Science Policy and the Industrial Sector
Herman Smith *(Organic Chem., The Upjohn Co., Kalamazoo, Mich.)*

Discussants:
Ruth Kirschstein *(Dir., Natl. Insts. of Gen. Med. Sciences, NIH, Bethesda, Md.)* and Geraldine Woods *(Consultant, Natl. Insts. of Gen. Med. Sciences, NIH, Bethesda, Md.)*

Financial Support for Minority Scientific Activity in Education and Research

FRIDAY, 20 FEBRUARY

9:00 a.m. Presiding: Charles M. Goolsby

The Importance and Impact of Funding Science Programs at Minority Institutions
Miles M. Fisher, IV *(Exec. Secy., Natl. Assn. for Equal Opportunity in Higher Educ., Washington, D.C.)*

Minority Programs Funded by the National Institutes of Health
Zora J. Griffo *(Special Prog. Officer, Office of the Dir., NIH, Bethesda, Md.)*

Foundation Support for Individual Studies
Samuel M. Nabrit *(Exec. Dir., The Southern Fellowships Fund, Atlanta, Ga.)*

Minority Programs Funded by the National Institutes of Mental Health
Mary S. Harper *(Asst. Chief, Ctr. for Minority Group Mental Health Prog., NIMH, Rockville, Md.)* and Paul Wohlford *(Health Scientist Admin., Div. of Manpower Training Prog., NIMH, Rockville, Md.)*

Funding of Minority Programs from the Private Sector
Maxine Bleich *(Assoc. Prog. Dir., Josiah Macy, Jr. Foundation, New York, N.Y.)*

Minority Programs Funded by the National Science Foundation
James W. Mayo *(Head, Instructional Improvement Implementation Sect., Div. of Higher Educ. in Science, NSF)*

Affirmative Action: Myth or Reality?

FRIDAY, 20 FEBRUARY

3:00 p.m. Presiding: Ermon Hogan-Kamara *(Dir., Comm. on Higher Educ., Natl. Council of Negro Women, Washington, D.C.)*

Affirmative Action and the Academic Community
Patricia Garrison *(Asst. to the Equal Opportunity Officer, MIT)*

Rules of the Game
James Goodwin *(Asst. to the Vice Pres., Univ. of Cal., Berkeley)*

A National Policy for Affirmative Action
Margaret Gordon *(Assoc. Dir., Carnegie Council on Higher Educ., Berkeley, Cal.)*

Affirmative Action and the Private Sector
Brock Heylin *(Labor Relations Attorney, US Chamber of Commerce, Washington, D.C.)*

Affirmative Action: A Congressional Perspective
Edward Roybal *(Member, US House of Representatives, D-Cal.)*

Special Training Programs for Minority Students in Science—College Level

SATURDAY, 21 FEBRUARY

9:00 a.m. Presiding: Edgar Smith *(Provost, Univ. of Mass. Sch. of Med., Worcester)*

Basic Science Enrichment Courses for Incoming Minority Medical Students
Alonzo Atencio *(Asst. Dean, Univ. of N.M. Sch. of Med., Albuquerque)*

Postbaccalaureate Premedical Program
Jewel Cobb *(Dean, Conn. Coll., New London)*

Medical Training and the Minority Student
Stanford Roman *(Asst. Dean, Boston Univ. Sch. of Med.)*

Health Careers Program
William Wallace *(Dir., Summer Programs, Harvard Univ.)*

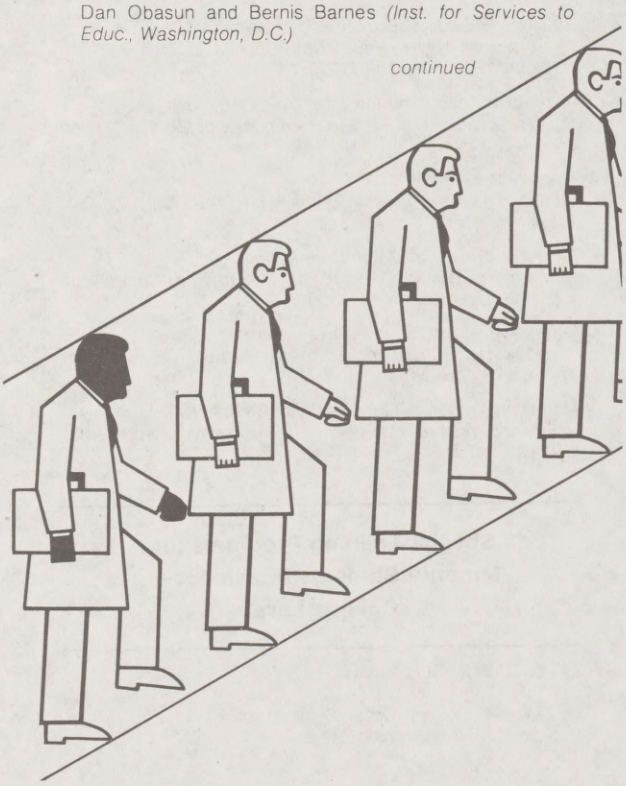
Prehealth Summer Programs
Richard McGinnis *(Assoc. Prof., Tougaloo Coll., Tougaloo, Miss.)*

Undergraduate Research Training
Franklin D. Hamilton

Industrial Research for College Students
Kenneth McLin *(The Proct. & Gamble Co., Cincinnati, Ohio)*

Thirteen College Curriculum Program—Student Involvement and Motivation in Science
Dan Obasun and Bernis Barnes *(Inst. for Services to Educ., Washington, D.C.)*

continued



Special Training Programs for Minority Students in Science—Precollege Level

SATURDAY, 21 FEBRUARY

2:00 p.m. Presiding: Cyrus J. Lawyer

Innovative Methods for Piagetian Development in Pre-college Science Students
Sidney A. McNairy, Jr. *(Health Scientist Admin., Minority Biomed. Support Prog., Div. of Res. Resources, NIH, Bethesda, Md.)*

Training at the Precollegiate and Collegiate Interface
Joseph Gayles *(Prof., Morehouse Coll., Atlanta, Ga.)*

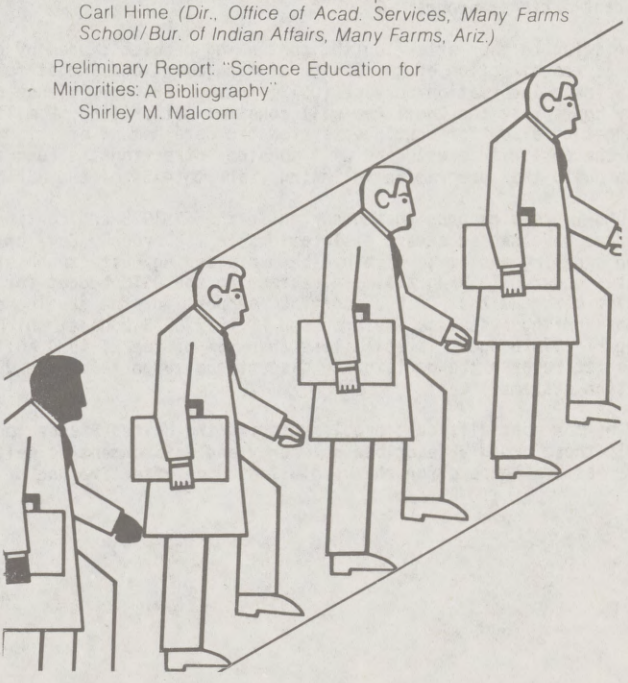
Professional Impact of Television as a Teaching Tool
Lee Colquitt *(Managing Dir., Project One, Educ. Devel. Cir., Newton, Mass.)*

Project City Science: A Systematic Approach to Improving Science for Inner-City Minority Youth
James Rutherford *(Dir., Project City Science; Past Pres., NSTA; Chm., Dept. of Science Educ., N.Y. Univ.)* and Staff

Motivating Upper Elementary Level Mexican-American Students Toward Science Careers
Robert A. Warren *(Assoc. Prof., Texas A & I Univ. at Kingsville)*

Ethnoscience: An Educational Concept
Carl Hime *(Dir., Office of Acad. Services, Many Farms School/Bur. of Indian Affairs, Many Farms, Ariz.)*

Preliminary Report: "Science Education for Minorities: A Bibliography"
Shirley M. Malcom



American Chemical Society

OFFICE OF THE
PRESIDENT

1155 SIXTEENTH STREET, N.W.
WASHINGTON, D.C. 20036
Phone (202) 872-4600

Glenn T. Seaborg, *President*

March 4, 1976

The Honorable Edward M. Kennedy
Chairman
Special Subcommittee on National Science Foundation
Committee on Labor and Public Welfare
United States Senate
Washington, D.C. 20510

Dear Senator Kennedy:

Enclosed for your information is the statement of the American Chemical Society, as approved by the Board of Directors, on the "National Science Foundation Authorization Act, 1977," regarding science information systems. We appreciate being given this opportunity to have the views of the American Chemical Society included in the official hearing record. It is our understanding from discussions with Ms. Anne Strauss that you are planning additional hearings specifically on the subject of science information systems, and that the American Chemical Society will be invited to testify at that time. The Society will look forward to that opportunity to elaborate on its views on this very important national program.

In bringing to your attention the continuing problem caused by cutbacks in funding at the direction of the Office of Management and Budget for the Office of Science Information Service (OSIS) in the National Science Foundation, the Society hopes that the Committee will consider authorizing $9 million for the NSF budget to allow for continued systematic development of information systems in the public interest, and will consider directing the Foundation to continue to build this program in following years to 4-5% of the NSF budget.

The OMB-imposed changes that occurred in the FY 1975 and continued in the FY 1976 budget have caused severe dislocations in the orderly development of information handling systems, which had been proceeding quite successfully in the United States under OSIS programs. In decreasing the OSIS budget for FY 1975 by 33%, OMB also directed that OSIS discontinue support for the development of information-handling systems. The proposed FY 1977 OSIS budget, which is the same as the FY 1976 budget, is still less than 75% of the FY 1974 obligations, and it does not reverse the decision to discontinue support for the development of information systems.

Many of the most difficult problems facing the United States today -- particularly those broadly described as energy and environment as well as those related to health -- depend for their solutions upon effective use of scientific

AMERICAN CHEMICAL SOCIETY 1876-1976

and technical information, but such informational capabilities do not presently exist. Other national governments (notably the West German, Japanese, and Soviet governments) are making much larger national commitments to the development of information-transfer systems.

In the United States, the NSF is the only federal agency which has supported systematic development of information services and coordination of these services across the full range of U.S. national interests. There is no obvious alternative to the Foundation. The American Chemical Society believes that science information problems are critical and that the recommendations proposed here are modest in comparison to the benefits that will accrue. The Society, therefore, requests the Committee's support of these recommendations.

Sincerely yours,

Glenn T. Seaborg

Enclosure

ACS 76-003

STATEMENT

of the

AMERICAN CHEMICAL SOCIETY

to the

SPECIAL SUBCOMMITTEE ON THE NATIONAL SCIENCE FOUNDATION

COMMITTEE ON LABOR AND PUBLIC WELFARE

UNITED STATES SENATE

on the

NATIONAL SCIENCE FOUNDATION AUTHORIZATION ACT, 1977

regarding

SCIENCE INFORMATION SYSTEMS

March 4, 1976

The American Chemical Society appreciates being given this opportunity to comment on the National Science Foundation Authorization Act, 1977, regarding science information systems. Primarily through its Committee on Chemical Abstracts Service of the Board of Directors, the Society has monitored the amounts previously allocated in the National Science Foundation Budget for science information systems. The Society recognizes this federal support as fundamental to national science and technology policy and of vital significance to the ability of our nation to resolve many of the problems which confront it. We believe that the views presented by the American Chemical Society represent a consensus of the nation's science community.

We wish to offer for the consideration of the Subcommittee the following specific recommendations:

- That $9 million be authorized in the NSF budget for FY 1977 to allow for continued systematic development of information systems in the public interest;
- That funding for development of information systems be increased over the next several years to 4% - 5% of the NSF budget.

The Society has made similar recommendations in past years which have been supported by testimony describing the nature of the flow of scientific and technical information, the need for systematic development of information-transfer technology, and the crises in support that are faced by private-sector information services. In earlier testimony, the American Chemical Society has focused on the role of the Office of Management and Budget in NSF information support programs. In preparing the FY 1975 budget, OMB instructed NSF that the Office of Science Information Service (OSIS) (now the Division of Scientific Information, DIS) could no longer provide support for systematic development of information services. This restriction, in combination with the OMB-imposed reduction of approximately 33% in the OSIS FY75 budget, was the clumination of OMB pressures which are readily apparent from a review of the history of OSIS funding (see Attachment 1). The DIS FY76 budget has increased to $6 million from the FY75 level of $5.4 million -- still 25% below the FY74 spending level. The President's FY77 budget again proposes a limit of $6 million for Science Information activities. We recommend that the FY 1977 Authorization Bill contain provisions for the allocation of funding support for information activities by the Foundation and the National Science Board which is more adequate for the long-range national interest.

The problem of information transfer is not a problem for only science and technology; it is a general problem that pervades all of society. Information may be technical, financial, or social. The needs for it may be governmental, academic, or industrial. Therefore, the solutions must involve support and expertise from both the public sector and the private sector. The net result must be a coordinated, systematic development without wasteful duplication.

A brief review of the development program undertaken at the Society's Chemical Abstracts Service (CAS) division can serve as an illustration of the aforementioned problem. CAS is one of a small handful of discipline informa-

tion services operating in the United States today. (There are only a dozen or so such services in the world at the present time.) All but one of these services are provided by scientific and educational societies outside the Federal Government. Discipline services are intended to provide access to information content which appears in source publications in all areas of science and technology, with no restriction as to country of origin or language of publication. The services are used to locate principles, facts, and observations which are buried in primary publications. Each serves to correlate information in such a way as to extend the usefulness of the information not just in that discipline, but throughout science and technology and the world at large. The intent is to organize a continuous record of accomplishment which will provide consistent access through time to all scientific and technical literature. Although the nature of the information differs from one discipline to another, the same basic processing problems exist.

The CAS development program began in 1965 with an evaluation of the concept of automatically identifying chemical substances based on computer processing of structural formula diagrams. During 1965-68, this work was supported jointly by the Department of Defense, the National Institutes of Health, the National Science Foundation, and the American Chemical Society. In 1969, the Society, with NSF support, launched a program directed at limited automation of other CAS processing operations. A primary objective of this development was to make chemical information more easily accessible by automated search of computer-readable files. It should be noted that in 1969, CHEMICAL ABSTRACTS, the main CAS service, included almost 45,000 pages of English-language abstracts and indexes which provide access to over 285,000 journal papers, reports, and patents, from more than 100 countries and in about 50 languages.

In 1971, encouraged by the initial results in automation of CAS process-

ing operations, NSF requested the Society to prepare a long-range development plan to produce an information accessing system which could be a prototype for such systems in various other disciplines of science and technology. The National Science Board reviewed this plan, which included implied support, and approved the funding requested by the Society. In 1971, CAS launched, with NSF and Society funding, a program to combine all CAS processing operations into a single integrated system which would provide printed, microform, and computer-readable information services depending on the user's need.

The success of the CAS automation program can perhaps be assessed best by comparing CHEMICAL ABSTRACTS in 1975 with its 1969 data. The 1975 CHEMICAL ABSTRACTS (publication of the indexes to be completed by June, 1976) will include nearly 66,000 pages of English-language abstracts and indexes which provide access to almost 455,000 journal papers, reports, and patents coming from over 125 countries in some 50 languages. This represents a 60% increase in source documents covered by CHEMICAL ABSTRACTS in 1975 in comparison to 1969. During this same period, the time lag on CHEMICAL ABSTRACTS indexes has been reduced by over nine months. Also, the cost of processing a document for CHEMICAL ABSTRACTS has been slightly lowered on a constant dollar basis, despite a nearly 12% increase in the average number of index entries per document.

Progress in CAS automation has followed the strategy of a stepwise shift of pre-1971 manual operations to an automated base as the new system has developed. Until now, the cost reductions, resulting from the increased efficiency gained at each step of the continuing shift from the manual to the automated system, have more than offset the additional cost and time resulting from the increased flow of paper generated by the automated system. At the present stage of our basic conversion to an automated system, continued growth of the work load will lead to a rapid escalation in processing costs and serious losses in timeliness of CAS services, because the checking, proofing, and correcting functions are still manual paper work. A shift of these functions

to interactive computer terminals would eliminate this paper problem. The development of such a so-called on-line processing system was part of the CAS 1971-77 program approved by the National Science Board. Although the American Chemical Society intends to continue its investment in the development of the CAS system, the funds available from the Society and from users of CAS services are far from sufficient to accomplish this objective. The program approved in 1971 included more than $5 million in government support to implement the required on-line processing capability at CAS. (This need has recently been reviewed. The required government support has not changed.) Now is the time to start such development before the viability of CAS services is severely reduced.

In response to a request which the American Chemical Society sent to OSIS in 1975, L. Burchinal, Director of OSIS, stated in his letter of January 16, 1976:

> "The Foundation recognizes what an outstanding job CAS had done in substantially automating preparation of Chemical Abstracts, creating a machine-readable data base, and deriving various related information products. We are proud to be associated with your effort. We are also pleased to see other organizations benefit from your work, as represented by contracts CAS has negotiated with the National Library of Medicine and use of your software and methods by other public and private information organization. Further development of CAS would also benefit chemistry, science and the country as a whole. However, you recognize, I am sure, that there are numerous competing needs for research in information science and for development of new and improved methods of creating access to scientific literature and data. To meet these needs, there exists only one major source of funds in the Nation -- the budget for the Office of Science Information Service in the National Science Foundation. As with all programs today, hard choices have to be made.
>
> It is now clear that funds available for scientific information activities in FY 1976 and the estimated level for FY 1977 make it unlikely that $5.1 million would be available for further CAS development. We understand the disappointment which this must bring to you and your staff, and we recognize the difficulty of maintaining the high quality of your service without unduly increasing its cost to subscribers."

Since CAS is the only English-language service in the world that provides comprehensive access to chemical information, CAS development is not just a

problem for the United States. It is not surprising that nearly two-thirds of the users of CAS services live outside the United States and, therefore, nearly two-thirds of the ACS investment in CAS system development comes from outside the United States. Certainly, failure to bring the CAS system to stability will have a very serious international impact on United States leadership in scientific and technical affairs throughout the world.

The timing of NSF's withdrawal from supporting systematic development and information systems is especially bad from an international standpoint. During the past two years, agreements have been reached which share responsibility for producing and using CAS services between the Society and the Internationale Dokumentationsgesellschaft fuer Chemie (IDC) of the Federal Republic of Germany and between the American Chemical Society and The Chemical Society of the British Isles. These agreements are the first steps toward spreading the burden of continuity of CAS services beyond the United States. Additional agreements are under active consideration with France and Japan. The agreement with IDC was initiated partly as a result of a national program of the West German Government directed at making scientific and technical information more accessible throughout Germany. The French and Japanese agreements, should they be established, will be based on support from their national governments.

The need for easy access to scientific and technical information can be justified in several ways, for example: the role of information in the creative processes and the need for logical development of knowledge by reasoning forward from what is already known; greater return on investment by eliminating wasteful duplication of time and effort resulting from unknowing repetition of work which is already a matter of public record, and fruitless investigations which could have been avoided by correlation of related but uncoordinated published facts; and, improved responsiveness in dealing with unexpected social crises in matters of health, food, energy, materials, et cetera.

But all such justifications are no more than facets of an effective information supply system. Public and private enterprise do not demand separate sources of information supply. In fact, to permit such separateness can become impossibly expensive for those who are served. Nevertheless, there is a strong tendency among federal agencies to establish independent information services, disregarding the other governmental and nongovernmental services in existence. The result is the erection of a technology barrier which not only cuts off federal agencies from privately operated sources of information, but also prevents private services from working effectively together and with federal agencies. This barrier could be removed by automation. However, with OSIS support for systematic development cut off, at the present time only the government services have the resources for such automation. Wasteful duplication of processing effort, and user problems in recognizing useless overlap in content among governmental and nongovernmental information services, will continue to grow unabated until systematic development of existing information supply services is undertaken. Systematic development implies a carefully planned, stepwise buildup of information systems in a way that permits the diversity of information users to utilize efficiently combinations of corresponding services for specialized purposes. The only productive systematic development of information services -- inside or outside of government -- has come through the OSIS initiative and leadership, and its momentum can only be continued through adequate funding for NSF's Division of Scientific Information.

In order that you may place the recommendations of the Society in perspective, we should mention that we are an individual member organization. Chemical or other companies are not eligible for membership. Approximately 110,000 individual

chemists and chemical engineers, reflecting a broad spectrum of academic, governmental, and industrial professional pursuits, constitute the membership. About 60% of our members are employed by industry, about 25% by academic institutions, and 15% by government and non-profit institutions.

Founded in 1876, the American Chemical Society was chartered as a non-profit, scientific and educational organization by an act of Congress which was signed into law on August 25, 1937. Its National Charter imposes obligations on the Society to provide assistance to the government in matters of national concern related to the Society's areas of competence and also to work for the advancement of chemistry in the broadest and most liberal manner, "thereby fostering public welfare and education, aiding the development of our country's industries, and adding to the material prosperity and happiness of our people."

We offer the foregoing recommendations to the Congress in a spirit of cooperation in the hope of developing the best possible mechanism for achieving fast, efficient, and comprehensive dissemination of scientific and technical information. We recognize, as surely you do, that the availability of scientific and technical information is vitally necessary to the conduct of research and development in this country. Our hope is that we can continue to contribute to sustaining the tradition of scientific excellence and technological competency in the United Staes, on which our national well-being is dependent.

Attachment 1

FEDERAL OBLIGATIONS FY65-77

National Science Foundation
Research and Development

	1965	1966	1967	1968	1969	1970	1971
1. Total Federal R&D	15,745,900,000	16,178,800,000	17,149,000,000	16,525,100,000	16,310,100,000	15,864,800,000	16,175,400,000
2. Total NSF	415,966,689	466,428,184	465,103,802	505,227,669	432,645,493	460,617,944	494,408,290
3. Total Nat'l & Internat'l Prog.	77,309,758	75,341,674	61,107,176	89,768,018	77,477,872	105,214,409	121,892,099
4. Nat'l & Special Research Prog.	42,194,266	25,978,383	11,887,338	15,483,126	13,479,919	38,964,163	49,856,351
5. National Research Centers	19,480,000	23,017,805	24,503,656	31,464,080	28,564,461	27,211,800	37,174,506
6. Computing Activities (1)	4,512,503	4,000,000	12,690,598	21,997,555	16,979,280	16,918,585	15,042,905
7. Science Information	11,122,989	11,445,486	10,024,737	14,396,057	10,664,541	11,433,279	10,694,898
8. Research Applied to Nat'l Needs							33,955,291

	1972	1973	1974	Estimated 1975	1976	TQ	1977
1. Total Federal R&D	17,014,000,000	17,595,600,000	17,407,000,000	19,844,000,000	22,247,000,000	5,552,000,000	24,680,000,000
2. Total NSF	597,720,263	605,928,234	639,998,974	689,575,000	726,268,000	167,605,000	806,000,000
3. Total Nat'l & Internat'l Prog.	160,492,101	165,341,441	150,157,347	146,900,000	189,200,000	43,600,000	X
4. Nat'l & Special Research Prog.	85,885,701	112,463,727	91,641,465	86,500,000	116,000,000	25,400,000	X
5. National Research Centers	39,734,697	39,750,000	43,200,000	50,400,000	62,200,000	15,000,000	60,000,000
6. Computing Activities (1)	20,915,968	9,895,322	9,762,500	11,800,000	12,500,000	X	15,800,000
7. Science Information	9,710,922	8,464,408	8,077,358	5,400,000	6,000,000	X	6,000,000
8. Research Applied to Nat'l Needs	53,766,889	69,887,314	75,079,165	83,590,000	73,615,000	17,300,000	64,900,000

X - Data not available

(1) FY65 University only
FY66 Not available - estimate only

Data Sources:

For Federal R&D -

- FY65-73 from Federal Funds for Research Development and Other Scientific Activities Vol. XXIII, NSF 74-320
- FY74-77 from FY77 U.S. Government Budget

For NSF Total and all programs -

- FY65-74 from NSF Annual Reports - Financial Section
- FY75-77 from News Release NSF 75-9

Senator KENNEDY. We are going to follow these programs closely ourselves and will work to and try to get some decent appropriations.

The subcommittee stands adjourned.

[Whereupon, at 4:25 p.m., the hearing was adjourned.]

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