R E P O R T R E S U M E S

ED 020 145 SE 004 806

SCIENCE POLICY BULLETIN NUMBER 4.

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BATTELLE MEMORIAL INST., COLUMBUS, OHIO

PUB DATE APR 68

EDRS PRICE MF-$0.50 HC-$2.80 68P.

DESCRIPTORS- *ANNOTATED BIBLIOGRAPHIES, *BIBLIOGRAPHIES, *FINANCIAL SUPPORT, *INDUSTRY, INTERNATIONAL PROGRAMS, *NATURAL RESOURCES, *NATIONAL PROGRAMS, *SCIENTIFIC RESEARCH, *RESOURCE MATERIALS, *SCIENCES, *TECHNOLOGY, AGRICULTURE, BIOLOGY, CONFERENCE REPORTS, DEVELOPING NATIONS, ENGINEERING, FEDERAL LEGISLATION, GOVERNMENT ROLE, HIGHER EDUCATION, INFORMATION SCIENCE, NEWSLETTERS, OCEANOLOGY, PHYSICS, SOCIOECONOMIC INFLUENCES, TECHNOLOGICAL ADVANCEMENT, BATELLE MEMORIAL INSTITUTE, NATIONAL SCIENCE FOUNDATION,

THIS BULLETIN, PUBLISHED BIMONTHLY, REPORTS THE CURRENT LITERATURE IN THE AREA OF SCIENCE AND PUBLIC POLICY. THE COVERAGE ENCOMPASSES BOTH "POLICY FOR SCIENCE" AND "SCIENCE FOR POLICY" MATTERS. SCIENCE IS USED TO DENOTE ENGINEERING, TECHNOLOGY, AND SCIENCE. THE BULLETIN IS INTENDED FOR PERSONS ENGAGED IN STUDYING, FORMULATING, AND IMPLEMENTING PUBLIC POLICY RELATING TO SCIENCE AND ITS USE. ITS PURPOSE IS TO AID SUCH INDIVIDUALS BY ALERTING THEM TO NEW ADDITIONS TO THE SCIENCE POLICY LITERATURE. THE INFORMATION PRESENTED CONSISTS PRINCIPALLY OF A BIBLIOGRAPHIC LISTING, SOME ANNOTATED, OF CURRENT PUBLICATIONS IN THE AREA. PUBLICATIONS OF A HIGHLY TECHNICAL AND NARROWLY SPECIALIZED NATURE ARE EXCLUDED. THE BIBLIOGRAPHIC INFORMATION IS PRESENTED UNDER A NUMBER OF TOPICAL CATEGORIES--(1) GENERAL, (2) SCIENCE, DOMESTIC PROBLEMS, AND NATIONAL GOALS, (3) NEEDS AND ALLOCATION OF RESOURCES FOR SCIENCE, (4) NATIONAL R AND D PROGRAMS, (5) SCIENCE, EDUCATION, AND THE UNIVERSITY, (6) SCIENCE MANAGEMENT AND POLICY MAKING BODIES, (7) SCIENCE, FOREIGN AFFAIRS, AND NATIONAL DEFENSE, AND (8) SCIENCE POLICY IN FOREIGN COUNTRIES. EACH CITED PUBLICATION IS RECORDED UNDER A SINGLE CATEGORY. CROSS INDEXING IS NOT USED. MAJOR MEETINGS AND OTHER EVENTS IN THE SUBJECT AREA ARE ALSO REPORTED. (DS)

Vol.1 Number 4
April, 1968

Science Policy Bulletin

Battelle Memorial Institute

SCIENCE POLICY BULLETIN

The Bulletin, published bimonthly, reports the current literature in the area of science and public policy. The coverage encompasses both "policy for science" and "science for policy" matters. For brevity, "science" is used to denote engineering, technology, and science.

The Bulletin is intended for individuals engaged in studying, formulating, or implementing public policy relating to science and its use. The purpose of the Bulletin is to aid such individuals by alerting them to new additions to the science policy literature.

The information presented in the Bulletin consists principally of a bibliographic listing of current publications in the area. In addition, major meetings and other events in the subject area are reported.

The bibliography, although covering a broad topical scope, is selective in that publications of a highly technical and narrowly specialized nature are excluded.

The bibliographic information is presented under a number of topical categories. Each cited publication is recorded under a single category; cross indexing is not used. The numbering of publications under each category runs consecutively through all issues of the Bulletin, so that a given number refers to only one citation.

Copies of the listed publications are not available through Battelle but can normally be obtained from the originating agency.

The contribution of information to the Bulletin as well as suggestions and comments on its content, coverage, and format are solicited. All correspondence should be addressed to:

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BOOK REVIEW

THE POLITICS OF PURE SCIENCE, by Daniel S. Greenberg, The New American Library, 1967, 303 Pages, $7.95.

Reviewed by Samuel Globe*

Those who follow the "News and Comment" columns of Science, the AAAS weekly, will be familiar with Greenberg's lively and occasionally acerbic reports on current events in the world of science politics. In the same style he uses there, but concentrating on "basic" or "pure" science, Greenberg gives us in this book a review of the last 30 years of science politics.

"An inquiry into the relationship between science and government in the United States" is how Greenberg subtitles his book. In exploring this relationship, however, he has occasion to examine briefly other matters that may interest some readers as much as the focal topic itself. Among these satellite topics are: the nature of politics within the scientific establishment, or how scientists govern themselves; the relationship between science and technology; and the ideology of pure science, as perceived by the scientists themselves, and as contrasted by them with the values of those parts of our culture that, in their eyes, are less blessed, the latter including not just the humanities, but also the social sciences and applied science.

The examination of these subsidiary questions, though it is to some extent distributed throughout the book, is concentrated mainly in the first two chapters, especially in Chapter II, which is provocatively entitled "Chauvinism, Xenophobia, and Evangelism". This is a description Greenberg would pin on the scientific community, and not on some know-nothing political movement. Cries of anguish and protests of misunderstanding are certain to arise from some sectors of the scientific community, just as murmurs of appreciation will no doubt be heard from some of the laity. But before any of the high priests of the scientific culture become too enraged over Greenberg's perceptions, perhaps they ought, in the spirit of the objectivity they so often tout as the great virtue of their religion, to consider what virtue there may be in trying "to see ourselves as others see us".

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As for the main topic of the book, it is presented as a drama in three acts: science politics as it was (before World War II and the Bomb); science politics in the recent past (twenty years of expansionism); and science politics as Greenberg sees it beginning to evolve for the future. The dramatic scene is both panoramic and detailed. It is panoramic in its review of science and science politics before World War II, in the oft-told study of the scientific successes during and after World War II, and in the story of the post-war marriage of convenience between science and the military. (Until recently one might have supposed that this marriage was one of true love, but strong doubts are beginning to arise). The dramatic scene is detailed in its portrayal of two of the juicier happenings of recent science politics, the Mohole project, and the various skirmishes in the battle over high energy accelerators.

Greenberg is accused by some of being a chronicler of scandals, of yielding to the baser instincts of journalism by trumpeting the stories of sensational scientific sin but playing softly the successes of righteous research. However that may be in the news of columns of "Science", this reviewer believes that in this book the chronicles of Mohole and of high energy accelerators are necessary and useful in illuminating the message that Greenberg is trying to convey, namely the changing nature of science politics and some of the reasons for the changes that are occurring.

Summarized as succinctly as possible, the politics of science as seen by Greenberg has gone through three stages corresponding to the three acts of his drama. In the ancient regime, before World War II, it was a politics of strict separation and mutual distrust. In the post-war era, during the time of what Greenberg calls the "old politics", it was a politics "predicated on government money and scientific sovereignty". In this era, science successfully maintained the position that only it could be the judge of what was best for it, that furthermore, as Greenberg says, "what was good for science was good for society", and that government's job was to provide the financial wherewithal to accomplish the ends science set for itself. Now the third stage of science politics is beginning to emerge. It is the stage of the "new politics of science, a politics characterized by a diminution of the de facto sovereignty [of] pure science". The new politics is emerging for a variety of reasons, among them the increasing expense of scientific ventures, the demands of other sectors of the body politics, public revelation of some of the workings of politics within science itself, as in the Mohole and high energy conflicts, and the resurgent desire of government administration to control all expenditures of public funds, even those of science. "By the early 1960's, science, viewed [by Congress] as one with technology, had become too expensive, too poorly understood and misunderstood in terms of its intrinsic and economic values to be left to the scientists. Thus began the new politics of science".

The book closes with an epilogue to the main action of the drama in which Greenberg offers a few pages of Dutch uncle advice to the scientific community. There are two themes to this advice: first that science should do a better job of policing the activities of its

practitioners in the use of funds, in grantsmanship, in needless proliferation of papers, etc; and second that science should reexamine its own ideology and its relationship with society. As regards the first theme, it is probable that the peccadilloes of science are no worse than those of any other sphere of human activity, and certainly compare favorably with the ragged edges on the seamy side of national politics. Still it is hard for scientists to line up in favor of sin and in opposition to virtue. But the second theme of Greenberg's advice is deeper going. The catchy shibboleths of yesteryear about the place and virtues of science are losing their appeal. A reexamination of the nature of science and the role of science in society is a desirable endeavor that scientists, in keeping with their tradition, should encourage and undertake themselves. And among the most interested in such an undertaking should be those scholars whose sphere of interest comprises the title of this bulletin: science policy.

BIBLIOGRAPHY

I GENERAL

74. Kranzberg, M., "The Disunity of Science-Technology", American Scientist, v. 56, no. 1, Spring 1968, pp. 21-34

> "It is possible to build a historical case both for and against the unity of science and technology as a development of the contemporary era." This article, partly historical, but largely philosophical, emphasizes the differences, and yet tries to explain the interactions between science and technology. The basic difference is one of intention: science tries to explain; technology to construct. They differ also in methods of procedure. Their development has been independent of each other to a greater extent than is usually supposed. Yet they can, and do, interact in varying degrees in "dialetical relationships" in which each may help support the other, and yet retain its differences. But the "fact is that ... new technology grows mostly out of old technology, not out of science. Similarly, science has its internal dynamics, and scientists concern themselves chiefly with the problems posed by science, not by technology".

75. Daddario, E. Q., "A Challenge to the Scientific Community", Proceedings of the National Academy of Sciences, v. 59, no. 2, February 15, 1968, pp. 305-312

> In a public lecture, Daddario commended recent studies in science policy but noted that many issues were still unresolved: (1) how much should be spent on support of basic scientific research, and (2) how funds should be allocated among fields of science and institutions engaged in scientific endeavors. He reviewed the relations between the scientific community and the legislator and urged "a truly effective liaison between science and the legislature ... not just a science lobby". He concluded that "while all the mounting ills of our age are not going to be cured either by government or by science alone, they will not be cured without them either". "The proponents and practioners of science and technology can no longer afford to let themselves be

isolated or attempt to serve in the Miltonian manner of standing and waiting."

76. Schuster, R. P., (Ed.), The Next Ninety Years, Proceedings of a Conference, California Institute of Technology, Pasadena, California, (March 7-8, 1967), 1967, 186 pp.

In 1957, three of the seven participants in this conference "undertook a series of nationwide symposia to consider resources and population problems with executives of certain major corporations". They published their findings in a book, The Next 100 Years, "that attempted a long-range projection for the future course of our technical-industrial culture". The present conference, conducted 10 years later, consists of a reevaluation and revision of the forecast made 10 years ago. The topics discussed by the participants (Harrison Brown, James Bonner, John Weir, J. George Harrar, Norman H. Brooks, Thayer Scudder, and Athelstan Spilhaus) included energy resources, population, air and water pollution, education, transportation, problems of emerging nations, and experimental cities.

77. Seitz, F., "Technical Implications of Emerging National Goals", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp. 45-52.

Any "political and social system which is built upon innovations ... will encounter major problems which stem from the very successes of those innovations. Unless the innovative force is kept alive and active, the new problems which are not solved by further innovations will overwhelm the system". Four "major problems of our time and the kinds of innovation that will be needed to cope with them" are discussed. The problem areas discussed are transportation, education, world food, and national defense. With respect to the latter the author states that "it is indispensable for our national welfare in the foreseeable future that some of our best minds and much of our wealth be devoted to the field of defense technology".

78. Nieburg, H. L., "R&D Program Inplementation", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp. 203-210.

"In the decade ahead, R&D programs will be a battleground of public attention, anxiety, and trouble." The question "what are the social and political implications

of R&D?" is "emerging as the next great debate of our time. Those who paint a glowing picture of the 1970's, of the magnificent opportunities around the corner, are destined for disappointment. Instead the R&D Establishment faces a period of retrenchment and skepticism". The author discusses a variety of topics, including: the "blending of government and contractor into an integral whole" that puts it "beyond democratic scrutiny"; the use of the government contract "to achieve a variety of policy ends"; the definition of all public problems as R&D that fall within the "special province for the systems capability of large corporations"; the need for greater control over "those interest groups and power coalitions" who are making public policy for the whole society; the need for democratized planning instead of "R&D as back-handed pump-priming"; new institutions for funding R&D, such as public foundations and corporations; and the "need to assimilate the mysteries of science and technology to ordinary political analysis, common-sense political judgment, and plain English".

79. "National R&D for the 1970's", Proceedings of the Symposium, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, 235 pp.

This symposium, held by the National Security Industrial Association, focused on the topics of (1) objectives and uses of R&D in the 1970's, (2) methods of technology forecasting and planning R&D, (3) the institutions that will execute and apply R&D, and (4) the methodology and management of national R&D programs in the 1970's. The individual papers presented included:

The Widening Objectives of R&D in the 1970's
- Projection of Government R&D in the 1970's
- Congress and R&D in the 1970's
- Trends of Research in the Universities

Technology Forecasting and R&D Planning
- Technical Implications of Emerging National Goals
- Techniques for Forecasting Advances in Technology
- Forecasts of the State of the Art in 1980
- Effective Long-Range R&D Planning in Industry

Institutions of the Future
- Technological Forecasting for Planning and Institutional Implications
- Department of Defense Laboratories in the Future
- Federal R&D in the Universities in the Future
- R&D in Industry in the 1970's

Methodology for National R&D Programs
R&D for the Socio-Economic Environment of the 1970's
Technical Program Formulation--Today and Tomorrow
R&D Program Implementation
Evolution of Major R&D Program Methodology in Government

(The papers are cited individually in this issue of the Bulletin).

80. Hollomon, J. H., Address presented at the 1967 meeting of the National Security Industrial Association, Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp. 96-99.

The changing patterns of R&D are described in terms of funding sources, growth areas, and public attitudes. Significant shifts in the funding pattern include: the decline in funding by AEC, DOD, and NASA; increased funding by the private sector; rapid growth of funding for crime prevention, pollution, safety, education, etc.; and, increasing support by states and local communities for "the solution of problems that are local, municipal and regional rather than federal". As to change in attitudes toward R&D, the public is "beginning to have a lack of confidence in science"; "there is a clear trend that technology has been over-sold and that science has been sold to lead to direct development, rather than to what it is, the examination of questions important to mankind which occasionally and importantly lead to new developments". Industry is beginning to say "it isn't the research and development that is so important, it is the entrepreneur". The support of the engineering schools in universities by AEC, NASA, and DOD "has biased that support in a direction which to some degree does not reflect the needs of the nation". This and other factors are leading universities to ask: "Who runs our house? Do we run our own house or does someone else run it?"

81. Goodman, P., "R&D for the Socio-Economic Environment of the 1970's", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp. 187-191.

Essential goals for the 1970's are "reviving American democracy", rescuing "the majority of mankind from deepening poverty", and insuring "the survival of mankind". "These goals indeed require research and experimentation ... but not by you ... the military industrial." The "best service that you ... could

perform is rapidly to phase yourself out, passing on your relevant knowledge to people better qualified, or reorganizing yourselves with entirely different sponsors and commitments". Topics discussed include aid to undeveloped regions, disarmament, impact of the "military industrial" on the national economy, education, urbanism, and the "quality of man's environment". For each topic the author proposes "solution" and criticizes present approaches and policies, especially those involving the "military-industrial complex": for example, the "under-developed regions ... need an intermediate technology" tailored to local conditions that does not entangle "them in Great Powers struggles"; the "unbridled expansion" of military expenditures "has been the chief factor of social instability"; "electronics companies have ... tried to palm off teaching machines, audio-visual aids, and programmed lessons in excess of the evidence of their utility".

82. Waddington, D. H., "A British Perspective on American Science Policy", Science, v. 160, no. 3823, 5 April 1968, pp. 46-48.

The author, who was one of the four OECD "examiners" involved in assessing U.S. science policy, clarifies his appraisal in a series of comments, questions, and suggestions. The comments on U.S. policy include: the U.S. "has a well-developed system for formulating science policy"; the "machinery for putting science policy into operation is highly diversified"; the "project-grant system ... facilitates the rapid development of new areas"; the U.S. has not been successful in "maintaining a balance between subjects within the field of science as a whole"; and, the "social sciences are not represented in the main ... policy-making bodies". Questions addressed to the U.S. center around the "considerable duplication" of policy analysis and appraisal of the government, the possible effects of the "administrative linking of research to practice", the "reorientation of ... science toward Great Society projects", "greater support to ... social sciences", and how far "increased federal support of universities" is to go. A few suggestions are offered the European countries on how their science policies might be improved.

83. Freeman, C., "Science and Economy at the National Level", paper in Problems of Science Policy, Seminar held at Jouy-en-Josas (France), February, 1967, Organisation for Economic Co-operation and Development (OECD), pp. 55-71.

The author, Director of the Unit for the Study of Science Policy at the University of Sussex (England), considers the reasons why nations support science and concludes that primary motivations are military, national prestige, and economic, rather than "welfare" or science for science's sake. He suggests that resources should be allocated to R&D on a rational, cost-benefit analysis, with special consideration given to (1) the scale of the R&D activity, (2) the relation of the research to innovation, and (3) alternative methods of achieving the same objectives. The rationality of science-policy decisions can be improved by "the systematic collection of statistics on ... scientific manpower" and expenditures; but, the "difficulty in relating output to input" in R&D "is the biggest problem of science policy".

84. SSF Newsletter, Science of Science Foundation, London, v. 3, no. 2, February 1968, 12 pp.

The bimonthly Newsletter "is concerned with topics of interest in the field of the science of science", and includes activities of the Foundation, news, and reports dealing with science-policy matters.

85. Nelson, W. R. (Ed.), The Politics of Science, Oxford University Press, New York, 1968, 495 pp.

This collection of readings on the scientific enterprise and the political process consists of essays published between 1945-66, and is organized around six headings. Part I, "The Scientific Revolution", emphasizes "the growth of science and the new intellectual and material affluence of the scientific community". Part II, "Organizing for Science", discusses the need for " ... structural adaptations in the federal government ... to marshall, co-ordinate, and direct the official portion of the scientific effort". Part III, "The Management of Research and Development", is concerned with the " ... new systems of allocation and control (which) have been instituted. . .to make the most effective use of funds ... ". Part IV, "The Scientist as a Decision-Maker", discusses the "increased involvement of scientists and engineers in the decision-making process and in politics in general". Part V, "Science and Foreign Policy",

discusses the interrelationship between the scientific revolution and foreign policy. Part VI, "Government and the Future of American Science", is "an overview of the general position of science vis-à-vis government"; "the maker of public policy in the future will be called upon repeatedly to solve problems in which scientific and political considerations are inextricably intertwined".

86. Caldwell, L. K., (Ed.), Science, Technology, and Public Policy; A Selected and Annotated Bibliography, Volume 1, Prepared for the National Science Foundation, By The Program in Public Policy for Science and Technology, Department of Government, Indiana University, Bloomington, Indiana, 1968, 492 pp.

This is Volume I of a two-volume selective annotated bibliography on science policy prepared by the Department of Government, Indiana University for the National Science Foundation. "It focuses upon public affairs and public policies in relation to science and technology." Books, monographs and government documents on science policy which have been published in English over the last 20 years are included. The bibliography is organized around the following topical headings: Philosophy of Science; History of Science and Technology; Nature and Impact of Science and Technology; Science, Politics and Government; Science, Technology, and the Law; Science, Education, and the Universities; Scientific and Technical Personnel; Scientific Organizations and Institutions; Organization and Management of Research and Development; Science, the Humanities, and Religion; Science and Society.

87. Haskins, C. P., "Report of the President, 1966-1967", Carnegie Institute of Washington, January 1968, 86 pp.

About 30 of the first pages of this report deal with the broad issues and problems now confronting science and science policy. The several questions and topics discussed include: "What do we truly most wish to achieve in our current level of government support for science?"; the implications and significance of the slowing growth of government support to research, both in the U.S. and in other industrialized countries; the role of Congress and the Executive in setting the direction and magnitude of the nation's scientific effort; government-university relationships; and the need to deal with and prepare for the social changes created by scientific advances.

88. Spencer, D. L., and Woroniak, A. (Eds.), The Transfer of Technology to Developing Countries, Praeger Special Studies in International Economics and Development, Frederick A. Praeger, Publishers, New York, 1967, 209 pp.

The theme of this book "is the search for the optimum method of transferring technology". This work is "organized in eight chapters to cover topics which seem essential for examining the concept of transfer of technology, its utility as a research tool, and its operational potentiality". Its content includes:

Retrospect and Prospect	J. J. Murphy
Economic Theory and Transfer of Technology	J. Kmenta
The Schumpeterian Theory and Continental Thought	E. Salin
The Socio-Economic Variables	B. F. Hoselitz
Transfer of Technology Simulation Studies	M. Shubik
Training and Human Capital	N. W. Chamberlain
The Strategy of Transfer	I. Svennilson
Summary: Discussion of Issues and Controversies	D. L. Spencer and A. Woroniak

89. Reviews of National Science Policy: United States, Organisation for Economic Co-operation and Development, Paris, France, 1968, 546 pp.

The science policy of the U.S. is reviewed and appraised by an OECD "Team of Examiners". The first section of the report, covering some 350 pages, provides descriptive background information on the scope and magnitude of R&D in the U.S., the roles of the President and of Congress in science policy, the formulation and implementation of the scientific effort, and the national and international impact of U.S. science. The next section presents the individual reports of the four examiners, and the account of the confrontation meeting between OECD and U.S. representatives. Issues and questions raised in the confrontation centered on "science policy proper" (mechanisms for formulating and implementing policy and the policy orientations), science policy and academic research, science policy and industry, and the political, economic, and social impacts. General conclusions on U.S. policy include: "what is conveniently called science policy, does not have the same aspect on both sides of the Atlantic, the magnitude of the resources deployed in the United States leading to a real change of character in its concepts, aims and implementation"; "science policy proves to be so manifold in its

means and effects that it is better to speak in the plural"; and, in the U.S., "science is no longer an isolated aspect of human activity but the essential instrument for accomplishing the aims of a society".

90. Hall, C. C., "Science's Place in the Political Spectrum", Technology Review, v. 70, no. 5, March 1968, pp. 6-7.

This is a brief account of a portion of the sessions devoted to science policy during the 1967 annual meeting of the American Association for the Advancement of Science. Attention is confined to a discussion of Herbert Roback's paper on "The Role of Congress" in national science policy, and to a "recapitulation of the unstructured Workshop on Science and Public Policy" convened by Eugene Skolnikoff.

91. "Science Policy Information 4", Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, 215 pp.

Science policy news, information, and abstracts from OECD countries and international programs. A new feature is the inclusion of brief, original articles.

92. Problems of Science Policy, Seminar held at Jouy-en-Josas (France), February 1967, Organisation for Economic Co-operation and Development (OECD), Paris, France, 1968, 195 pp.

Proceedings of a seminar held at Jouy-en-Josas (France), 19-25 February 1967. The purpose of the seminar was "to provide material from a number of experienced people in this field and to make possible an exchange of views on the application of science to the formulation and implementation of public policy between administrators concerned with such policy and academic research groups". Contents include:

Keynote Address	Lord Bowden
Institutional Aspects	J. -J. Salomon
Science and Economy at the National Level	C. Freeman
Science and Economy at the Level of the Firm	M. Ponte
Some Implications for Government Policy	K. Pavitt
Can Science be Planned?	H. Brooks
Technological Forecasting--A Tool for a Dynamic Science Policy	E. Jantsch
Forms of Co-operation	L. Villecourt
Science and Underdeveloped Countries	C. Cooper

93. Dessauer, J. H., "R&D in Industry in the 1970's", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp. 159-169.

This paper discusses some of the "constants" of industrial R&D and the changes that they will bring about in the 1970's. The constants cited are: the "consumer orientation of industrial research"; the need for innovative, entrepreneurial-oriented research personnel; and "the important role in R&D which will be played by small companies". In order to preserve the consumer orientation of R&D, management will demand a better selection process and a stiffer accounting of results from R&D programs. To insure the existence of small research companies, such companies must be aided in finding intermediate products which can produce revenue to continue their research. In addition, government funding should be used in the 1970's as a technique of protecting the small and medium sized companies from being swallowed up by the big companies.

II SCIENCE, DOMESTIC PROBLEMS, AND NATIONAL GOALS

62. Ramo, S., "The Systems Approach: Automated Common Sense", Nation's Cities, v. 6, no. 3, March 1968, pp. 14-15, and 18-19.

> The systems approach to large social problems--air and water pollution, traffic congestion, urban decay--will ultimately be the key to their alleviation. But, before this approach can be effective in the public sector, "new arrangements of society" are required: "What is needed is an inter-acting arrangement of people and things, of material and information flow for which there is little precedence". The need for such a "social invention" is illustrated by the issues that would arise from an effort to eliminate "a regional smog problem". The author concludes that the systems approach is "probably going to be applied very rapidly on an increasingly larger scale, but probably 10 years will pass before" science and technology are fully applied to "the area of social engineering problems". This time delay reflects both the need for society to mature in its appreciation of the systems approach, and the shortage of "really good systems engineers".

63. "Setting Environmental Criteria", Industrial Research, v. 10, no. 3, March 5, 1968, p. 12.

> Hearings held by the House Subcommittee on Science, Research & Development revealed the lack of technical information for setting criteria and standards for air quality, and a fragmented and competing federal structure for initiating the required R&D. The co-ordinating organizations involved in the area are cited and their roles briefly described; these include the Committee on Environmental Quality (with several sub-committees) within the Federal Council on Science & Technology, and a planned Panel on the Environment under the President's Science Advisory Committee. Although organizational problems dominated the House hearings, it was noted that "technical uncertainties hamper the development of criteria for air quality". "The standards for air quality cannot be set until both criteria and knowledge of ... control technology are available." "Such technical information does not now exist."

64. "Office of State Technical Services--Annual Report, Fiscal Year 1967", U.S. Department of Commerce, U.S. Government Printing Office, Washington, D.C., 1968, 108 pp.

This second annual report describes the activities and accomplishments of the Office of State Technical Services (OSTS), which is designed to "promote commerce and encourage economic growth by supporting State and interstate programs to place the findings of science usefully in the hands of American enterprise". For fiscal year 1967, planning grants and state program grants accounted for almost $4.5 million of the appropriated OSTS budget of $5.5 million. Over 150 areas of technology were the subjects of projects, with computer applications, field services, information services, and management technology among the most common areas. State activities, program staff, expenditures, and descriptions of specific projects carried out in each participating state are tabulated.

65. Macy, B.W., Bednar, J.M., and Roberts, R.E., "Impact of Science and Technology on Regional Development", U.S. Department of Commerce, U.S. Government Printing Office, Washington, D.C., December 1967, 168 pp.

This study is "a survey to identify what is known about the impact of science and technology in regional development and to identify those facets of the subject area about which our knowledge appears limited". The report, in addition, presents a discussion of different approaches to stimulating regional economic development, and the "characteristics and conditions necessary for each"; among the topics considered are the role of education, technical assistance, planning and promotion, financial-assistance schemes, and sites for science and industry. An annotated bibliography of some 100 items is included.

66. "Program Environmental Quality Control", U.S. Congressional Record, U.S. Senate, Ninetieth Congress, Second Session, v. 114, no. 17, Tuesday, February 6, 1968, pp. S959-S963.

Excerpts from ten articles and reports "describe various needs and ongoing programs and ... propose several new solutions for achieving better controls over environmental change". This material was compiled by the Legislative Reference Service as background for forthcoming hearings on Senate Bill 2805, which would establish a Council on Environmental Quality in the Executive Office of the President.

67. Carlson, J.W., (Chairman), Cost Sharing With Industry, A report of a working committee on the Federal Coordinating Committee on the Economic Impact of Pollution Abatement, November 20, 1967, 37 pp.

This report is a study of the government assistance needed by industry for abating air and water pollution. The study was prepared by the Working Committee on Economic Incentives of the Federal Coordinating Committee on the Economic Impact of Pollution Abatement. The report concludes that the "average additional annual cost caused by higher levels of pollution abatement are ... significant but relatively small for all manufacturing firms". Moreover, Federal assistance to industry is already sizable and is growing especially in the area of R&D intended to lower abatement costs. Therefore the need ... of additional assistance for industry should be judged on the basis of hardship or burden on particular industries, firms or plants ... caused by abatement actions rather than on the burden to industry as a whole."

68. Rittenhouse, C.H., "The Transferability and Retraining of Defense Engineers", Prepared for U.S. Arms Control and Disarmament Agency, ACDA/E-110, U.S. Government Printing Office, Washington, D.C., November 1967, 126 pp.

The objectives of the study are " ... to identify and describe any special barriers to the transfer of engineers from defense to commercial work and to identify and evaluate retraining and reorientation techniques that will aid in easing the transfer". The report consists of a summary and analysis of data obtained from self-administered questionnaires from 2,100 engineers and 100 managers in 14 industrial companies. Over 20 conclusions are extracted from the data, including: "Individuals are transferable, particularly if they can be brought gradually into a functioning commercial unit so that they can learn on the job by absorption"; and, "Among those engineers who had experienced transfers, more than three out of five felt that defense-to-commercial transfers were about equal in difficulty to other kinds of transfers they had made".

69. "Water Pollution Control, 1969-1973", Report to the Congress, U.S. Department of the Interior, Federal Water Pollution Control Administration, Washington, D.C., January 1968, 70 pp.

"This report outlines an optimum program to meet the Nation's pollution control needs over the next five

years", and estimates the cost of carrying out the provisions of the Federal Water Pollution Control Act. Some of the elements of the program include: "a waste treatment facilities construction grant program", "stimulation and support of State and interstate water pollution control agencies", "establishment and maintenance of water quality standards", a vastly increased training effort for skilled manpower, and "an accelerated research effort to develop improved or new techniques to combat water pollution". The estimated total cost of the program through 1973 is about $3.3 billion, with almost $2.5 billion going to grants for construction.

70. "Incentives to Industry for Water Pollution Control: Policy Considerations", For the Federal Water Pollution Control Administration, Department of the Interior, Washington, D. C., Contract No. 14-12-138, Prepared by ABT Associates Inc., Cambridge, Massachusetts, December 1967, 119 pp.

This report, is "an examination of alternative possible approaches for providing incentives to industry to comply with the pollution abatement standards being created under the Water Quality Act of 1965 and the Clean Water Act of 1966. The report, prepared for the Federal Water Pollution Control Administration of the Department of Interior, focuses on the policy issues connected with the abatement of pollution due to organic and inorganic material generated by manufacturing industry. It concludes that simple "administrative regulatory rules do not seem adequate to deal with the problem"; "general incentives to firms of the sort usually considered seem unlikely to affect the amount of pollution control investment undertaken". "The answer ... is regional or river basin treatment authorities of various forms. Only this change in orientation and focus in the nation's pollution control efforts will produce abatement in an efficient and equitable manner."

71. "Can We Keep Pace With Technology's Fallout?", Nation's Cities, v. 6, no. 3, March 1968, pp 9-12.

An interview with Sen. Edmund S. Muskie (D-Maine) focuses " ... on the rapid technological changes currently taking place in our society and the needed municipal government responses to such changes". The origin, outcome, and efforts to establish a select Senate Committee on Technology and the Human Environment are discussed. The Committee would focus on the following areas: (1) future need for a new federal department of environmental health, (2) possibility of channeling federal R&D funding into urban technology, (3) the slow

process of using new technology to deal with urban problems, (4) no ready market for urban technology, and (5) danger from "lack of real comprehension of technological developments on the part of citizen leaders and ... elected officials ... (that) could lead to an undue reliance on the technicians and the scientists".

72. "Science and Local Problems", Science, v. 159, no. 3818, 1 March 1968, p. 960.

"A 1-year project designed to promote the use of science and technology in solving state and local problems" will be supported by NSF and the Southern Interstate Nuclear Board--"a nonfederal publicly supported advisory and developmental agency for nuclear and space fields". Part of the program will include a conference in Louisville, Kentucky in mid-September to assess the role of science and technology in local affairs. Federal, state, and academic representatives from a number of disciplines, including, science, technology, planning, and health will participate.

III NEEDS AND ALLOCATION OF RESOURCES FOR SCIENCE

50. "New, Hard Look at Scientific Manpower Gets Underway", Scientific Research, v. 3, no. 6, March 18, 1968, p. 21.

A Department of Commerce panel was formed in March "to take a hard look at the nation's scientific and technical manpower problems, to determine the mismatch between supply and demand of professionals and the effects of federal policies on these variables". Specific goals of the panel are to: (1) "establish whether federal support of science and engineering education is adequate, well-balanced and viable"; (2) " ... investigate whether new curricula are emerging fast enough to keep up with new technologies"; (3) " ... outline an appropriate federal role in providing manpower for growing and changing professions and technologies, and for new disciplines ... as they come into existence". Among those already accepted for the panel are: Philip M. Hauser, University of Chicago; Roy Wooldridge, Northeastern University; Herbert E. Carter, University of Illinois; and Dael Wolfle, executive officer, AAAS.

51. "Johnson Pulls R&D Down to Earth", Business Week, no. 2007, February 17, 1968, pp. 94-96.

"The President has stalled (the) upward path of R&D spending, shifting emphasis from space to more earth-bound problems." Reasons cited for the spending pause include: " ... the White House and Congress have become more demanding of visible results on the part of scientists"; increasing effort is being made to match "research to broad national goals" on a cost-effectiveness basis; and, the "concept of the federal government's role in R&D" is being altered. "All of this will have important consequences for the future of research and for the men engaged in it." "For universities, the outlook ... is for tighter belts." "For industry ... it will probably mean an influx of researchers from the campuses to fill long-standing vacancies in the job market." The "government will welcome the shift", according to Dr. Hornig, who is also quoted as stating that "we need not accept the idea that the federal government is obliged to operate a permanent WPA for these highly trained people". The growing emphasis on social problems and the social sciences "means that R&D-oriented sections of industry will have to adapt to some unfamiliar partners and territory"; here, "social and

political barriers may hamper companies trying to introduce new ... technology in fields such as education and pollution". "And some of the research the federal government says it needs may not appeal to industry at all."

52. Green, J. H., "Projection of Government R&D in the 1970's", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp. 17-21.

Government support of R&D will continue to grow and is likely to reach a level of $30 billion per year in the mid 1970's, but a gap will continue to exist between what the researcher would like to do and what he can do. However, the real constraint on R&D in the 1970's is likely to involve a shortage of trained personnel and a lack of well-defined programs, rather than a lack of funding. Increasing R&D efforts are anticipated in the areas of crime control, urban inaccessibility, pollution control, transportation, education, and public health. Although these needs are "being recognized", there has not yet been a "substantial and basic shift of emphasis" in our R&D toward these areas.

53. Cote, A. J., Jr., "The Up-and-Down R&D Budget", Industrial Research, v. 10, no. 3, March 5, 1968, pp. 11-12.

"Federal R&D obligations for the 1969 fiscal year ... will be $17.8-billion, up 5.3% from FY 1968; expenditures will reach $17.3-billion, up 4.8% over last year." "The budget offers the first clear indication of the impact of last session's congressional cutbacks on federal R&D. Despite feeling on the part of some House leaders that R&D was a prime prospect for cuts, those agencies which had a choice did most of their trimming elsewhere". The proposed budget boosts support to universities by 13% to $1.64 billion, by 15% for oceanology (up to $516 million), and by about 5% for both medical and water research. Some "important new directions" include pollution ($250 million), educational research ($164 million), transportation ($148 million), post office research ($36 million), and housing & urban development ($20 million). "Appraising the R&D funding package as a whole, Hornig sees the 'level-of-effort' being maintained with facilities bearing the brunt of the squeeze." "How Congress will view all of this remains to be seen."

54. Westheimer, F. H., "Chemistry: Opportunities and Needs", Scientific Research, v. 3, no. 4, February 19, 1968, pp. 24-26, 28, and 30.

The National Academy of Sciences released a report in 1965 on basic research in chemistry that called for increased federal funds for university research and departmental grants for young researchers. The chairman of the committee that prepared the report assesses the present opportunities and needs in chemistry, and concludes that: (1) although funding has increased in the interim, the level of support still falls far short of that recommended, (2) departmental grants are even more urgently needed now, and (3) more basic research is needed to bolster the lagging chemical industry.

55. Boffey, P. M., "Scientists' Travel Abroad: 25 Percent Cutback in Federal Funds Imminent", Science, v. 159, no. 3819, 8 March 1968, pp. 1080-1081.

"Federal funds for scientific travel abroad will be cut back sharply ... as a result of President Johnson's drive to curtail foreign travel as a means of reducing the U.S. balance-of-payments deficit." A "presidential memorandum, issued 18 January, ... directed all federal departments and agencies to 'reduce U.S. official travel overseas to the minimum consistent with the orderly conduct of the government's business abroad'". The Bureau of the Budget later established a 25-percent reduction as the objective for each agency. Travel by contractors and grantees is to be reduced also, but no percentage amount has been set. Agencies will determine their own treatment of contractors, fellowship holders, and grantees. In general, HEW, NASA, and the AEC are expected to pursue stricter policies than will the Office of Naval Research and the Air Force, while NSF policy will be intermediate between them.

56. "1969 Academic Research Budget Increases Barely Seven Percent", Physics Today, v. 21, no. 3, March 1968, p. 81.

This brief article reviews the main features of the proposed budget for 1969, with special reference to academic support for physics. For the university: (1) Higher education construction grants declined from $307.5 million in fiscal 1968 to $225.6 million in fiscal 1969; "fellowship programs either remained static or declined" ... the only new construction item in the entire budget is $25 million for the 200-GeV accelerator. (2) DOD's Project Themis (supporting mission-oriented university research) increased from

a base of $17.6 million to $36 million. For agency programs: (1) AEC operating expenses for its physical research program are $280 million, $15 million over 1968--"an increase is expected to cover the usual accelerator improvements", but not the Omnitron, the Brookhaven bubble chamber, or Stanford's 3-GeV storage rings. (2) NSF funds came to $500 million (same as last year), plus $27 million deferred from 1968; basic research grants jumped from $172 million last year to $198 million in fiscal 1969, while institutional program support decreased slightly, and fellowship and traineeship programs remained static. (3) "NASA funds for its university program are limited to $10 million (decreased from $46 million in 1966), while its physics and astronomy programs reserved $141.9 million as opposed to $142.9 million in 1968.

57. "DOD Asks Congress to Leave Basic Research Funds Intact", Chemical & Engineering News, v. 46, no. 9, February 26, 1968, p. 14.

DOD is asking $450 million in fiscal 1969 for the basic research program while warning Congress "that the long-range defense posture faces a 'serious weakening' unless increased funds are provided" for basic research support. J. S. Foster, Jr., director of Defense Research and Engineering, testified before Congress that (1) "action must be taken to reverse the recent downward funding trend because ... DOD may begin to run the risk of not meeting its genuine technological goals", (2) "the cost of doing research has steadily increased at least 5% a year", (3) the recent decline in DOD and other federal agencies' support to universities will eventually "cripple the nation's technological position" by curtailing postdoctoral fellowships and reducing the number of technicians and supporting staff. Dr. Foster also appealed to Congress not to cut the 1969 Project Themis' request for $35 million.

58. "International Biological Program: U.S. Effort Stands on Shaky Ground", Science, v. 159, no. 3821, 22 March 1968, pp. 1331-1334.

"American participation in the 50-nation International Biological Program (IBP) ... stands on shaky ground--organizationally and financially, according to a report by the House Subcommittee on Science, Research, and Development." "Four major difficulties" stand in the way of a successful U.S. endeavor, including (1) "loose" administration, resulting in a "difficulty in identification of the areas for research", (2) "an inadequate and unrealistic mode of funding", with monies dispersed by several separate agencies, (3) "a

shortage of trained ecologists" due to a "lack of response from the biological fraternity in general", and (4) a "lack of concern for the program on the part of the public, the Congress, and the executive branch". The Subcommittee recommends that: (1) a third of the money needed should come from state, local, and private, rather than federal sources; (2) that the federal government "provide financing of $3 to $5 million from its contingency funds for fiscal year 1969", and (3) a "firm commitment to support the IBP to the maximum feasible extent" be given.

59. "The '69 Budget: A Study in Contradictions", Scientific Research, v. 3, no. 3, February 5, 1968, pp. 13-14.

"The fiscal '69 science budget", according to the President's science advisor Donald F. Hornig, "carries no dramatic increase in federal monies for research but ... permits some true growth in the face of a budget crisis". "It budgets a record $6 billion for basic and applied research", including $25 million toward the Weston, Illinois accelerator, and a 13% increase in funds for university research". The budget represents an "attempt to get overall federal research spending back to at least 5% per year rate of growth". An agency-by-agency breakdown reveals: (1) an NIH budget "up by $75 million--to $1.2 billion", with the number of project grants down, (2) an NSF request of $527 million, with "a 15% increase ... in basic research project grants ... at the expense of research facilities and equipment and institutional grants", (3) an AEC request for the full $250 million authorization for the Weston accelerator, (4) an "austerity" program at NASA with all research construction deferred and and the sustaining university program funded at $10 million", and (5) a Defense "comeback" from $1.4 billion in '68 to $1.6 billion in '69.

60. Niblock, R. W., "President Asks $81.5 Million for DSSP R&D", Aerospace Technology, v. 21, no. 20, March 25, 1968, pp. 28-29.

"The fiscal 1969 budget request for the Navy's Deep Submergence System Project, the primary research and development effort in the Federal oceanology program, is $81.5 million, a $9.3 million increase over the previous fiscal year." Although this budget has risen while many other non-Vietnam efforts were being cut back, "the new budget is less than required to keep the deep submergence program moving at its intended pace". The primary impact of funding limitations will fall on development of a Deep Submergence Search Vehicle and the Large Object Salvage System. The article also summarizes other aspects of the report--"Marine Science Affairs--A

Year of Plans and Progress"--of the National Council of Marine Resources and Engineering Development.

IV NATIONAL R&D PROGRAMS

49. "Research in the Service of Man: Biomedical Knowledge, Development, and Use", Conference sponsored by the Subcommittee on Government Research and the Frontier of Science Foundation of Oklahoma, for the Committee on Government Operations, (Oklahoma City, Oklahoma, October 24-27, 1967), U.S. Senate, Ninetieth Congress, First Session, Document No. 55, U.S. Government Printing Office, Washington, D.C., 1967, 246 pp.

This conference was co-sponsored by the Subcommittee on Government Research and the Frontiers of Science Foundation of Oklahoma for the Senate Committee on Government Operations. It was called "to discuss what areas of biomedical knowledge might be exploited to provide additional benefits to the nation, and the implications of a policy directed toward greater attention to applied medical research". The collection of 28 papers contains a wide variety of specific recommendations for identifying and implementing national goals in biomedical research. Among the papers of special relevance to science policy are:

Application of Biomedical Knowledge, The White House View: Ivan L. Bennett, Jr.

The Public Stake in an Accelerated Program of Applying Biomedical Knowledge: Gerard Piel

Prospects for Big Biology: Alvin M. Weinberg

The Federal Establishment for Science and Technology: Contribution to New National Goals: Harvey Brooks

NIH--Present and Potential Contribution to Application of Biomedical Knowledge: James A. Shannon

50. "Physics Information System Initiated", Aerospace Technology, v. 21, no. 17, February 12, 1968, p. 4.

"A national, computer-based information system covering physics and astronomy will be established this year by the American Institutes of Physics." An initial $239,000 of a projected $1.18 million grant has been funded by the National Science Foundation. "The proposed information program will include the creation of a classification system for

information searches and automated index production, developing search strategies through computer retrieval, evolving a computer composition program using magnetic tape for physics journals ... and constructing a network of physics information exchange."

51. "Space Applications Summer Study", 1967 Interim Report, Volume 1, Report of the National Academy of Sciences, Published by the National Aeronautics and Space Administration, U.S. Government Printing Office, Washington, D.C., January 1968, 65 pp.

The benefits to be obtained from practical space applications appear to be much larger than the cost of achieving those benefits. This conclusion is one of several reached by a Central Review Committee of the National Academy of Sciences after a study of those aspects of space technology which showed the most promise for practical benefits. Other important conclusions of this study are that the "international development of useful satellites presents an array of remarkable opportunities, public and private, and that there exist areas in which great benefits might be obtained from satellite systems, but no organizations now exist that could create and operate such systems. Because the potential impact of new space systems is so large, the "assimilation and exploitation of new technology raises questions of national and international policy, as well as problems of industrial economic interest, which must be faced squarely".

52. Wenk, E.,Jr., "Marine Science Affairs: Impetus and Promise", Defense Industry Bulletin, v. 4, no. 2, February 1968, pp. 7-10.

Dr. Wenk, the Executive Secretary of the National Council on Marine Resources and Engineering Development, describes the federal government's approach to marine science following the passage of the Marine Resources and Engineering Development Act of 1966. He emphasizes the new initiatives which have been taken toward food-from-the-sea, deep ocean engineering, oceanographic data, Sea Grant colleges, and sub-polar oceanographic research. Organizational arrangements for administering marine-science research are briefly discussed with the conclusion that the Council is striving to make the total marine science effort "more than the previous sum of the parts" through Presidential and Vice-Presidential leadership in providing goals,

minimizing the effects of duplication, and by taking "advantage of fresh ideas that may have in the past filled in the gaps between agencies".

53. "Hearing to Air U.S. Planetary Objectives", Chemical & Engineering News, v. 46, no. 8, February 19, 1968, pp. 32-33.

"The Administration's new planetary exploration plans are scheduled to undergo searching analysis" by the House Science and Astronautics Committee's Subcommittee on Space Science and Applications. Critics of the plans "charge that the proposed new program lacks imagination and ... relegates the U.S. to begin 'last with the least vis-à-vis the Russians in the meaningful exploration of the planets'". Originally, the Voyager program was planned as a ten-year, $2.4-billion effort that would be the main U.S. unmanned program to explore the planets. But, Congress "failed to appropriate any part of the $71.5 million the Adminstration had requested ... for ... 1968". In Voyager's place, the Administration is now proposing a much more modest effort of $500 million that concentrates on Mars. Since the U.S.S.R. is expected to land an instrument package on Mars next year, it is argued by Rep. Joseph Karth (subcommittee chairman) that our planetary efforts should be directed toward Jupiter and Mercury.

54. "Major Design Problems Delay Boeing SST", Aviation Week & Space Technology, v. 88, no. 9, February 26, 1968, p. 25.

"Major design complications of the Boeing 2707 supersonic transport have caused at least a one-year delay in the prototype development program, pushing the first flight back from about the end of 1970 to, perhaps, early 1972." "One factor in the stretch-out is believed to be Boeing's growing conservatism about how long it would take to overcome the challenges of building such an advanced aircraft." "Despite the strong assertions that politics played no part in the latest schedule slip, one airline source contended that the progress could be speeded up if more funds were readily available."

55. "National Marine Sciences Program", Hearings before the Subcommittee on Oceanography, of the Committee on Merchant Marine and Fisheries, U.S. House of Representatives, Ninetieth Congress, First Session, Part 1, (August-December 1967), U.S. Government Printing Office, Washington, D.C., 1968, 509 pp.

These hearings were scheduled to review the status of the national marine sciences program. Dr. Edward Wenk, Jr., the Executive Secretary of the Council, opened the testimony with a general overview of federal activity in marine science. Following this, witnesses from various federal departments and agencies involved in marine science described their plans and programs in detail.

56. U.S. National Council on Marine Resources and Engineering Development, Marine Science Affairs: A Year of Plans and Progress, Second Report to the Congress on Marine Resources and Engineering Development, U.S. Government Printing Office, Washington, D.C., March 1968, 228 pp.

This report presents a comprehensive survey of federal policies and programs in marine science. Among topics discussed are: government organization for marine science; international cooperation in marine science; accelerating use of food from the sea; military oceanographic programs; the state of oceanographic data and information management; current research activities; and the proper relationship between the federal government and private and other public institutions in marine science activities. Both the discussion in the text and accompanying tables show in detail the President's FY 1969 budget request for marine science activities. In a brief message transmitting the report, President Johnson called for increased research in marine science and greater international cooperation in the exploration and use of the oceans.

57. "Apollo Applications Cut", Aviation Week & Space Technology, v. 88, no. 10, March 4, 1968, p. 21.

The Apollo Applications Program (AAP) funding for fiscal year 1969 was cut by $44 million by the Subcommittee on manned space flight. NASA, operating with a $253.2-million budget for AAP in 1968, had requested $439.6 million for 1969. The subcommittee also reduced the requested 1969 budget "for the Apollo lunar program by $13.8 million, from $2.038 billion", and "halved the request for advanced manned mission studies, to $2.5 million". Total cuts in manned-space-flight R&D of $60.3 million reduced the overall NASA request to $2.42 billion.

58. Normyle, W. J., "Space Budget Faces Hurdles in Congress", Aviation Week & Space Technology, v. 88, no. 12, March 18, 1968, pp. 123-125, 127, and 129-130.

"U.S. space budget is being held within lower limits than anticipated last year, and almost all programs except those involving previous commitments to manned flight are affected. Even the strongest supporters of space exploration believe that the conservative trend will continue and that spending may be reduced further." This report reviews the trends and prospects for the overall U.S. space budget. The 1969 expenditures are estimated at $6.8 billion, with NASA accounting for $4.5 billion and DOD $2.2 billion. The Apollo request of $2.03 billion for 1969 is not expected to be drastically cut by Congress, but a "hefty reduction is forecast" for the Apollo Applications program.

59. Doctors, S. I., "Transfer of Space Technology to the American Consumer: The Effect of NASA's Patent Policy", Reprinted from Minnesota Law Review, v. 52, no. 4, March 1968, Minnesota School of Law, pp. 789-818.

This report describes and analyzes NASA's patent policy in relation to its technology-transfer program, and recommends certain policy changes aimed at enhancing the transfer process. A "patent policy may influence ... technology transfer ... in one of two alternative ways. A liberal ... policy--one that allows ... contractors to retain title to ... patentable inventions discovered in the course of government sponsored research ...--may act as an incentive to ... disclose inventions to the government". "Such reporting may be termed the 'input' function in ... technology transfer." "On the other hand, a 'strict title' policy--one in which the government retains title to any patentable inventions--frees the device for all to use." "This may be termed patent policy's influence on the 'output' function in ... technology transfer." Conclusions and recommendations include: NASA's patent policy emphasizes the reporting of inventions more than it fosters the utilization of such inventions by other segments of the economy; advance waivers should be abolished, and waivers on individual inventions should be granted only where the "contractor has the requisite commercial position or an intent to commercialize the innovation"; NASA's patent policy would be more effective if it placed greater emphasis on the output function; and, the patent policy should be revised so as to be more consistent with the aims of NASA's technology-transfer program.

60. "Aeronautical Research and Development Policy", Report of the Committee on Aeronautical and Space Sciences, U.S. Senate, Ninetieth Congress, Second Session, Senate Report No. 957, U.S. Government Printing Office, Washington, D. C., January 1968, 28 pp.

This report presents the Committee's findings from hearings in 1967 on aeronautical R&D policy. It discusses such issues as (a) the adequacy of present research in aeronautics, (b) whether NASA should continue to have responsibility for some aeronautical research, (c) how research costs should be shared between government and industry, (d) procedures for relating aeronautical research to overall transportation policy, and (e) government responsibilities for air safety research. The report concludes: "There is general agreement that more R&D ought to be done, but there is a wide divergence of view on what and how much should be done, who should do it, and who should pay for it."

61. "The Research Grant Program of the National Institute of Mental Health", U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 1620, U.S. Government Printing Office, Washington, D. C., 1967, 28 pp.

"A 'Sourcebook of Descriptive Data', which described ... the content and execution of the National Institute of Mental Health research grant program, was published in fiscal years 1961 and 1964. This third edition of the sourcebook is limited to the major dimensions of the research grant program--including the type of sponsoring institution, the geographic distribution of awards, the discipline of principal investigators, and the primary research areas of the projects. The purpose of the document is to provide supplementary data to the two more extensive descriptions of the program published previously. The descriptive text accompanying the tables provides an overview of the kinds of research supported in fiscal year 1965 and describes differences in similarities in fiscal years 1964 and 1965."

V SCIENCE, EDUCATION, AND THE UNIVERSITY

40. "Donald F. Hornig and Science Funding", Scientific Research, v. 3, no. 6, March 18, 1968, pp. 40, and 42-46.

> This article is a report of an interview with Dr. Hornig on "the federal role in financing research". "In his view, the U.S. is merely taking a breather after a period of almost galloping growth in the federal investment in science--and, therefore, adjustments, some of them painful, are inevitable." Hornig "feels there has been an overreaction to the recent cuts in federal research budgets": "There hasn't been any cutback in basic research until now" and the reduction now is only a few percent. "The problem ... derives from the drastic cuts by Congress in the NASA and Defense Dept. budgets ... people who have gotten support from ... these agencies may find the budget pinch much more severe than others." As to the situation in the universities: " ... no information ... identifies any crisis situations ... or ... indicates a threat to the number of science students the universities can take care of". "By far the highest priority problem, and the one we will protect at all costs, is the training of the next generation of scientists."

41. Stever, H. G., "Trends of Research in Universities", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp. 29-33.

> Research in universities is so fundamental to higher education that it will "grow in direct proportion to the growth of higher education". The "upsurge of interest in the social sciences ... will be a major change in the research patterns" of the future. Associated with this change of interest is an expected decline in the rate of support of the physical and life sciences. Another change predicted is "that a larger number of universities will participate in research activity", because of the influx of research-oriented graduates into the smaller schools.

42. Chambers, C. C., "Federal R&D in the Universities in the Future", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D. C., 1968, pp 153-156.

> We "can look forward to a need for twelve to fifteen percent of the total R&D resources for use in our

universities in order to supply the personnel needs of the R&D industry". "This is in contrast to a present figure" of about "five percent". Although basic research will predominate as part of the technical education, "mission-oriented research should be included in their repertoire of research" experience in order to produce "highly motivated individuals for the R&D industry". To satisfy the educational requirements, "there should be one faculty member engaged in graduate work ... for every seven or eight professionals working in all of our R&D institutions.

43. "Indirect Effects of Federal Budget Cut Starting to Pinch U.S. Universities", Scientific Research, v. 3, no. 3, February 5, 1968, p. 15.

Ramifications of the reduced budgets for research are now showing up throughout the university scientific community. These include a retardation in laboratories and graduate programs, a shift in field and physical location for many research scientists, an increase in undergraduate teaching loads, an increase in applications to private foundations, and an increase in the use of large block grants, institutional and regional grants. Previous high funding levels in the biological sciences is expected to cushion the effects of present reductions, while funding for the physical sciences may decline by five percent or more from the present level. Concurrent with funding reductions are cutbacks in personnel ordered throughout the federal government, which are expected to delay the processing of grants and to increase the number of grants controlled by the universities themselves.

44. "Change IDA or Leave? Two Universities Act", Scientific Research, v. 3, no. 6, March 18, 1968, pp. 13-14.

"A university retreat from direct association with the Institute for Defense Analysis (IDA) has begun." A special faculty committee at the University of Chicago, one of IDA's 12 member-universities, has recommended complete separation from IDA. At Princeton, a similar faculty committee urged changing the IDA structure to one in which the universities are no longer responsible for its management and activities. Failing such action, the committee recommended that Princeton completely sever its relation with IDA. G. J. F. MacDonald, IDA executive vice president, has indicated that these actions "could" trigger other withdrawals, but "withdrawal of one or two universities is not a decisive factor". He is also quoted as saying that IDA "would wish to continue to operate with university sponsorship".

45. "Foreign Scientists Urge U.S. End Classified Work on Campuses", Chemical & Engineering News, v. 46, no. 6, February 5, 1968, pp. 19-20.

A statement signed by more than 400 French and Japanese scientists urged "an end to military and secret research in universities on the basis of ethical and professional responsibilities". Laurent Schwartz, professor of mathematics at the University of Paris and president of the Comité Nationale Vietnam (an active anti-Vietnam war group), is organizer of the single-page statement. Not only does the statement express active opposition to the war, but it also threatens that " ... continuation of military activities in American universities (will) ... lead world scientists and universities to interrupt their relations with universities engaged in military research", and this would be the ruin in international scientific exchanges. Albert Kastler, Shanichiro Tomonaga, Hideki Yukawa--all Nobel Prize winners in physics--were among the many prominent scientists who supported the statement.

46. "Ideas for Higher Education", Science News, v. 93, no. 7, February 17, 1968, p. 157.

"President Johnson's proposals for education this year substitute ideas for funds." Money is being sought for student loans with the help of states and banks--at the expense of university construction programs. The Administration's plan is to: (1) encourage all states to guarantee commercial bank loans to students, (2) provide $52 million to upgrade programs in 100 middle-quality institutions which show excellence in limited fields, (3) provide $8 million for "Networks for Knowledge", a plan to encourage resource sharing among institutions.

VI SCIENCE MANAGEMENT AND POLICY-MAKING BODIES

61. Roback, H., "Role of Congress in R&D Allocations", paper presented at the 1967 Meeting of the American Association for the Advancement of Science, New York City, December 28, 1967, 28 pp.

This address, by a staff administrator of the House Committee on Government Operations, describes the role and activity of Congress with respect to R&D, and discusses some proposed changes in the way Congress might deal with science and technology. Included is a description of the funding process (some 13 or 14 appropriations subcommittees in each house are involved with R&D), the annual authorization and appropriation process, the review and investigative function of Congress, and the significant role of personalities ("Whether a ... chairman is strong or weak, liberal or conservative, interested or inactive, makes a big difference to the legislative result"). As to possible changes in the future, Roback advises against the development of a "corps of technical experts on the Hill", attaching scientific advisors to Congress, or establishing coordinating mechanisms for R&D within Congress. However, "better integration of committee activities on the congressional side possibly could be achieved if a Department of Science and Technology were created".

62. "Shannon a Winner in HEW Reorganization", Scientific Research, v. 3, no. 3, February 5, 1968, pp. 23-24.

A proposal has been made to reorganize HEW's structure to incorporate all of NIH, except for The National Institute of Mental Health, under the new Research and Education Administration. The other proposed health administrations are Consumer Protection and Health Services. "The Bureau of Health Manpower and the National Library of Medicine will be hitched to the NIH, bringing together these organizations with common aims in research, training, scholarships and information on medical sciences." The Division of Biological Standards will remain a part of NIH. "This shift meets Shannon's (director of NIH) expressed desire to keep NIH dedicated to research, and allows for closer supervision to keep both research and training up to NIH standards." Congress willing, the heads of all three new health administrations will report to Surgeon General Stewart ... who would become deputy to Dr. Philip Lee, Assistant Secretary of HEW for health and scientific affairs."

63. Westrate, J.L., "Science Policy Formulation: The Role of the Legislator", Address before the Indian Institute of Constitutional and Parliamentary Studies, Reprinted in U.S. Congressional Record, Daily Edition, March 11, 1968, pp. H1828-H1830.

> An attempt to define the respective roles of the scientist and the legislator in determining science policy is made. The policy maker (whether legislator or executive) "must raise" questions concerning: the relationship between national needs and possible accomplishments of science; priorities for research and development; criteria for deciding priorities and fund allocations; basic policies such as whether government or contract research should be emphasized; the portion of the budget to be spent for science; and the impact of government science activities on institutions such as universities. He concludes, "By his words and his deeds, the legislator ... should do everything possible to build an atmosphere of faith and confidence in science and technology without standing in awe of the scientist or engineer's intellectual equipment, without yielding his capacity for critical evaluation of research and development performance, or abdicating to scientists and engineers those public policy decisions which are rightfully the legislator's."

64. "PSAC Appointments", Science, v. 159, no. 3817, 23 February 1968, p. 861.

> "President Johnson has appointed two new members to the President's Science Advisory Committee (PSAC), including the first social scientist in the 10-year history of the committee. Appointed to 4-year terms were Herbert A. Simon, professor of industrial administration and psychology at Carnegie-Mellon University, and Harland G. Wood, dean of science at Case Western Reserve University." "On PSAC, Simon and Wood succeed Philip Handler and Herbert F. York, Jr., whose terms expired at the end of 1967."

65. "Plea for Science Department", Industrial Research, v. 10, no. 3, March 5, 1968, p. 13.

> Herbert J. Hollomon (former Assistant Secretary for Science and Technology in the Commerce Dept.) proposed the creation of a Dept. of Science and Technology during current hearings of the Senate Subcommittee on

Executive Reorganization. Collecting the NSF, NBS, ESSA, NASA, the Geological Survey, the Census Bureau, and some elements of NIH and AEC into "one package" would provide a "federal mechanism for supporting the examination of man and the character and nature of his physical and social environment, even reaching out into space." Hollomon also sees a need for techniques appropriate to the management of multi-agency projects, and mechanisms for changing agencies themselves when they become outmoded.

66. Jantsch, E., "Technological Forecasting for Planning and Its Institutional Implications", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D.C., 1968, pp. 104-140.

"This paper attempts to sketch the emerging new planning process and the role of technological forecasting in it, and to discuss the institutional implications." The principle task for the 1970's, according to the author, will be the mastery of planning for policy making. Such planning will involve continuous feedback for anticipations of "possible futures". In this period, industry will emerge as "planned for society" at an equal level with government. A "look-out" institution will be established to coordinate alternative strategic inputs and to interact with the academic community, the not-for-profit institutions, and the national laboratories for planning purposes. Governmental and industrial "innovation structures" may result in a strong "Corporate Development" branch of government which would run the national laboratories and take over the present funding agencies. And, industry will develop a "constitutional" framework characterized by highly adaptive individuals who interact flexibly with one or more organizations in the manner of "free entrepreneurs".

67. Schriever, B.A., "Techniques in Technological Forecasting", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D.C., 1968, pp. 55-59.

"Technological Forecasting" is defined as "a periodic effort to determine the long-range implications of technological change". Although there are various forecasting techniques, all involve certain fundamentals. First, "there must

be a considerable organizational effort before the study can begin"; goals, objectives, time frames, parameters, and terms of reference must be spelled out. The second fundamental asserts that the study can be no better than the sum total of the knowledge of the participants; the Delphi method is especially helpful in this information-gathering phase of the study. The third fundamental requires that the information gathered be reduced to a "brief, hard-hitting report designed to be useful to" policy-makers. The last fundamental requires a provision for a group to carry on and update the study. The future of technological forecasting and its uses in long-term development and production programs is discussed.

68. Miller, G.P., "Congress and R&D in the 1970's", Proceedings of the Symposium on National R&D for the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D.C., 1968, pp. 23-27.

Congressman Miller emphasizes the need to direct more attention to human needs, including urbanization, pollution, population control, and conservation. Science and technology, "which to a large degree has been the prime source of many of our environmental problems, must be the means by which those problems must be solved". "A system in which science and technology have been glorified to the point where they have become the end objective rather than the means to a nobler end--the advancement of human progress--contains within it the forces of its own destruction." In the decades to come, "as a matter of government policy, as a matter of congressional intent, and as a part of National security, scientific research and applied technology ... must be centered ... upon the elimination of human problems".

69. Augenstein, B.W., "Technical Program Formulation--Today and Tomorrow", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D.C., 1968, pp. 193-201.

The "scope and breadth of technical program formulation is going to widen immensely in the next decade ... to satisfy the future needs of both military and domestic problem areas". The author examines the questions of the transferability of program formulation techniques developed for national security to domestic problems, and the

usefulness of "the present tools for handling problems of such wide scope". Conclusions include: "The basis for this ... formulation will have to be enormously expanded" to take account of the program's "long-run impact on society and society's environment"; tools for "attacking the analytical parts of such problems are in reasonable shape"; the "greatest need will be for the quantitative social scientist"; the "most important new tool needing much more development is a set of techniques for using judgment and intuition"; industry must accept the "responsibility to ... apply technology to ... beneficial ends and not simply acquiesce to the belief that the future is both unpredictable and unchangeable", and industry must "learn how to involve and use social scientists."

70. Zwick, C.J., "Evolution of Major R&D Program Methodology in Government", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D.C., 1968, pp. 213-216.

The Planning-Programming-Budgeting (PPB) system is appropriate for programming the government's R&D activities, according to the author who is an Assistant Director of the Bureau of the Budget. The need and desirability of "subjecting the ever-increasing demands for more R&D resources to a more systematic and penetrating analysis" is necessitated by the monetary size of R&D programs and the limited funds now available. Arguments by distinguished individuals or professional bodies that these programs are important will be insufficient to justify their support." After reviewing the main features of PPB, the author briefly discusses how the system can be used for allocating resources to applied and basic research.

71. "Research in Education Program Planned", Washington Science Trends, v. XIX, no. 26, April 8, 1968, p. 154.

The National Academy of Sciences' Division of Behavioral Science will "plan an expanded program of basic research in education". The Division will develop an "overall strategy" of basic research in the field, prepare guidelines for a multidisciplinary program, identify potential researchers and solicit relevant research proposals. The program, for which about $1 million is expected to be available in FY '69, will be carried out through grants to individuals and institutions from the U.S. Office of Education.

72. "NAS to Study Medicine's Impact on Social Policy", Scientific Research, v. 3, no. 4, February 19, 1968, p. 21.

The National Academy of Sciences has set up a committee, under the Division of Behavioral Sciences, to study the social implications of findings in biological, chemical, and medical research. Motivated by such advances as organ transplants and the synthetic creation of active DNA, the committee will seek to identify and clarify social-policy issues, specify and stimulate the research needed to resolve the issues, and recommend public-education programs.

73. Ferry, W.H., "Must We Rewrite the Constitution to Control Technology", Saturday Review, v. 5, no. 9, March 2, 1968, pp. 50-54.

The "regulation of technology is the most important intellectual and political task on the American agenda". "Technology has a career of its own, so far not much subject to the political guidance and restraints imposed on other enormously powerful institutions." "Technological development today is in the enshrined position in political-economic theory that was accorded to economic development in the nineteenth and early twentieth centuries." Several examples of technology are discussed to show its "ineluctable persistence" and the lack of control that is exercised over its growth. The author calls for constitutional revisions that would allow "not merely extensive police power to inhibit the technically disastrous, but legislative and administrative authority to direct technology in positive ways: the power to encourage as well as forbid, to slow down as well as speed up, to plan and initiate as well as to oversee developments that are now mainly determined by private forces for private advantages".

74. "A Military Role in Basic Research?", Scientific Research, v. 3, no. 5, March 4, 1968, pp. 25-27

William J. Price, director of the Air Force Office of Scientific Research, feels that "federal agencies, such as DOD, AEC, and NASA, should not be forced to reduce significantly their funding of basic research at the universities". Taking the mission-oriented agencies out of basic research would (1) " ... be bad for the agencies, bad for the universities, and would result in a loss of scientific knowledge to the nation", (2) " ... cause serious long-term losses to university research and graduate education ... which in turn feed

into technology in many ways", (3) impair "government-university relations". Price points out that recent cuts in the support of basic research by mission-oriented agencies are not being matched by increased support from the National Science Foundation, nor is it "clear that such funds will be forthcoming". He notes also that "the mission-oriented agencies and NSF, together have a much better chance of getting adequate support for science than does a centralized science support agency".

75. "National Science Foundation Act Amendments of 1968", Hearings before the Special Subcommittee on Science, of the Committee on Labor and Public Welfare, U.S. Senate, Ninetieth Congress, First Session, on S. 2598 and H.R. 5404, (November 15 and 16, 1967), U.S. Government Printing Office, Washington, D. C., 1968, 332 pp.

In these hearings a variety of witnesses discussed proposed amendments to the National Science Foundation Act and reviewed generally the work of the Foundation. Witnesses included Donald F. Hornig, Leland J. Haworth, Frederick Seitz, Representative Daddario and Senators Harris and Pell. The issues discussed included (a) the adequacy of support for NSF (" ... the role intended for NSF is not being played with full effectiveness because it has not been given the necessary resources"), (b) the proper relation between NSF and other federal agencies, (c) NSF organization and procedures, (d) support for applied research, (e) support for the social sciences, and (f) international science activities.

76. Boffey, P. M., "NIH and Congress: Agency Rebuts Fountain Subcommittee Charges", Science, v. 159, no. 3818, 1 March 1968, pp. 959-961.

NIH has prepared a detailed response to Rep. L. H. Fountain's (Chairman, House Subcommittee on Intergovernmental Relations) "bitter attack" on its administration of grant programs. "Fountain's group had charged NIH with a wide variety of failures, including 'irresponsible' administrative procedures, 'weak and ineffective central management', favoritism in the distribution of money, and support of 'research of less than good quality'". NIH's response "includes a detailed rebuttal of ... specific charges and an attempt to put the charges in broader context". "NIH asserts that the nation's progress in the medical and health-related sciences over the past two decades has been 'impressive', and that, while there have been problems associated with

rapid growth, 'such misadventures do not characterize the whole'." In addition, the favorable appraisals of NIH made by the Wooldridge committee in 1965 and by the American Medical Association in 1967, are cited as studies that were "conducted under most distinguished and publicly responsible superintendence".

VII SCIENCE, FOREIGN AFFAIRS, AND NATIONAL DEFENSE

60. Greenberg, D.S., "Defoliation: AAAS Study Delayed by Resignations from Committee", Science, v. 159, no. 3817, 23 February 1968, pp. 857-859.

> " ... The AAAS's study of chemical and biological agents that affect the environment is temporarily delayed following the resignation of two of the four members of ... the Committee on Environmental Alteration." "Those who resigned are committee chairman David R. Goddard, and Athelstan F. Spilhaus." Although both cited "extensive professional commitments", Goddard added that he had received "pressures from all directions". "The immediate effect of the resignations is to delay the beginning of a AAAS review of a herbicide-literature review that was conducted by the Midwest Research Institute (MRI) under a Defense Department contract." A National Academy of Sciences review of the MRI study "pronounced it, with some minor qualifications, 'a creditable job'". The literature review held that "there are not substantial grounds for concern over the possibility of long-term adverse effects from the U.S. defoliation program in Vietnam".

61. "Brain Drain Slows Scientific Effort in Developing Countries", Chemical & Engineering News, v. 46, no. 16, April 8, 1968, p. 22.

> A recent report by the House Subcommittee on Research and Technical Programs concludes that the U.S. operates a "brain drain which seriously reduces the scientific development of foreign countries to which we send billions of dollars in foreign aid". In 1967, 3,772 of the 7,913 scientists, engineers, and physicians who immigrated "were students who had originally entered the U.S. with the declared intention of returning home after receiving their education ... (but) can't find employment at home in the specialized fields of study pursued in the U.S."; the "U.S. spent about $75 million toward providing some 5,400 trained persons to the very countries engaged in 'exporting' nearly 5,200 of their scientific professionals". The report recommends that the developing nations select students sent to the U.S. "with career interests which have a close relationship to future manpower needs of those countries", and that "AID curtail training and sending of technicians to a developing country in any field in which there is concurrent emigration".

62. "The Brain Drain of Scientists, Engineers, and Physicians from the Developing Countries into the United States", Hearing before the Research and Technical Programs Subcommittee, Committee on Government Operations, (January 23, 1968), U.S. House of Representatives, Ninetieth Congress, Second Session, U.S. Government Printing Office, Washington, D.C., 1968, 120 pp.

During this hearing, a panel of experts discussed the "brain drain", the migration of scientific and technical personnel from underdeveloped countries to the United States. The witnesses discussed the causes of this migration, the probability that it will increase, and the available statistics of the subject. The printed hearing includes an appendix of special tabulations showing the academic specialization and country of origin of scientists, engineers, and physicians immigrating to the United States in fiscal year 1967. The experts discussed, but did not agree upon, a range of policy alternatives to reduce the brain drain by (a) making return to underdeveloped countries more attractive, (b) reducing training offered in the United States, (c) expanding the United States supply of such manpower, particularly physicians, (d) increasing legal restrictions to prevent students trained in the United States from staying in the United States, and (e) ensuring that Federal research and development programs do not encourage immigration of scientific and technical personnel.

63. "NSF to Get Broader International Role", Scientific Research, v. 3, no. 3, February 5, 1968, pp. 24 and 26.

NSF will get new authority "to initiate and support specific scientific activities ... relating to international cooperation or national security", under a reorganization bill that is almost assured of passage. The extension of NSF's role in the international area will (1) " ... provide our government with an ... additional tool for the achievement of its foreign policy objectives", (2) assign NSF a " ... major responsibility for promotion of academic interest and activity in the social and international consequences of scientific and technological advance", (3) provide an "opportunity to exchange more scientists from developing countries", and (4) "assist American science in making greater contributions to total national interests ... not only those of American science".

64. "Europeans May Seek US Aid in Closing 'Technology Gap'", Scientific Research, v. 3, no. 3, February 5, 1968, p. 19.

> "Efforts are being made by Western Europe to open a new level of discussion with the U.S. aimed at closing the 'technology gap'." The recent OECD study of U.S. science policy was expected to provide "a master plan explaining U.S. progress that could be imported and superimposed on European economics", but the report offered little that could be readily adapted to Europe's circumstances and needs. In the confrontation meeting on OECD's report, the U.S. delegation was queried "on the possibility of a temporary hold on U.S. policy, while Europe strives to catch up", as well as "for a Kennedy-round of negotiations involving U.S. technology". "Hornig opposed any across-the-board talks on technology ... but ... would consider discussing specific instances in which U.S. technology has imposed unbearable burdens on Europe."

65. "The Technology Gap", The Economist, v. 226, no. 6499, March 16, 1968, pp. 71-72, and 75-76.

> An OECD meeting in March "was the first serious attempt to find out what the technology gap is all about and to treat it ... not as a nasty American plot, but as the major economic phenomenon of this generation". "It is beginning to look as if the answer has little apparent connection with science or scientists." Instead, the U.S. mass-education system "produces a management and a labour force that is more receptive to new ideas, and quicker to grasp their possibilities". Other conclusions include: Europe produces proportionally more engineers and scientists than the U.S., but does not have suitable investment and economic conditions for innovative use of them; the technology gap "has not hampered either economic growth or exports. The only casualty so far has been national pride"; in the science-based industries, there is the very real prospect of the U.S. taking an increasingly dominant position; the gap between the U.S. and Europe in industrial-research expenditures is not as wide as previously thought; the U.S. concentrates "huge sums on relatively few, big projects", while the European effort is "fragmented among a microcosm of small research teams"; and, the minimum threshold levels for innovative efforts in some fields is beyond the means of individual European countries.

66. Glass, E.M., "DOD Laboratories in the Future", Proceedings of the Symposium on National R&D in the 1970's, (18-19 October 1967), National Security Industrial Association, Washington, D.C., 1968, pp. 143-151.

Recent changes in the operation and structure of DOD laboratories are reviewed, and prospects for the future are described. "Weapon centers" will be created that concentrate "on a particular military problem or warfare area, such as undersea warfare, air-to-ground warfare", etc. Each center, which will employ 1,000 or more scientists and engineers, will do its own development engineering. The weapon center will be self-contained and will perform both research and development, with feasibility models as an important product. Advantages claimed for such centers include: the ability to "serve as a quick reaction facility ... particularly responsive during crises or war"; enhancement of the systems approach; orientation for "researchers and technologists towards more meaningful and productive areas of work"; and "a center's performance would be much easier to evaluate since its end products could be tested and evaluated".

67. Walsh, W.B., Science and International Public Affairs, Six Recent Experiments in International Scientific Cooperation, The Maxwell International Relations Program of Syracuse University, 1967, 161 pp.

The study was designed "to identify and trace some of the impacts of science and scientists on international public affairs". This was done by selecting six organizations and establishing "where, when, how and why and by whom each organization had been started and developed". The six organizations selected were the European Center for Nuclear Research, European Nuclear Energy Agency, European Atomic Energy Community, European Space Research Organization, and the European Launcher Development Organization. Specific achievements of each organization are cited, and several conclusions are reached regarding their contributions to international cooperation.

68. Häfele, W., "The International Implications of Modern Technology", NATO's Fifteen Nations, v. 12, no. 6, December 1967-January 1968, pp. 55-56, 60, 62, 64, and 66.

The problems and prospects for international cooperation through science and technology are discussed with special reference to nuclear energy. Emphasis is placed on "the mutual interactions and feedbacks of international politics and modern international technology". One conclusion is that "modern technology requires more

sophisticated schemes of international co-operation than in the case of science"; a reason given for this is that "technological accomplishments cannot be easily compared and forwarded by written papers ... they fall largely into the categories of knowing how and knowing why".

69. Nelson, R.R., "The Technology Gap: Analysis and Appraisal", The RAND Corporation, Santa Monica, California, P-3694, October 1967, 32 pp.

This study of the technology gap explores the meaning and reality of the concept, the development of the gap, and its bases. It is concluded that the "gap is a meaningful concept, and the phenomenon probably is real"--(the gap is identified as a lag in the creation and application of technological knowledge); that such a gap between the U.S. and Europe "has existed for upwards of one hundred years"; that what is "new about the situation ... has less to do with general economic well-being than with issues of national military power"; and that the "reasons for the ... gap are complex and poorly understood, but ... they probably have far less to do either with U.S. Government R&D policy, or with the size of the U.S. corporate giants, than many people seem to believe".

70. Petrullo, L., "Government Sponsorship of Overseas Research", American Psychologist, v. 23, no. 2, February 1968, pp. 108-111.

The mechanisms for coordinating government-supported foreign-area research are described and assessed, and a new mechanism is proposed. Coordination is presently handled by two bodies: the Foreign Area Research Council and the Foreign Area Research Coordinating Group. But, the final approval and review authority now resides with The State Department, based on a Presidential directive following the Project Camelot incident. However, "State's function in this is not to promote the growth of scientific knowledge, but to prevent behavioral scientists from creating trouble abroad". "A new mechanism, one with a positive approach, is needed--one which incorporates ... responsibilities for ... guidance and development of research abroad. Such a mechanism, staffed or aided by both behavioral scientists and foreign-area experts could then give proper guidance and direction to ... agencies, universities, and private firms which have need for foreign area research and research products."

71. MacArthur, D.M., "Current Emphasis on the Department of Defense's Social and Behavioral Sciences Program", American Psychologist, v. 23, no. 2, February 1968, pp. 104-107.

DOD's program in the social and behavioral sciences is described in terms of (1) current research areas and their funding, (2) areas to be emphasized, and (3) management goals and problems. In Fiscal Year '67 those sciences (divided into five categories: human performance, human factors engineering, etc.) received $40 million from DOD, which is about ten percent of the total government support for the field. In the future, special emphasis will be placed on the following research areas: manpower, organizational studies, decision making, and man and his physical environment. Management goals and problems include: stating DOD's research needs in terms which are more meaningful to investigators, recruiting of behavioral scientists, closer relations between DOD laboratories and universities, and greater attention to ways of implementing research findings.

72. Bush, V., Modern Arms and Free Men, The M.I.T. Press, Cambridge, Massachusetts, 1968, 273 pp., (Original edition published by Simon and Shuster, Inc., in 1949).

In the foreward to the 1968 edition of this book, the author states that the primary objective of the book is " ... to examine the relationship between military strength and political systems in a world in which military strength would depend intimately upon the progress of science and its applications". In particular, the author asserts that the development of beneficial science is best accomplished in a democracy. "Science and its practical application, proceed by trial and error, with tentative experiment and hypothesis, with the winnowing of chaff by competition and criticism, and the gradual formation of a sound line of advance by the survival of the fittest." The author explores the operations of science in a democracy with special reference to education and the planning of military programs in the light of scientific advance.

73. Beringer, C., "Aid for Research in Agricultural Development", OECD Observer, Paris, France, no. 32, February 1968, pp. 12-15.

The crucial role that the agricultural sector plays in economic development of underdeveloped countries is emphasized in terms of the needs for further research. Recent examples of how research has been a vital factor in the transformation of the agricultural sector of a developing country's economy are cited. Specific programmes already being carried out by the U.S. and European countries are listed. Emphasis is placed on the following research problems and possible solutions: (1) "introducing modern techniques (for example, fertilizers, improved seeds and irrigation) can significantly raise agricultural productivity, but to maintain higher level of productivity" and avoid additional problems, research on the spot must continue, (2) the problems of providing finance and staff on a permanent and stable basis could be overcome by "setting up an international consortia of universities in the donor countries ... to supervise the work of their department in developing countries", (3) promotion of additional regional and international research centers with emphasis on those aspects of research that are insufficiently covered needs continuing exploration.

VIII SCIENCE POLICY IN FOREIGN COUNTRIES

87. "Sweden, USSR Sign Research Pact"; Scientific Research, v. 3, no. 5, March 4, 1968, p. 21.

> "Sweden and the Soviet Union will shortly inaugurate an exchange of nuclear researchers, under the terms of a one-year bilateral agreement." This agreement will " ... enable individuals and groups of specialists to visit the research facilities in nuclear physics, plasma physics and nuclear power in each other's countries", and will allow " ... the exchange of information on peaceful uses of atomic energy, radioisotopes, radiation effects, uses of radiation in biology and medicine, and instrumentation".

88. "Swiss Spend $278-Million", Industrial Research, v. 10, no. 3, March 5, 1968, p. 19.

> The Swiss Science Council reported that $278.4 million--about 1.9 percent of the gross ational produc --was spent on research and development in Switzerland last year. Approximately 70 percent was invested by private enterprise and 30 percent by federal and cantonal authorities. The Council also reports that "about 10% of all working graduates in Switzerland are employed in research and development operations".

89. "Soviet-British Technical Pact", Industrial Research, v. 10, no. 3, March 5, 1968, p. 18.

> "The Soviet Union and Great Britain have negotiated an agreement that will result in a wide range of technological cooperation." Working parties of the two governments will determine the specific fields of cooperation within the broad areas of technological R&D and industrial technology. Specific fields of activity already selected for joint consideration include: educational technology (programed learning and teaching machines); transport technology; materials research; and information storage, processing, and retrieval. The two governments also will annually review progress in the fields of atomic energy and aviation.

90. "Education, Science, Technology Get $16.5 Million OAS Pledge", Chemical & Engineering News, v. 46, no. 10, March 4, 1968, p. 15.

A pledge of $16.5 million was made at an Organization of American States (OAS) meeting in Maracay, Venezuela, to kick off several multinational programs in education, science, and technology". The meeting was called to reorganize the Inter-American Cultural Council, one of the three operating arms of OAS, "into a body that would guide and coordinate education, science, and technology under directives laid down last April at the Latin American summit conference at Punta del Este". The fiscal goal for the first year of the program is $25 million--$15 million for science and technology, and the rest for education. Of this total, the U.S. will contribute two-thirds under a 2:1 matching formula. The educational programs proposed included educational research experimentation, curriculum reforms in line with integration goals, and an educational TV network among the Americas. Science and technology projects were less clearly spelled out, but are expected to include regional centers for research, science and engineering education, visiting professorships, and the involvement of technical societies.

91. Low, I., "Europe's Old-Fashioned Science", New Scientist, v. 37, no. 587, 7 March 1968, p. 531.

In his study of "the institutional recommendations of the OECD report (1966) on fundamental research and the policies of governments", Professor Joseph Ben-David analyses Europe and the United States. He contends that "Europe had been falling back as early as the latter half of the nineteenth century", and that "the obstacles to development are structural and not financial". Among the obstacles he cites are (1) an unwillingness to disturb "'existing hierarchies of prestige'", (2) a lack of "'entrepreneurial leadership'", and (3) a conservatism in research policy resulting from the prevailing view of science as a consumption item. The report recommends: (1) "increasing the density of pure and applied research and ensuring that ideas and problems shuttle as rapidly as possible between the two fields", (2) increasing competition for government funds "to decentralize science policy making" and "to intensify local growth", (3) placing "emphasis on large multidisciplinary research institutes with the authority to confer at least graduate degrees", and (4) systematically collecting "information on the effects of different policies" to improve future decisions.

92. "Science Policy Meeting", Nature, v. 217, no. 5132, March 9, 1968, p. 892.

On March 11 and 12, ministers of science and education from 22 countries met in Paris at OECD headquarters to discuss: a report produced by OECD that attempts to establish the factual basis for the technological gap, fundamental research policy, and problems of scientific- and technical-information systems and associated policies. The technology-gap report, which is to be published at a later date, studies nine sectors of industry (e.g., computers, scientific instruments, pharmaceuticals, machine tools) in an effort to assess their effectiveness as performers of R&D and as innovators, and to establish the relationships between R&D and industrial prosperity. Discussion of fundamental research policy was based on several OECD reports published in recent years, and centered on ways of making universities more effective. Technical aspects of information retrieval (e.g., compatibility of U.S. and European systems) and policy issues were taken up in the final discussion of information systems.

93. Benn, A.W., "The Government's Policy for Technology", New Technology, v. 1, no. 13, January 1968, pp. 1-2.

The Minister of Technology describes the policy, problems, and prospects for British technology. "Our technological policy is an industrial policy"; "the Government intends to strengthen the growth points in the economy and to speed up the introduction of new technologies by direct action in conjunction with industry". Reorganizational changes, culminating in the transfer of most of the Ministry of Aviation to the Ministry of Technology, have combined defense R&D with civil-research efforts under a single management; these changes permit, for the first time, "intelligent choices to be made between alternative developments in different fields". The Minister concludes with some comments on the technology gap and the brain drain, and calls for a more favorable public attitude towards technology in Britain.

94. "Tug-of-War Over Who's in Charge Stalls Japanese 40-GeV Lab Project", Scientific Research, v. 3, no. 4, February 19, 1968, p. 13.

Japan's plans for an elementary particle institute are stalled by the lack of agreement on whether the institute should be government controlled or autonomous. The proposed $83.3-million institute, which would include a 40-GeV accelerator, is expected to take five years to construct and to have an annual operating cost of $14 million.

95. "Survey of Professional Engineers 1966", SSF Newsletter, Science of Science Foundation, London, v. 3, no. 2, February 1968, p. 6.

This is a comprehensive questionnaire survey of British professional engineers by background, present activities, and income. Some findings include: (1) half of the new engineers have university degrees--by 1970 it is expected nearly all new chartered engineers will be graduates, (2) private industry and commerce take 53 percent of the total stock of engineers, with design, research and development accounting for 31 percent, (3) rise in median incomes over the past six years was 7.2 percent per annum for electrical engineers, 7.0 percent for civil engineers; 6.2 percent for mechanical engineers and 3.9 percent for chemical engineers, and (4) about 40 percent of the engineers "had primarily technical and engineering functions", with the remainder having management duties.

96. Clarke, R., "The Structure of Mintech", New Technology, v. 1, no. 14, February 1968, pp. 1-3.

The Permanent Secretary of the Ministry of Technology (Mintech) describes the activities, size, and structure of the Ministry. Under Mintech is "an articulated chain of Government activity, linking together scientific and technological research and innovation, the problems of industrial structure, and the role of public procurement". "The real problem is to develop the work and organization of the Department to carry this out." The staff (36,000) of Mintech is described, and the functions and problems of the three groups of the Ministry--Aviation, Research, and Engineering--are surveyed.

97. "CSIRO Budget", SSF Newsletter, Science of Science Foundation, London, v. 3, no. 2, February 1968, p. 3.

Australia's Commonwealth Scientific and Industrial Research Organization will spend about $46 million during fiscal year 1968 on research. "Although the Organization's budget is nearly 10 per cent greater than last year's, higher salaries and higher general running costs will soak up most of the extra money." Roughly three-quarters of the 1968 budget will be provided by the Federal Treasury, and the remainder will be contributed by several industries (wool, wheat, etc) which levy their products to raise money for research.

98. "Industrial R&D 1965", SSF Newsletter, Science of Science Foundation, London, v. 3, no. 2, February 1968, p. 3.

"The Central Planning and Co-ordinating Office of the Ministry of Science conducted an annual census of R&D undertaken by French industrial firms. The 1965 census has been examined and the main results published in Le Progrés Scientifique, No. 106." "Preliminary results show that research staff in industry increased 6.5 per cent compared with 1964, and expenditures rose by 17 per cent to 4,700 million francs. Much of the increase was accounted for by two large firms in the aircraft industry; if these are excluded, the growth in spending was only 11 per cent. State aid for industrial research rose by 33 per cent, and the proportion of industrial research financed by the firms fell from 60 per cent to 56 per cent."

99. "300 GeV: CERN Nations Set on Fence", Scientific Research, v. 3, no. 4, February 19, 1968, pp. 11-12.

CERN's proposed accelerator has received written guarantees of support from only three (France, Belgium, and Austria) of the 13 CERN nations; the remaining countries are expected to follow the lead of Britain and Germany, neither of which has yet decided to participate in the joint program. This report surveys the current positions of the member nations, and discusses the problems (principally, lack of money and disagreement over the accelerator's site) and prospects for the accelerator.

100. "A Space Policy for Britain", Spaceflight, v. 10, no. 2, February 1968, pp. 56-57.

"Despite the activities of ELDO, ESRO and the Conference European des Telecommunications par Satellites (CETS), Europe has yet to play an effective role in space technology. Lack of purpose at the political level, and a stubborn refusal to establish a viable European space programme, are root causes of the waste, frustration and general dissatisfaction that surrounds this increasingly important field of European co-operation." This report presents the recommendations of the British Interplanetary Society for setting up a European communications-satellite program. Emphasis is placed on: (1) "the importance of maintaining a national programme in individual countries while at the same time participating in broader international projects", (2) "insuring that countries participating in CETS have a stronger bargaining position in Intelsat", (3) "establishing a European Space Agency as a central planning and contractual authority with a separate budget combining interests of ELDO, ESRO, CETS, etc.,

maintaining liason with national programmes, NASA, Intelsat, etc." "Apart from pulling Europe into space communications, it would provide the opportunity to extend many branches of space competence with other types of applications satellites."

101. Ponte, M., "Science and the Economy at the Level of the Firm", paper in Problems of Science Policy, Seminar held at Jouy-en-Josas (France), February 1967, Organisation for Economic Co-operation and Development (OECD), pp. 73-85.

The author, Chairman of the French "Compagnie Générale de Télégraphie sans Fil", focuses his attention upon research and development decisions within individual firms. He considers the factors affecting these decisions both in normal private firms and in firms which primarily contract with government. Using the United States' atomic energy program as an example, he argues that "the highest return is obtained when fundamental research and applied research take place together. The concept of independent fundamental research, with other bodies applying the findings, is an inefficient one".

102. Walsh, J., "German Science Policy: Bund Shifts the Balance", Science, v. 159, no. 3821, 22 March 1968, pp. 1340-1341.

Science-policy emphasis in Germany is now on "bringing science and technology to bear on problems of economic development and social well-being". Toward this end, the Wissenschraftsrat--an advisory body to the Ministry for Scientific Research--"is charged with developing an overall plan for the promotion of science, establishing scientific priorities in research, and ... coordinating plans for nonindustrial science:, in the civil science area. The Ministry's budget for 1968 is $482.5 million (20.3 percent increase over last year). A five-year financial plan "provides for an average annual growth rate of about 10% ... (especially) in the priority programs--nuclear energy, data processing, marine research and space". Some of the "obstacles of German self-realization in science" are cited.

103. Nove, A., "Soviet Research Problems", New Scientist, v. 37, no. 579, 11 January 1968, pp. 84-85.

Some of the problems of Soviet research are discussed by S. Lisichkin in the monthly journal, Novyi Mir (1967, No. 8). These include: (1) departmental

organization in industry lacks coordination--"every industrial sector is still confining itself to research within its own sector"; (2) "lack of direct links between industrial research and industrial production"--"only two percent of scientific research workers are employed in industry"; (3) excessive administrative and social burdens on senior scientists; (4) "present regulations on housing and working limit the migration of scientific workers"; (5) rank consciousness resulting in salary stratification and recruiting problems as well as extreme shortages of support personnel; (6) shortages of scientific-information digests and books. Some of these problems "are common to all large scientific establishments". "Others, however, seem to be due to some peculiarities of their system."

104. "Reviews of National Science Policy, Japan", Organisation for Economic Co-Operation and Development, Paris, France, 1967, 231 pp.

Japan's science policy is reviewed and assessed by OECD in this report. The report includes the OECD examiner's report, on account of the confrontation meeting, and a background report describing science and its organization in Japan. "There is as yet", the report states, "only the most tentative formulation of a national policy for science". Two areas calling for improvement were: flexibility in the allocation of research funds, and increased mobility of researchers between posts in government, industry, and universities. More generally, the report states that Japan "will increasingly depend for her economic progress on domestic innovation" and "will need to develop technological advantages to maintain her competitive position in international trade".

105. Klappacher, W., "A Law for the Promotion of Research", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 11-13.

"On the 25th October 1967, the Austrian Parliament approved a law for the Promotion of Research under which science and industry are granted extensive powers for the independent administration of government research funds. This law provides for the creation of two organisations, the Fund for the Promotion of Scientific Research and the Fund for the Promotion of Research in Industry." "The Funds will be financed out of Federal Budget allocations, and contributions by local authorities, officially recognised representative organisations and private bodies."

106. "78 Per Cent Increase in Research Expenditure", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp 14-15.

> According to the Austrian Federal Budget estimates, "expenditure for the promotion of pure research in 1968 will amount to A.Sch. 62.62 million, an increase of 78 per cent, compared with 1967 (A.Sch. 35.078 million)." A 314-percent increase in allocations for the Institute of High Energy Physics (from 2.1 million A.Sch. in 1967 to 8.7 million in 1968) is for a major CERN plant in Göpfritz.

107. "Not Enough Technology Students", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, p. 16.

> "Although during the last seven years the number of [Austrian] undergraduates has increased by about 10 per cent, the number of technology students has decreased by 30-60 per cent. The causes of this decline are considered to be the excessive length of science and technology studies, and above all, the lack of space and inadequate equipment in the institutes. However, all technical universities are now working on a reorganisation of curricula and courses which should lead to a reduction in the duration of studies."

108. Science Secretariat, Privy Council Office, Ottawa, "Recent Trends in Canadian Science Policy", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 19-22.

> "Comparisons with other developed countries leave no doubt that Canada is devoting proportionately fewer resources to scientific research and development. A major reason for this is the extensive use which Canada has made of imported technology. However, it is recognised that spending on research and development is inadequate despite the substantial increase in expenditure by the government in this area in the past few years." "The Third Ministerial Meeting of Science in March 1968 will be discussing the topics of fundamental research, technological gaps and the scientific and technical information systems and policies." This article discusses policy developments in these three areas.

109. "A Space Programme for Canada", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 23-24.

> "A Space Program for Canada, published by the Science Council of Canada, ... gives a broad outline of Canadian activities in the upper atmosphere and space in regard to research into the physics of the upper atmosphere, university research and scientific training in rocket and satellite technology, and satellite communications." "In its findings and recommendations the Council ... recommends "'the establishment of a broadly conceived central agency responsible to the Government of Canada for the advancement of Canadian capability in the science and technology of the upper atmosphere and space; for furthering the development of Canadian industry in relation to the use of the upper atmosphere and space; and for the planning and implementation of an overall space programme for Canada'."

110. Maréchal, A., "New Elements in French Science Policy", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 25-28.

> The former Delegate-General for Scientific Research briefly describes some measures France is taking to encourage technological development in selected industries, and in the computer and oceanic fields. In the industrial-development program, firms engaged in areas designated as of "vital importance for the economy", can apply for grants which pay "up to 50 per cent of the cost of developing a prototype or pilot unit". Along similar lines, a "Computer Plan" was "put into operation last year with the object of preserving a certain degree of independence for France" in this field; under this plan, the government "would help ... to put a ... range of computers on the market as quickly as possible". For oceanology, a "Centre d'exploitation des oceans" was set up in 1967 to recommend guidelines, develop technical policy, and coordinate research in this field.

111. "The Second Federal Report on Research", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 43-46.

> "The Second Federal Report on Research, approved by the [German] Federal Cabinet on 20th July, 1967, gives an overall view of the financial and institutional situation regarding support for research from the public and private sectors." The report calls for "centers of

excellence" in research at universities; and an average annual increase of 16 percent between 1968-1971 for R&D expenditures by the Federal Ministry for Scientific Research; a redirection of space research to "specific satellite and space-probe projects"; over DM. 300 million for data processing; and more support for applied research.

112. "New Advisory Committee for Research Policy", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, p. 48.

> "The [German] Federal Minister for Scientific Research has set up an Advisory Committee on Research Policy which will help to coordinate the research promotion efforts of the Ministry of Scientific Research. It is also to make recommendations on planning and priority questions outside the scope of existing advisory bodies, and will help to make research results available for political decision-making by the Federal Government." "The members of the Committee are leading personalities drawn from universities, scientific organisations and Government advisory bodies. Its Chairman is the Minister for Scientific Research."

113. "Science Budget Proposals for 1968", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 48-49.

> "The draft budget proposals for 1968 which were adopted by the [German] Federal Government in September 1967 provide for an increase in appropriations for the Ministry of Scientific Research, from DM. 1,610 million ... to DM. 1,930 million, i.e. 20.3 per cent. Total Federal expenditure for science, research and technical development (including defence research) thus rises from DM. 3,200 million to about DM. 3,700 million." For the first time major allocations will be made in the following fields: Oceanography (DM. 60 million); regional computer centers (authorization budget of DM. 14 million); society for supporting applied research (DM. 2 million); university centers of excellence (DM. 5 million); and nuclear research and technology (DM. 57 million).

114. "Space Programme 1967-1971", Science Policy Information 4, Directorate Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 50-53.

> The Federal Ministry of Scientific Research has published details of Germany's first comprehensive multi-annual programme for the promotion of space research over the years 1967 to 1971. Total expenditures are planned to rise from DM. 272.6 million in 1967 to DM. 430.9 million in 1971; an additional DM. 200 million is planned over the same period for a supporting program. The overall program calls for continued participation in E.L.D.O., E.S.R.O., and C.E.T.S. satellite and space probe projects carried out bilaterally with other countries, the development of measuring instruments for space exploration, supporting research, and construction of ground stations.

115. "The Brain Drain of German Scientists is Declining", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 55-56.

> "In a written answer to a parliamentary question, Dr. Stoltenberg, Minister for Scientific Research, recently announced the following figures concerning the emigration of German scientists and engineers to the United States:
>
> 1964: 451 scientists and engineers
> 1965: 388 scientists and engineers
> 1966: 363 scientists and engineers
>
> The greater part of these emigrants were engineers. For instance, out of 363 emigrants in 1966, 234 were engineers, 112 natural scientists, and 17 scientists from other disciplines."

116. Piekaar, A. J., "Science Policy in the Netherlands", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 61-64.

> This article briefly describes the organization of research, the principal institutions involved, and the function of the newly formed Science Policy Council. "Of Government funds for R&D, almost half goes to the universities, 13 per cent to the Central Organisation for Applied Scientific Research (T.N.O.) and 5 per cent to the Organisation for the Advancement of Pure Research (Z.W.O.). About 7 per cent is earmarked for contributions to international organisations. The

share of defense research is 3-1/2 per cent. Only a small part of Government funds, about 2-1/2 per cent, goes directly to industry. Expressed as a percentage of gross national income at market prices, total R&D expenditure has risen to about 2 per cent. The expansion of Government aid for R&D in the past years has been considerable, but financial limitations are nevertheless making themselves felt more and more."

117. Adams, W., (Ed.), The Brain Drain, The Macmillan Company, New York, 1968, 273 pp.

This book comprises papers presented at an international conference on the "brain drain", held at Lausanne, Switzerland, in August 1967. The book includes a total of 16 papers: four deal with the dimensions, history, and scope of the brain drain; four other papers discuss different analytical frameworks for the problem; another treats the education-migration aspect; six papers present case studies; and, the final paper presents an agenda for action.

118. "Science in Search of a Policy", The Economist, v. 226, no. 6495, February 17, 1968, p. 49.

This brief article reviews the proposed federal R&D budget for 1969, and points out a possible change in U.S. science policy. The budget is described as "austere", primarily because of the absence of any larger new programs. But, there are "some interesting small ones": funds for air-pollution abatement rise from $37 to $59 million; there will be "more money for oceanography, for improving transport and the postal services and for finding new ways to stop crime"; a new "National Centre for Health Service Research and Development" is to be set up; and research into better and cheaper housing will receive increased funding. "These slight increases, scattered here and there through various budgets ... add up to what may be a change in direction in American scientific policy." This directional change towards what was "once labeled the Great Society" reflects "the belief ... that the federal government must take responsibility for improving the quality of American lift".

119. "Proceedings of the Special Committee on Science Policy", The Senate of Canada, Second Session, Twenty-seventh Parliament, 1967-68, No. 1, 2, 3, 4, 5, 6, 7, and 8, (March 1968), Queen's Printer and Controller of Stationery, Ottawa, Canada, 1968.

These hearings were held by a special committee of the Canadian Senate that was formed to study Canada's

science policy. The objective of the committee is "to consider and report upon the scientific policy of the Federal Government with the objective of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age". Specific topics of inquiry are: trends in R&D expenditures; R&D activities carried out in the fields of the physical, life, and human sciences; the pattern of federal assistance in these areas; and "the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient scientific policy for Canada".

120. "The 1967 Science Budget", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 65-69.

"The [Netherlands] 1967 Science Budget constitutes a compilation of all R&D expenditures contained in the national budget. It is not a budget in the proper sense of the word, but a list of all appropriations for R&D activities in the national budget." "In the past four years government expenditure on R&D was as follows: 1967, Fl. 797 million; 1966, Fl. 695 million; 1965, Fl. 589 million; 1964, Fl. 477 million. This shows a rise of 67 per cent over a period of four years (as compared to a rise of 39 per cent for total government expenditure)." Tabular data are also presented for industry and government supported R&D, government expenditures by sector of performance, R&D expenditures as a percentage of departmental expenditures, and funds for R&D by government missions.

121. Heden, C. G., "Governmental Support for Applied Research in Sweden", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, no. 23629/February 1968, pp. 77-81.

"At the end of November 1967 the Ministry of Finance [Sweden] published a short paper giving the Government's views on what it should do to promote the application of R&D in industry." "The Ministry states that it regards R&D as absolutely vital for economic growth, even if it is impossible to make any precise assessment of its actual effects." "The Government must ... itself assume the responsibility for raising R&D in industry to the optimal level." A new Board for Technical Development will "be responsible for grants for technical research and development", "represent the government in negotiations with the representatives of industry about questions concerning the financing of co-operative research institutes",

and "it would have some responsibilities ... for the organisation of contract research and technical documentation". "The new board is intended to start its activities on 1st July, 1968. It is unlikely however that it will be fully operational before the Autumn."

122. "Proposed Reorganisation of the Atomic Energy Authority", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/ February 1968, pp. 100-101.

> "Early in 1967 a Parliamentary Select Committee [United Kingdom] was set up 'to consider Science and Technology' and make its report during the current session. The Committee selected the nuclear reactor programme as the subject of its first investigation since this was considered to be a topic of prime national importance and involved large sums of public money." "In its report, published in October 1967, the Committee suggests that the introduction of atomic power stations for electricity generation should be speeded up and proposes fundamental changes in the structure of the Atomic Energy Authority and the nuclear energy industry." "The Committee further recommended a fresh look at the decision to reduce expenditure of fusion research and the establishment of a technical assessment unit capable of advising the Government on the merits and prospects of particular projects proposed to be undertaken by the Authority."

123. "Atomic Energy Authority to Undertake Research on Air Pollution", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, p. 101.

> "The [United Kingdom] Atomic Energy Research Establishment, Harwell, is to undertake a five-year programme of research into certain aspects of the character and behaviour of atmospheric pollutants. This programme will complement studies being carried out by other organisations. The estimated cost of the Authority's programme, which will be carried out in collaboration with the Ministry of Technology's Warren Spring Research Laboratory, will be £535,000 spread over five years."

124. "£5 Million Government Plan for Computer Development", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23692/February 1968, p. 107.

> "The Ministry of Technology [United Kingdom] is to put more than £5 million into a scheme for the production of specific computer programmes and systems that can

be applied in a wide cross-section of commerce and industry. This is the first time that a big Government expenditure has been directed towards the development of 'software'. The main purpose of the scheme is to encourage smaller organisations to adopt computer methods."

125. "E.E.C. Resolution on Scientific and Technical Co-operation", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 118-120.

"On the 31st October 1967, the Council of the European Economic Communities meeting under the chairmanship of the Minister for Scientific Research of the Federal Republic of Germany, decided to promote scientific and technical co-operation in a number of fields, i.e. in data processing and telecommunications, the development of new means of transportation, oceanography, metallurgy, air and water pollution and meteorology. A Working Party on Scientific and Technical Research Policy will report to the Council early in 1968 on these and other suitable subjects for co-operation."

126. "A Proposal for International Patent Reform", Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23692/February 1968, pp. 125-126.

"The European Industrial Research Management Association (EIRMA), an independent organisation grouping over 70 of the leading science-based firms in Europe, has published a report on patents, the first in a series of publications by the Association's specialised working groups. The report stresses the vital role of patents in modern industrial society and examines the reasons why the patents system in its present state falls so far short of present-day requirements. It sets out what industry wants from the patent system and the means considered appropriate for achieveing these objectives." The Association proposes: (a) "a single official international body ... be established to undertake the search into the prior state of the art; (b) the countries subscribing to the Arrangement ... transfer to the international body all of the patents documentation, technical publications, etc., held at present by their national patent offices; and (c) the international body ... be equipped with the most modern techniques of classification, storage, and retrieval".

127. "Planning and Policy-Making for Scientific and Industrial Research in Norway", Condensed from a speech by Robert Major, Director of the Royal Norwegian Council for Scientific and Industrial Research, at the Workshop for Managers of Industrial Research Institutes, (4-8 July 1967), Science Policy Information 4, Directorate for Scientific Affairs, Organisation for Economic Co-operation and Development, Paris, No. 23629/February 1968, pp. 70-75.

The "Royal Norwegian Council for Scientific and Industrial Research recently" surveyed the "research activities in science and industry, and formulated plans for future activities". "This is the first time that an attempt has been made ... to harmonise research with the future needs of trade and industry in order to achieve satisfactory economic growth." Findings and recommendations of the report include: "The present organisation structure of Norwegian research seems to correspond ... to current and foreseeable research requirements"; "Even if research results in other countries were freely available, it would still be necessary to include fundamental research in the nation's research activities"; "It is strongly recommended that industry ... be encouraged to engage in more R&D."; "More applied research institutes should be set up in fields where a vigorous effort is needed to stimulate trade and industry"; and, the Research Council staff should be enlarged and the advisory and ad hoc committee systems should be greatly extended.

E R R A T A

P. 15

No. 66 - Title should read:

"Program on Environmental Quality Control"

P. 17

No. 70 - First sentence should read:

This report is "an examination of alternative possible approaches for providing incentives to industry to comply with the pollution abatement standards being created under the Water Quality Act of 1965 and the Clean Water Act of 1966".

P. 38

No. 70 - Third sentence should read:

"Arguments by distinguished individuals or professional bodies that these programs are important will be insufficient to justiiy their support."

P. 49

No. 88 - First sentence should read:

"The Swiss Science Council reported that $278.4 million--about 1.9 percent of the gross national product--was spent on research and development in Switzerland last year."