NATIONAL ACADEMY OF SCIENCES

ANNUAL REPORT

FISCAL YEARS 1973 AND 1974

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NATIONAL ACADEMY OF SCIENCES

NATIONAL ACADEMY OF ENGINEERING

INSTITUTE OF MEDICINE

National Research Council

ANNUAL REPORT

FISCAL YEARS 1973 AND 1974

April 24, 1975.—Referred to the Committee on Labor and Public Welfare and ordered to be printed with two illustrations pursuant to law

LETTER OF TRANSMITTAL

NATIONAL ACADEMY OF SCIENCES,
Washington, D.C., February 26, 1975.

SIRS: I have the honor to transmit to you herewith the Annual Report of the National Academy of Sciences for fiscal years 1973 and 1974. Included in this report are the Annual Reports of the National Academy of Engineering and the Institute of Medicine, covering the period, July 1, 1972, through June 30, 1974.

Very truly yours,

PHILIP HANDLER,
President.

The President of the Senate
The Speaker of the House of Representatives

PREFACE

In this Annual Report, the descriptions of the activities of the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council cover the period, July 1, 1972, through June 30, 1973. The NAS–NAE–IoM–NRC appendix material, however, covers fiscal years 1973 and 1974. This was done in order to bring the Academy's annual report up to date; the next report will cover fiscal year 1975.

The National Research Council has recently been reorganized to strengthen the Academies' ability to respond more effectively to scientific and technical questions raised by the increasingly complex problems faced by American society; this reorganization will be reflected in the forthcoming fiscal year 1975 annual report.

This report is divided into six sections: Part I describes selected major studies completed and published during the year; Part II describes some of the major studies in progress; Part III deals with international activities; and Parts IV, V, and VI summarize, respectively, the activities of the National Academy of Engineering, Institute of Medicine, and National Research Council.

There are six appendices: Appendix I: The National Academy of Sciences, contains accounts of Autumn and Annual Meetings, the Act of Incorporation, Constitution and Bylaws, members and foreign associates, reports of trust and endowment funds, and a list of deceased members. Appendix II: The National Academy of Engineering, includes similar information about the meetings, membership, and organization of that Academy; Appendix III covers the Institute of Medicine; and Appendix IV covers the National Research Council. Appendix V is the report of the Treasurer for fiscal years 1973 and 1974, and Appendix VI is a selected bibliography of NAS–NAE–IoM–NRC reports published during those two years.

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OFFICERS AND COUNCIL

NATIONAL ACADEMY OF SCIENCES

July 1, 1972

PHILIP HANDLER, *President*
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ALLEN V. ASTIN, *Home Secretary*
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E. R. PIORE, *Treasurer*

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PRESTON CLOUD
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OFFICERS AND COUNCIL

NATIONAL ACADEMY OF SCIENCES

July 1, 1973

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OFFICERS AND COUNCIL

NATIONAL ACADEMY OF ENGINEERING

July 1, 1972

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FRANCIS H. CLAUSER
JOHN H. DESSAUER
EUGENE G. FUBINI
MARTIN GOLAND
JAMES HILLIER
FREDERIC A. L. HOLLOWAY
J. ROSS MACDONALD
KENNETH G. MCKAY
H. GUYFORD STEVER

OFFICERS AND COUNCIL

NATIONAL ACADEMY OF ENGINEERING

July 1, 1973

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J. H. MULLIGAN, JR., *Secretary*[1]

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ROBERT W. CAIRNS
PAUL F. CHENEA
W. KENNETH DAVIS
JOHN H. DESSAUER
DONALD N. FREY
PHILIP HANDLER, *ex officio*
FREDERIC A. L. HOLLOWAY
RALPH LANDAU
W. DEMING LEWIS
CLARENCE H. LINDER
J. ROSS MACDONALD
KENNETH G. MCKAY
JOSEPH M. PETTIT

[1] Not a member of the Academy.

OFFICERS AND COUNCIL

INSTITUTE OF MEDICINE

January 1, 1972

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CHARLES G. CHILD, 3RD
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RASHI FEIN
DONALD S. FREDRICKSON
ROBERT J. GLASER
DAVID A. HAMBURG
ALVIN J. INGRAM
IRVING M. LONDON
WALSH MCDERMOTT
COLIN M. MACLEOD
DAVID MECHANIC
HENRY W. RIECKEN
WALTER A. ROSENBLITH
ERNEST SAWARD
ROZELLA M. SCHLOTFELDT
EUGENE A. STEAD, JR.
ADAM YARMOLINSKY
ALONZO S. YERBY
CHARLES L. DUNHAM, *ex officio*

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INSTITUTE OF MEDICINE

January 1, 1973

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LORRETTA C. FORD
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DAVID A. HAMBURG
ALVIN J. INGRAM
WALSH MCDERMOTT
DAVID MECHANIC
JULIUS RICHMOND
HENRY W. RIECKEN
WALTER A. ROSENBLITH
ROZELLA M. SCHLOTFELDT
LEWIS THOMAS
ADAM YARMOLINSKY
ALONZO S. YERBY

*Dr. Glaser relinquished his place on the Council in May; Walter A. Rosenblith was named to complete Dr. Glaser's term.

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CHAIRMEN OF DIVISIONS

NATIONAL RESEARCH COUNCIL

July 1, 1972

ROBERT McC. ADAMS, *Behavioral Sciences*
DONALD S. FARNER, *Biology and Agriculture*
CHEVES T. WALLING, *Chemistry and Chemical Technology*
ALLAN V. COX, *Earth Sciences*
ERNST WEBER, *Engineering*
SAMUEL EILENBERG, *Mathematical Sciences*
CHARLES L. DUNHAM, *Medical Sciences*
ROMAN SMOLUCHOWSKI, *Physical Sciences*
ROBERT A. ALBERTY, *Advisory Committee to Office of Scientific Personnel*

CHAIRMEN OF ASSEMBLIES, DIVISIONS, AND COMMISSIONS

NATIONAL RESEARCH COUNCIL

July 1, 1973

ROBERT McC. ADAMS, *Behavioral and Social Sciences*
DONALD S. FARNER, *Biology and Agriculture*
CHEVES T. WALLING, *Chemistry and Chemical Technology*
CHARLES L. DRAKE, *Earth Sciences*
ERNST WEBER, *Engineering*
ANDREW M. GLEASON, *Mathematical Sciences*
PAUL A. MARKS, *Medical Sciences*
ROMAN SMOLUCHOWSKI, *Physical Sciences*
ROBERT A. ALBERTY, *Advisory Committee to Office of Scientific Personnel*
GORDON J. F. MACDONALD, *Commission on Natural Resources*

PART I: SELECTED COMPLETED STUDIES

A NATIONAL MATERIALS POLICY

The rapid and growing world requirements for non-renewable resources, coupled with declines in world supplies of materials considered essential for the maintenance of modern industrialized societies, led to a request from the National Commission on Materials Policy to the Academy for definitions of issues and problems toward which national materials policies should be directed. The task was assigned to the *ad hoc* Committee on Materials Policy, established under the National Materials Advisory Board in the NRC Division of Engineering.

According to the Committee's report, *Elements of a National Materials Policy,* the United States is now almost completely dependent on foreign sources for 22 of the 74 essential non-energy mineral commodities, and our dependence is growing. At the same time, world industrial demands are escalating and the developing countries are calling for an equitable share of the Earth's material resources.

"It is clear," the Committee said, "that a fresh and flexible materials policy must be formulated and continue to evolve if we are to cope with present challenges and expected changes. The concept of continuing *material* growth as an axiom and keystone of such a policy needs to be reexamined, particularly where it does not demonstrably add to the quality of life in terms of variety and flexibility of options for living generations and avoidance of their foreclosure for future ones." Further, the Committee pointed out that environmental, social, and energy costs must be considered, in addition to financial costs, as the "total price we pay for continuing material affluence."

The Committee pointed out that some mineral commodities are globally abundant, others are abundant but unevenly distributed geographically, and still others are both rare and geographically limited. They recommended that, so far as possible, the United States base its industrial future on widespread and abundant basic commodities, such as iron, aluminum, magnesium, and the silicates. They recommended, in addition, the creation or strengthening of institutions and support of research needed to evaluate and monitor the complete spectrum of mineral supplies on a continuing basis. Several major issues were considered relevant to the formulation of a comprehensive national materials policy. They include: the natural supply of

each vital mineral commodity, processing methods, conservation and recycling, the role of government, manpower problems, education, and increasingly significant international aspects of materials policies.

"Environmental costs of materials supply, already severe, will increase still further in the absence of firm and continuing precautions," the Committee warned. "To produce, fabricate, and dispose of wastes from ever larger quantities of metals obtained from ever leaner deposits demands ever larger investments of energy and creates growing potential for damage to all aspects of our environment on, above, and below the land surface, including living organisms." The Committee urged that the United States adopt strict conservational measures, not only to stretch existing resources, "but to restore, protect, and perpetuate a livable human habitat."

MAN, MATERIALS, AND THE ENVIRONMENT

The study of economic and technical processes involved in materials use as they affect the environment was undertaken by the Committee for International Environmental Programs of the NAS–NAE Environmental Studies Board in May 1972 under a contract with the National Commission on Materials Policy. The Committee's report, *Man, Materials, and the Environment,* was published the following spring by The MIT Press.

The charges to the Committee were "to assess how materials policy for the United States may be affected by national environmental policies or by international agreements; to evaluate the effects on United States materials policy resulting from the United Nations Conference on the Human Environment; by reference to selected important materials and their flow through the environment and the economy, to identify and assess the implications of alternative environmental criteria; and to identify other issues of environmental significance that are appropriate and essential for consideration by the National Commission on Materials Policy in its report to the President and Congress, June 30, 1973."

From the outset, the Committee realized that the short time schedule for the study would not permit detailed investigation of the questions and issues assigned to it. It did, however, attempt to identify major issues and to suggest specific steps based on available evidence. The study was designed to take a new look at the economic and technical processes involved in materials use by building into them safeguards designed to arrest, abate, and reverse the trend of physical and social degradation. Recommendations are offered in such program areas as the economic implications of environmental quality and materials policy; environmental problems associated with metallic and nonmetallic mineral resources, fuels, and forest products; environmental quality, basic materials policies, and the international economy; and international legal determinants of national materials policy. Questions of resource depletion and allocation of resources on the world scene were dealt with in the NMAB report, *Elements of a National Materials Policy,* published earlier in the year.

Citing the projected exponential growth in population, the growth in per capita product, and the growth in environmental stress per unit of product, the Committee warned that the environmental ills presaged for the United States cannot be completely avoided by available technology. The Committee, therefore, urged a profound change in national values and reexamination of common beliefs that (1) "natural resources can be used in whatever amount is evoked by public demand for goods and services as stimulated by producers' efforts to enlarge their markets; (2) that well-being of society is adequately measured by aggregate volume of the production of goods, increasing per capita consumption of materials and energy; and (3) that technological development should and will continue to contribute to and accelerate the increased throughput of materials per person as it has in the past." The Committee called for "a clear assertion of each person's right to an environment that is not only healthful but possesses a beauty that reflects regard for and insistent action to cherish and preserve its natural qualities."

To this end, the Committee recommended "the examination of the need for and the development of both an amendment to the National Environmental Policy Act of 1969 and to the Constitution of the United States declaring that the right of an individual citizen to a safe, healthful, productive, and aesthetically and culturally pleasing environment shall not be abridged."

The proposed amendments are based on the assumption, the Committee said, that the orderly transformation of the nation's production machinery away from concentration on scarce materials and accelerated use of energy will be accompanied by adjustment to standards set by new environmental policies and by a compatible population policy.

The report offers the following principal conclusions:

1. It is in the national interest that policies and practices aimed at satisfying the nation's need for materials essential to social well-being should reflect and accommodate at all stages, from extraction to waste disposal, considerations of environmental cost to human health, quality of habitat, and stability of ecosystems.

2. This principle should be included in all pertinent policies and legislation stipulating the right of each citizen to a healthful environment in accordance with Principle I of the Declaration of the United Nations Conference on the Human Environment.

3. The resources of all countries should be regarded as part of an interdependent habitat rather than merely as possible sources of supply; and our national policy should therefore conform to the principles of conduct adopted by the community of nations in a common effort to protect the human habitat and its resources.

4. While we can today identify and deal with environmental problems relevant to a materials policy, the Committee said, and while we are prepared

to propose appropriate remedies, the incomplete state of our knowledge requires urgent, systematic expansion of research and of the institutional arrangements needed to widen the data base.

The Committee pointed out that, in its international aspects, U.S. materials policy will have to operate within a growing body of legal and quasi-legal constraints, designed for environmental protection, and that the international community as a whole—notably at the U.N. Conference on the Human Environment—is coming to recognize that the human environment is a matter of international concern.

GENETIC VULNERABILITY OF MAJOR CROPS

In 1970, the Agricultural Board, Division of Biology and Agriculture, established the Committee on Genetic Vulnerability of Major Crops to study the role of technology in the great epidemic of corn blight that destroyed about 15 percent of the corn crop in the United States in 1970. The corn blight epidemic study was undertaken as an example of an anatomical study of genetic vulnerability of a number of major food and fiber crops. The Committee's report was released in the fall of 1972.

Although a major portion of the report deals with the corn blight, the Committee also considered wheat, sorghum, pearl millet, rice, potato and sweet potato, sugar beet, soybeans and other edible legumes, vegetable crops, and cotton. For each crop, plant pathology, genetics, climate, ecology, entomology, biochemistry, and plant physiology were taken into account, and, in each case, the Committee found a common theme: "Crops become genetically vulnerable to pathogens and pests because of the uniformity society demands of the plant breeder."

According to the report, the technology that resulted in the 1970 epidemic of corn blight passed through several stages over nearly sixty years. Through intensive plant breeding, crop yields had increased threefold since 1929, but at the expense of creating genetic uniformity. The pathogen involved was a fungus, *Helminthosporium maydis,* that had probably always been present in American corn fields, but because of the variability in American corn had caused no serious crop losses until 1970. Even then, the Committee found that not all corn was affected by the blight—only those plants that descended from parents carrying what is known as Texas cytoplasm were affected. Unfortunately, because the Texas cytoplasm had produced the desired uniformity in high-yield hybrid corn, by 1970 this hybrid was grown by nearly every corn farmer in America. In due time, a mutant form of *H. maydis* had developed that proved ideal for Texas cytoplasm, weather conditions were favorable, and the blight "spread like wildfire."

The Committee found that most major crops in the United States are "impressively uniform genetically and impressively vulnerable"—a situation that poses substantial challenges, both to scientists and to the nation. The

scientist must be on the constant lookout for exotic pests and for parasite mutants that may attack crops, and must provide "a backup capability comprising diverse genes to be thrown into the breach as needed."

Several measures were suggested by the Committee for national implementation; some of these already exist, others must be established. One of these measures is to set up a "watchdog" system that would include the establishment of overseas laboratories to study diseases and insects and their effects on American plant varieties. Some of these diseases and pests are relatively harmless in their homelands abroad, but could be devastating to American crops if introduced here. Offshore laboratories to study the susceptibility of American crops to exotic pests would also be useful, the Committee said. It cited the Plum Island Animal Disease Laboratory on Long Island and laboratories in Puerto Rico as examples of this type of facility already in existence, and proposed that much more of this sort of testing should be done to assess the vulnerability of our crops to exotic pests. The Committee noted that the United States has an effective quarantine service, but pointed out that interception of pests at the borders is the very last opportunity to stop them.

The Committee suggested the establishment of a national monitoring committee "to keep a watchful eye on the development and production of major crops and to remain alert to potential hazards associated with new or widespread agricultural practices." It could best serve under the auspices of a nationally recognized organization, and should be comprised of scientists from the Department of Agriculture, state experiment stations, universities, industry, and the general public.

The report also stresses the importance of germ plasm resources and of sufficent personnel to maintain them, the introduction of new plant materials, seed storage, maintenance of a living collection, variety development, collections of parasites, and economic devices to mitigate the impact of losses from an epidemic.

WEATHER AND CLIMATE MODIFICATION

In January 1973, the Review Panel on Weather and Climate Modification of the Committee on Atmospheric Sciences, Division of Physical Sciences, transmitted to the National Oceanic and Atmospheric Administration and the National Science Foundation its report, *Weather and Climate Modification: Problems and Progress.* The report summarizes weather modification activities that have taken place since 1966 when an earlier report of these activities was issued by the Academy. The 1973 report not only summarizes recent work, but sets forth goals for a national program to be met by 1980, as follows:

1. Identification by the year 1980 of the conditions under which precipitation can be increased, decreased, and redistributed in various climatological areas through the addition of artificial ice and condensation nuclei;

2. Development in the next decade of technology directed toward mitigating the effect of the following weather hazards: hurricanes, hailstorms, fogs, and lightning; and

3. Establishment of a coordinated national and international system for investigating the inadvertent effects of man-made pollutants, with a target date of 1980 for the determination of the extent, trend, and magnitude of the effect of various crucial pollutants on local weather conditions and on the climate of the world.

The report points out that federal support in the atmospheric sciences includes the fields of meteorology, aeronomy, and planetary atmospheres and is shared by the National Aeronautics and Space Administration, the Departments of Commerce, Transportation, Interior, Navy, Army, Agriculture, and the National Science Foundation. The Panel recommended that the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, which now monitors and keeps records of weather modification activities, be given principal responsibility for administering the national program in order to achieve "stronger and more unified federal programs" in this area. Also recommended was the establishment of a national laboratory to develop and coordinate a program devoted solely to weather modification.

The Panel recommended the continuation or expansion of existing programs in the use of numerical models of weather systems, satellite monitoring of the atmosphere, and international cooperation in the study of climatic variation through the Global Atmospheric Research Program (see page 129). Meeting the program objectives, the Panel said, would cost at least $50 million annually.

In order to meet program goals, the Panel set forth several needed areas of research, including:

1. More adequate laboratory and experimental field programs to study the microphysical processes associated with the development of clouds, precipitation, and thunderstorm electrification;

2. Development of numerical models to describe the behavior of layer clouds, synoptic storms, orographic clouds, and severe local storms;

3. Standardization of instrumentation in seeding devices and the testing of new seeding agents;

4. Establishment of Weather Modification Statistical Research Groups concerned with weather modification and the inadvertent effects of pollutants;

5. Creation by NOAA of a Repository for Data on Weather Modification Activities capable of making available for reanalysis complete data on these activities;

6. A comprehensive series of randomized experiments to determine the effects of both artificial and natural ice and cloud condensation nuclei on precipitation in the principal meteorological regimes in the United States;

7. Continued and expanded investigations into the feasibility of redistributing winter precipitation;

8. Continued and expanded studies of the effects of artificial seeding on cumulus clouds and the numerical modeling of the seeding process;

9. Investigations to determine whether the seeding techniques now used in the study of isolated cumulus clouds and in hurricane modification can be extended to, or new techniques developed for, the amelioration of severe thunderstorms, hailstorms, and even tornadoes;

10. An expanded program to provide continuous birth-to-death observations of hurricanes from above, around, within, and beneath seeded and nonseeded hurricanes and for the testing of existing and new techniques for reducing hurricane intensities;

11. Studies on the development of hurricane-modification techniques should include a randomization scheme in the design and conduct of experimental programs;

12. A major national effort in fundamental research on hailstorms and hailstorm modification;

13. A comprehensive program dealing with research on warm fog and its dissipation;

14. Development of a variety of research techniques specifically designed for observing severe storms;

15. Development of national and international programs for monitoring the gaseous and particulate content of the atmosphere, with particular emphasis on modifications by man's activities;

16. Satellite programs to monitor continually on a global basis, the cloud cover, albedo, and the heat balance of the atmosphere;

17. Enlarged programs to measure those parameters that describe the climate of cities and adjoining countrysides and to determine the physical mechanisms responsible for these differences;

18. Continued strong support for the major effort now under way, known as the Global Atmospheric Research Program, to develop properly parameterized mathematical models of the global atmosphere-ocean system, to obtain the observational data to test their efficacy, and to provide the computers that permit simulation of the effects of human activities on a worldwide scale.

The Panel was optimistic about the feasibility of altering weather and climate, but warned that problems are likely to arise as to which weather modification practices are in the public interest. Before cloud seeding is used as a means of increasing an area's freshwater supply, for example, its costs and benefits should be compared with such alternatives as desalinization, irrigation, and flood-control projects.

COMPUTERS AND PRIVACY

The proliferation of computerized databanks of information about individuals maintained by government, business, medical storage and retrieval

facilities, and universities has raised questions about possible invasions of privacy, the accuracy of the stored information, the uses to which it is put, and public and private access to personal information. By the late 1960's, these questions had become one of the most widely discussed civil-liberties issues facing American society.

In preliminary discussions of the invasion-of-privacy issue, the NAS Computer Science and Engineering Board found a lack of sound factual knowledge of what was actually taking place as organizations computerized their records. With support from the Russell Sage Foundation, the Board planned and conducted a two-year national study of computerized databanks.

The Board's report, *Databanks in a Free Society,* describes the operations of 14 governmental, commercial, and private organizations that are leaders in their fields in the use of computers for record-keeping. Detailed on-site investigations were made of databank operations of 55 organizations, including such governmental information collections as federal census records, Social Security and welfare records, military records, health and school-system records, law enforcement, civil service, etc., as well as banking, insurance, credit, and other private record-keeping operations. The Board summarized its findings and observations as follows:

1. We found no instances of complete-outsider intrusion, solely by technological means, into computerized files to obtain information content, and very few examples across 55 organizations of unauthorized disclosure or use of computerized records by employees. We found far more examples of information breaches from manual files. . . What were sometimes seen in public discussions as breaches of security frequently turned out to be sharing of data authorized by law or organizational policy, but disputed by various critical groups, or sharing that was being done as part of the informal information buddy system because of the general public's lack of knowledge or concern over the matter.

2. With a few exceptions in organizations with unusually strong confidentiality concerns, most organizations we studied have not been convinced that unauthorized persons want their information about people badly enough to try to get it without permission. As a result, the information security measures taken by computerizing organizations have, thus far, been distinctly minimal. . .

3. Although no system operating in the active world of government, commercial, and private life can be made permanently and completely safe, there are available techniques for providing far more security for information in computerized files than are presently being used. The strong impression that we drew at our site visits was that whether organizations would give the staff attention, spend the money, and accept the constraints on system operations that security measures generally require will depend primarily on outside pressures, especially the attitudes of regulatory agencies and lawmakers on how important it is to assure confidentiality of information in various sectors of record-keeping.

According to the Board, the rapid innovations and utilization of computerized record-keeping during the past 25 years point to the need for consideration of the impact on policy decisions that anticipated future developments in computer technology might have. The Board cited estimates that,

by the close of the 1970's, there will be 500,000 computers (including mini-computers) in use, as compared with the 90,000 in use at the beginning of the decade. In developing a technological forecast, the Board stated: "The assumption has been that technological possibilities invariably become organizational realities, unless an aroused public opinion forces the passage of prohibitory legislation holding back the tide of technological determinism." As for the future, the Board concluded that there will be "increasingly powerful and more flexible tools with which to pursue policies through the collection and use of information. . . . As more and more organizational record-keeping becomes computerized, and as important new record systems are developed, it will become critically important that the standards and procedures that are being applied more efficiently by these computerizing organizations are faithful to democratic goals, especially individual rights to privacy and due process."

Among the areas of priority for public policy set forth by the Board were: (1) Ensuring individuals access to their records, possibly through court rulings, although legislative action should be taken. (2) Legislation to ensure confidentiality and to set guidelines for data sharing. (3) Restrictions on unnecessary data collection. (4) Technological safeguards for information systems. (5) Government restraint in establishing a national numbering system for individuals. (6) Creation of "information trust" agencies with clear legislative mandates to be "guardian" institutions, on behalf of the public, with control over sensitive computerized information files.

In conclusion, the Board made the following statement on "Men and Machines":

> If our empirical findings showed anything, they indicate that man is still in charge of the machines. What is collected, for what purposes, with whom information is shared, and what opportunities individuals have to see and contest records are all matters of policy choice, not technological determinism. Man cannot escape his social or moral responsibilities by murmuring feebly that "the Machine made me do it."
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> Computers are here to stay. So are large organizations and the need for data. So is the American commitment to civil liberties. Equally real are the social cleavages and cultural reassessments that mark our era. Our task is to see that appropriate safeguards for the individual's rights to privacy, confidentiality, and due process are embedded in every major record system in the nation, particularly the computerizing systems that promise to be the setting for most important organizational uses of information affecting individuals in the coming decades.

EVALUATION OF COAL-GASIFICATION TECHNOLOGY

The declining rate of gas discoveries in the continental United States, accompanied by a continually increasing demand, has brought the country face to face with a shortage of natural gas at a time when there is urgent need for clean fuels to reduce pollution. Of the fossil fuels, coal and oil shale are

the only remaining abundant energy resources available in the United States.

Process development in coal gasification has been sponsored by the U.S. Department of the Interior for a number of years, and several processes are being studied under the auspices of the Bureau of Mines, the Office of Coal Research, the Institute of Gas Technology, Consolidation Coal Company, Inc., Bituminous Coal Research, Inc., the Environmental Protection Agency, and several universities. In June 1971, the Office of Coal Research, Department of the Interior, asked the National Academy of Engineering for a technical evaluation of current coal-gasification research and development efforts to produce pipeline-quality gas and to assess these efforts in terms of their commercial application. The task was assigned to the NAE-NRC Committee on Air Quality Management, which established an *ad hoc* Panel on Evaluation of Coal-Gasification Technology to conduct the study.

The Panel's report, *Evaluation of Coal-Gasification Technology, Part I, Pipeline-Quality Gas,* describes eight coal-gasification processes, most of which are in the small pilot-plant stage, and delineates the advantages and disadvantages of each. Among them only the Lurgi process has reached commercial application to date. The other processes described include the Hy-Gas processes (electrothermal, steam-iron, and steam-oxygen), the Synthane process, Hydrogasification, Bi-Gas process, Acceptor process, Molten Carbonate process, and Atgas process.

Based upon its review, the Panel recommended that:

1. Modern technology should be developed and applied as rapidly as possible to coal-gasification plants to be built in the United States. *Since the essential component being examined is the gasifier, it is not necessary in pilot-plant work to operate the full gasification train.* Several processes should be tested in order to determine the one or two that offer the best technological and economic benefits. These should be carried through the commercial demonstration level.

2. Pilot-plant work should go forward on the Hy-Gas (steam-oxygen), Synthane, Bi-Gas, and Acceptor processes. The IGT electrothermal and steam-iron options of the Hy-Gas process do not appear promising. Further work is recommended on the Hydrogasification process that is under test by the Bureau of Mines. This process gives promise of producing a high methane gas directly from coal.

3. Prime responsibility for coal feeding, as well as for gas purification and methanation, should be given specific attention by groups other than those developing the gasification processes. This division of effort should result in much faster progress on the total program.

4. As yet, the methanation process has not been used for the complete conversion of a high concentration of carbon monoxide to methane where there is a large evolution of heat. There are additional questions concerning the effects of gas produced from coal on catalyst life and performance. It is recommended that enough work be carried out to ensure that the catalysts are satisfactory under these conditions and to secure necessary design data on rates of heat release and on methods for the efficient recovery and use of this heat.

5. Development and design work to find satisfactory solutions to pollution and ecological problems associated with coal gasification should proceed concurrently

with the development of gasification processes. This work should be assigned to a special group for its full attention.

6. Basic research should be conducted on such factors as fluidization and reaction rates between carbon, oxygen, hydrogen, and steam at various temperatures and pressures in order to facilitate the design and construction of plants and reactors. Purification systems for high-Btu gas synthesis must be studied and analyzed to determine which are most suitable and economical. Catalyst research should be strongly supported on a continuing basis. Fluid-mechanics problems, including the effects of bed diameter on fluidization (scale-up factors are poorly known), the effects of changes in particle-size distribution, and the permissible concentration of sticky feed and ash, should be studied. Other process areas requiring research are those involving expansion and contraction with temperature in pressure joints and seals.

7. *All estimates should be made on a consistent and realistic basis to facilitate cost comparisons between the various processes. A base plant size of 250 million cf per day has been agreed upon. It would be desirable to select one or two coals and lignites of approximately a typical composition and have the plant designs based on these raw materials. Also agreement on approximate prices per million Btu would be desirable for fuels at a few locations. Site development, unit costs for utilities, auxiliary facilities, and major items of capital cost and operating costs should also be put on a standardized basis.*

The Panel strongly recommends that all estimates be reviewed and revised by an independent organization with experience in plant design, fuel conversion, environmental acceptability, and economic evaluations to ensure that they are accurate and based on sound engineering judgment.

8. *A management group should continuously review the entire government-sponsored program on coal gasification.*

The work for the next several years will involve a considerable number of research and engineering groups. The Panel recommends that the gasification step in particular be simultaneously investigated by at least four groups. One or perhaps two of the gasification processes will probably show superiority over the others, and decisions will have to be made to drop the least promising lines of development.

A second and equally important part of the management problem will be the division and coordination of the work between the development groups and the assignment of work to allow concentrated effort on the most critical problems."[13]

MOTOR VEHICLE EMISSIONS

The Clean Air Amendments of 1970, which established exhaust emission standards for 1975 and 1976 light-duty vehicles and light-duty vehicle engines, directed the Administrator of the Environmental Protection Agency (EPA) "to enter into appropriate arrangements with the National Academy of Sciences (NAS) to conduct a comprehensive study and investigation of the technological feasibility of meeting the emission standards" promulgated by the Clean Air Amendments. The Academy subsequently established the Committee on Motor Vehicle Emissions. In accordance with the terms of the NAS-EPA contract, the Committee submits semiannual progress reports to the EPA Administrator and to the Congress, to serve as bases for decisions regarding postponement of the standards deadlines called for in the Clean Air Amendments.

The first substantive report by the Committee was submitted on January 1, 1972; it was followed by two interim reports, and—in February 1973—by the Committee's report on the technological feasibility of achieving the 1976 emission standards established by the Act.

The Committee defined "technological feasibility" to mean that an emissions control system capable of meeting the standards set for hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x) can be developed, designed, produced in large numbers, and maintained in service, all at reasonable cost. The Committee concluded that "achievement of the 1975 standards may be technologically feasible and that achievement of the 1976 standards is likely but may not be attainable on the established schedule."

For 1975 model year light-duty motor vehicles, the Committee concluded that:

1. Four types of systems will meet the prescribed emissions standards during certification testing. These are: the modified conventional engine equipped with an oxidation catalyst, the carbureted stratified-charge engine, the Wankel engine equipped with an exhaust thermal reactor, and the diesel engine. For the catalyst system, one catalyst change must be permitted during the 50,000 mile durability testing for certification, and fuel with a suitably low level of catalyst poisons must be allowed. In determining whether vehicles mass-produced comply with an outstanding certificate of conformity under Section 206 of the Clean Air Act, provisions must be made for averaging of emission test results within a vehicle and engine class.

2. Vehicles incorporating these systems can be mass-produced in great enough volume to satisfy, in aggregate, the expected demand for vehicles in model year 1975.

3. It is important for two reasons that a suitable maintenance and inspection system be established for vehicles in use by the public.

First, there are no data concerning the deterioration of emission-control systems under conditions of customer use, and the Committee believes that the certification procedure alone is not a sufficient indicator of system durability. Even if it is determined that properly maintained vehicles can comply with the standards under conditions of customer use, an adequate vehicle maintenance and inspection system will be required to assure that most vehicles will meet the standards when used by the general public; this is especially important for catalyst-equipped vehicles.

Second, if it is determined that a substantial number of any class of vehicles or engines, although properly maintained and used, is not meeting the standards in use, Section 207(c) of the Clean Air Amendments empowers the Administrator of EPA to require the manufacturer to submit a plan for remedying the nonconformity. Under such a plan, the manufacturer is required to correct only those vehicles or engines which have been properly maintained and used.

4. The average increase in sticker price due to the emissions-control system of a catalyst-equipped vehicle is estimated to be $160 above a current (1973) vehicle and $230 above a 1970 model year vehicle. Except for the diesel engine, lesser increases are expected for the other emission-control systems, when comparing vehicles of similar size and type.

Model year 1975 vehicles using Wankel engines or catalyst-equipped spark-ignition piston engines will use significantly more fuel than their 1973 counterparts. Carbureted stratified-charge engines will suffer only a slight fuel penalty; and the diesel engine will offer improved fuel economy, enough to compensate for its high initial cost within a few years of driving.

For 1976 model year light-duty motor vehicles, the Committee concluded:

1. Five control systems now in early stages of development have met the 1976 emission standards at low mileage. These are: the modified conventional engine equipped with dual catalysts, or with dual catalysts plus thermal reactor, or with two thermal reactors and a reduction catalyst, or with a three-way catalyst and electronic fuel injection, and the stratified-charge engine employing fuel injection and equipped with an oxidation catalyst. It is possible, but not certain, that some of these systems may prove to be certifiable for 1976, contingent upon the acceptance of the same provisos previously mentioned for 1975 model year vehicles.

More importantly, the recently developed carbureted stratified-charge engine, after 50,000 miles of durability testing on a compact car, has achieved well over the 90 percent reduction in hydrocarbons and carbon monoxide emissions called for in the Act and about 83 percent reduction in NO_x. The Committee believes that this engine will be certifiable for 1976, at least in smaller engine sizes.

2. If certifiable, vehicles incorporating any of these systems can be mass-produced, but not necessarily in great enough volume to satisfy, in aggregate, the expected demand for vehicles in model year 1976.

3. The Committee holds the same concerns for performance of 1976 vehicles in use as discussed above for 1975 systems.

4. The average increase in sticker price of a dual catalyst-equipped vehicle is expected to be $290 above a current (1973) vehicle, and $370 above a 1970 model year vehicle. Average annual costs of a dual-catalyst emissions-control system, including maintenance and fuel, with the increase in sticker price amortized over five years, is estimated to be $260 per year, compared with a 1970 model year vehicle. In contrast, the annualized costs for several other systems are estimated to be less than $100.

The Committee expressed grave concern about the trend of development of the 1976 emission-control systems toward catalyst-dependent systems, which are the most disadvantageous in terms of first cost, fuel economy, maintainability, and durability, whereas the carbureted stratified-charge engine is superior in all these categories but may not be available in very large numbers in 1976. The Committee alerted both EPA and the Congress to the danger that, once committed to the catalyst-dependent systems, the automotive industry will continue their manufacture for some years rather than switch to some more generally acceptable system. It pointed out that "the dilemma, then, is to determine what course of action, by government, would assure the earliest possible optimal outcome while scrupulously avoiding dictation, by government, of the technology to be used.

In the long run, the Committee said, "the truly effective mechanisms for emission control must include a significant reduction in the number of cars operated in the city, a solution dependent upon acceptable, public mass transit systems, and a substantial reduction in the mean size (weight, volume, and horsepower) of those automobiles which do function in the city, as well as, perhaps, redistribution of the pattern of physical relationships among dwelling and working areas. Patently, these are relatively long-term goals, achievement of which will require extensive, meticulous study and planning with subsequent large public expenditures and careful public intervention into the behavior of the private sector."

In the short term, the Committee pointed out that, in view of the costs to the nation in dollars and in fuel consumption, attention might be given to the possibility of temporarily enforcing the established emissions standards only in those specific urban areas where air quality is known to be adversely affected by automotive emissions, reserving national implementation for the day when there are available reliable, relatively inexpensive emissions-control systems which exact no fuel penalty.

SAFETY OF RESOURCE DEVELOPMENT ON THE OUTER CONTINENTAL SHELF

There has been a great deal of controversy over the development of offshore oil reserves—possibly the largest domestic resources of oil and natural gas now available to the United States. Although many environmentalists consider any risk to the environment unacceptable and unnecessary, there is widespread conviction that these resources must be developed. If the United States is to maintain its present economic standards and improve the lot of many who do not now share adequately in the U.S. economy, it is essential to maintain and improve present levels of productivity.

In 1971, in response to a request from the Department of the Interior, a panel was established under the Marine Board of the National Academy of Engineering to examine the question of "safety in offshore resource development."

The panel's report, *Outer Continental Shelf Resource Development Safety: A Review of Technology and Regulation for the Systematic Minimization of Environmental Intrusion from Petroleum Products,* considers a broad range of opinions, data, and conclusions about the need for offshore recovery, the degree of biological and aesthetic degradation that has taken place or that can be tolerated, the adequacy of present offshore oil technology and regulations, the cost-benefit relationships of alternative energy resources, the magnitude and effects of other sources of ocean environmental intrusions, and the social benefits that might result from implementing various recommendations.

The panel pointed out that petroleum is trapped in a reservoir overlain by rock strata, which holds it at a pressure that would force the trapped fluid to flow to the surface through any uncontrolled channel into the reservoir. As the geophysical forces and formation that created and encapsulated the oil are never completely defined, the panel said, "even the most advanced, fail-safe recovery methods cannot guarantee a zero probability of oil spills. Therefore, certain risk is inherent in any recovery process." There is no way, the panel said, to eliminate the possibility of introducing oil in some form into the world's oceans by merely curtailing offshore domestic production. "The United States cannot unilaterally prohibit the recovery of petroleum from waters off other nations." The panel also pointed out that curtailment of domestic production would force the United States to obtain additional petroleum from abroad, and the risk associated with the trans-

port, transfer, and terminal operation of foreign oil would possibly be greater than the risk posed by domestic offshore production.

The introduction of oil into the marine environment from natural seepage, tanker incidents, and municipal and industrial wastes far surpasses in quantity and toxicity the potential environmental impact from offshore crude oil pollution from recovery operations. According to the panel, the history of domestic offshore oil production shows that release of oil to the environment is neither a frequent nor a large-volume occurrence.

At present, the panel said, the United States petroleum industry leads in the development of technology and its application to offshore resource operations. Through its domestic petroleum industries, the United States can continue to contribute technology and operating procedures that minimize the possibility of oil spills. In this connection, the panel set forth the following recommendations for action by the U.S. Government:

Encourage and sponsor the development and testing of damage-limiting and fail-safe systems and techniques in the areas of damage control, fire fighting, and well control.

Develop a policy regarding the testing of offshore equipment, including the establishment of criteria for selection of test sites for such equipment in the marine environment.

Make quantitative studies of the effectiveness of the various present and potential methods of cleaning up oil from the marine environment, and of their potential marine environmental impact.

Sponsor a coordinated program to specify reasonable limits of crude oil intrusion in accordance with biological and aesthetic standards. These standards should be set in a manner that will take full account of site variables. The effort should be carried out on a continuing basis in order to take advantage of improvements in the technology of offshore petroleum operations. The program should be specifically directed to provide a basis for engineering design and standards for components and systems to be used in offshore petroleum operations.

In order to avoid inhibition of technical development and to take maximum advantage of advances in equipment and technology, U.S. Government policy should be to establish regulations in terms of the objectives to be achieved and not in terms of specific methods of achieving them.

The Government should encourage and support the development of a comprehensive system of industry consensus standards and should make use of the resulting standards system in the regulation and inspection of the offshore industry, and make adherence to such standards a consideration in the issuance of permits.

Pointing out that, both ashore and in the marine environment, the oil industry places great reliance on highly skilled personnel at all levels, the panel recommended that the U.S. Government "actively encourage and support" operator training programs with the objective of providing "safe and reliable operation, installation, maintenance and repair of equipment systems and components." It was further suggested that the government sponsor industry-government standardization of training criteria; give consideration to the quality of job qualification requirements and training in the leasing and permit procedures; and ensure the participation in such training programs of U.S. Government personnel who are involved in standard setting, regulation, and inspection or permit procedures.

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INDUSTRIALIZED HOUSING

The Industrialized Housing Committee was established by the National Academy of Engineering in 1970 under a grant from the Scaife Family Charitable Trust. The Committee was charged with assessing the state of the art in industrialized housing and conducting market and feasibility studies to help determine whether or not America's leading manufacturing corporations might, through improved production technology, play a greater role in meeting the nation's housing needs.

There were several significant economic and social indicators that appeared to support the assumption that cooperative efforts among the nation's leading manufacturers were essential in the mass production of housing and would prove sufficiently profitable to attract the investment capital required to launch a new, high-technology industry. Among these indicators were: the federal government's housing goals, calling for the construction of 26 million units by 1978; the role of improved construction methods in several successful European housing programs; the emergence of new housing markets and the moves toward reforming existing building codes; changing attitudes of organized labor; and increasing confidence in the effectiveness of technology transfer.

In the report, *Industrialized Housing: An Inquiry into Factors Influencing Entry Decisions by Major Manufacturing Corporations,* the Committee set forth two major assumptions that were basic to the study design of the Industrialized Housing Project: (1) Leading manufacturers have experience in cost-saving, mass-production techniques and management skills that "suggest optimum transferability to an industrialized delivery system for housing," and are capable of "developing an integrated manufacturing process for adapting innovative housing hardware to high-volume production components." (2) The nation's leading manufacturers can command enough capital to sustain volume production of housing units in the face of market fluctuations, and "have the ability to deploy on a nation-wide basis sophisticated management, inventory, and distribution systems capable of aggregating markets and delivering housing in sufficient volume to assure profitability."

In preparing its report, the Committee relied heavily on technical staff provided by several of the nation's largest industrial organizations, who worked as consultant-contractors on studies of market research, industrial relations, the development of an information system, systems analysis, and environmental design. In addition, interviews were conducted with corporation executives and financial underwriters familiar with housing issues.

The major conclusion reached was that leading "American corporations would not, at this time, contribute to an improved housing stock by merely adding capacity through expanded mass production methods." According to the report, ". . . an improved technology yielding only increased produc-

tion can, at best, reduce costs to the consumer by less than ten percent." The Project inquiries also showed that federal housing goals can be met, or even exceeded, by conventional builders combined with production of mobile homes.

With regard to economic advantages to industry accruing from mass-produced housing, the Project disclosed that "economic advantages, specifically, return on investment over an acceptable period of time, would not accrue to large manufacturing corporations entering the factory-built housing industry on a large scale at this time." On the other hand, the report says that "increased industrialization would offer cost-effective opportunities for improving the quality of housing."

Despite the predominantly negative conclusions about the prospects of industrialized housing at this time, the Committee pointed out that social and technical changes are slowly taking place that may be favorable to its adoption at some later date.

GEOGRAPHICAL PERSPECTIVES AND URBAN PROBLEMS

In January 1973, the Academy published the report of a symposium that had been organized by the Committee on Geography, Division of Earth Sciences, in September 1971. The report, *Geographical Perspectives and Urban Problems,* contains the papers presented at the symposium. The following are excerpts from those papers:

With the new surge of activity in urban geography related to behavioral research we are moving closer to the development and integration of knowledge that will make possible even greater utilization of existing models for alternative urban-planning policies. If we are to be able to derive the difficult and complex answer to the question of what we want our cities to be, we must have models that will allow us to evaluate the impact of the implementation of policies. In this way, we shall be able to judge whether our policies are shaping cities in such a manner as to improve and maintain the quality of urban life. As individuals, we have little impact on the spatial structure and form of our cities; we respond mainly to alternative opportunities that ultimately define the success or failure of public and private investments. Models with integrated behavioral elements should allow us to assess individual response to alternative urban spatial structures and enable us ultimately to evaluate whether the urban environments that we are creating are appropriate for our long-term goals.

JOHN R. BORCHERT, University of Minnesota.
FRANK E. HORTON, University of Iowa.

. . . [T]he division of geographic space is at the heart of many political questions; we can speak of human cultures in the plural precisely because they are separated and protected by distances that take time, effort, and money to overcome. The sheer friction of distance prevents human homogenation, or has until recently in human history . . . Only now are we slowly turning our thoughts to metropolitan *regions,* ghetto *areas,* political *redivisions, realignments,* and *reapportionments*—indications that we are finally considering problems of society in terms of the specific "where" questions of the geographer. I would contend that the most important con-

tribution of the geographer comes precisely from his own particular bias—namely, his spatial viewpoint and the locational questions he brings to bear on human problems.

Many of these human problems today lie in our burgeoning cities whose difficulties are being carefully monitored by other societies in the hope that they can gain some lead time in which to alleviate the most pathological aspects of rapid and barely controlled urbanization. Rightly or wrongly, we feel we are the most economically advanced nation on earth, but we realize that we are paying a terrible human price for such a simplistic and, in important aspects, such a meaningless index as median income per capita. Every day our newspapers record the further breakdown of our cities and illustrate the unpalatable truth that in human and social terms we are an underdeveloped country with a lot of catching up to do.

PETER GOULD, The Pennsylvania State University.

For low-income communities to exercise a greater degree of discretion over the neighborhood environment implies greater control over four major functions: maintenance of existing properties, elimination of undesired land-use activities, prevention of noxious facilities from entering, and inducement of desired services and other land use . . .

To make metropolitan policy-making more responsive to the needs of communities requiring the most attention, the demands of such communities must be felt. Community mobilization in low-income neighborhoods must first overcome the self-fulfilling defeatism and self-perceived marginalism that breed defeat. The community that does not mobilize is subject to severe costs because of the wedge left open for outside opportunism and the city's expediency. Sometimes a community must run just to stay in place.

JULIAN WOLPERT, ANTHONY MUMPHREY, and
JOHN SELEY, University of Pennsylvania.

Three conclusions can be made on the relation between the physical environment and urban planning and development.

First, the separation between man and nature or between the physical environment and man-made phenomena is both artificial and misleading. Wolpert's essay, "Community Discretion over Neighborhood Change," demonstrates that the spatial distribution of facilities has a differential impact on different parts of the community, as do the magnitude and spatial distribution of natural processes. The absolute height of a flood, for example, is only one part of the needed information. The impact of a flood . . . will be assessed differently depending on where one lives, one's opportunities to move, and a host of other social conditions. It is the integration of these relations rather than the separation that constitutes the planning contribution.

A second conclusion was mentioned at the outset as a cautionary note. Geographic knowledge and the history of geographic thought have demonstrated that simple environmental determinism does not provide an adequate guide to human settlement. Information about the environment is essential to thoughtful planning because it helps to provide an evaluation of the consequences of alternative courses of action. The mere choice of information to be evaluated constitutes a decision about values, yet the values associated with alternative actions do not lie in inches of runoff or in acres of grassland. Such values must be determined by society.

Last, a great deal more is known about the environment than is currently used in planning and developing urban areas. At a minimum, sufficient knowledge of many

processes exists to predict that the modification of the environment inherent in the development of cities will lead to a sequence of changes at a given location and often at distances far removed from the site of the disturbance.

We should not be surprised at the chain of so-called inadvertent modifications of the landscape that follow development. Acceptance of this simple truth might in itself lead to more comprehensive, as well as more thoughtful, approaches to the use of the landscape.

M. Gordon Wolman, The Johns Hopkins University.

. . . We should like to be able to achieve a level of expertise in planning intercity and interregional relations comparable to that of national economic planning.

So far geographers have not contributed a great deal of information that might be useful in overcoming the different conceptual difficulties and technical problems now hindering the development of effective regional planning policies. For the most part, geographic research has focused on static situations and on narrow definitions of urban and regional economies. By contrast, the formulation of effective planning policy, whether at regional or national levels, demands a sound appreciation of the dynamics of the systems being planned and the ability to identify critical control variables."

Leslie J. King, McMaster University.

Our ability to determine what the landscape of the future will be like is greatly restricted because most of tomorrow's landscape will be inherited virtually unchanged from yesterday's. People and their activities are located in particular places; the material investment in improvements and modifications to the land is stupendous, at least $3 trillion. The human nonmaterial investment in current place-oriented behavior is just as overwhelming. The investment of a few years can have only a marginal effect in altering the human or natural features of the landscape or modes of behavior.

. . . the polarization of settlement resulting in metropolitan concentrations and rural stagnation is a severe problem because of the mounting costs and disorders of the metropolis and the poverty and waste of resources of much of the countryside. Above all, in a democratic society, perhaps the wishes of many people not to live in the over-crowded giant metropolis should receive more attention.

From this essay emerges an advocacy of establishing a set of growth centers in less-successful or less-urbanized regions to accommodate part of the future urban growth. This policy would permit more of the population to live in the regional setting of their choice, and indirectly, but much more efficiently, accomplish the aims of rural industrialization to revitalize nonmetropolitan America. At the same time, excessive pressure on the largest metropolises and metropolitan regions would be relieved, but these areas would continue to grow. If such a policy were adopted, however, we should realize that it would require greater public involvement, especially in land-use control and the location of future private investment, than has heretofore been accepted in our culture. This will also be true if we are serious about solving metropolitan problems. I believe that the gain in freedom of choice for large numbers of people more than offsets the small loss in discretion for far fewer firms, and that the change in priority is justified on economic grounds of regional equity and political grounds of public demand.

Richard L. Morrill, University of Washington.

The most pervasive feature of urbanization today, and the principal source of internal dynamics of the nation's daily urban system, is segregation—of land uses and activity systems, of income groups, family types, and ethnic and racial minorities—and the action space within which the interactions of opposing forces are being played out is the larger reality of the daily urban system.

BRIAN J. L. BERRY, University of Chicago.

DISEASE BY DISEASE TOWARD NATIONAL HEALTH INSURANCE?

The Panel on Implications of a Categorical Catastrophic Disease Approach to National Health Insurance was appointed in March 1973 by the Institute of Medicine in response to the passage of the Social Security Amendments of 1972 (P.L. 92–603). These amendments provide that workers and their dependents with chronic renal disease who would benefit from hemodialysis or kidney transplantation would be deemed disabled for purposes of coverage under Parts A and B of Medicare. The provision becomes effective July 1, 1973, with an estimated cost of $135 million for the first year, and possibly as much as a billion dollars per year by the 10th year. The Institute of Medicine undertook an analysis leading to a policy statement on the implications of a disease-by-disease approach to national health insurance. The statement was released in June 1973.

The Panel concluded "that the categorical catastrophic approach should not be used as a means for providing expensive care to specific patient groups."

In reaching this conclusion, the Panel considered not only the implications of renal hemodialysis or transplants in terms of numbers of patients who might be helped and in terms of cost, but also sophisticated medical technological approaches to hemophilia and end-stage heart disease. In the case of hemophilia, the Panel estimated that the overall annual expenditure by the federal government would be roughly $150 million; for end-stage heart disease, the cost might reach more than a billion and a half dollars per year, and, at best the "highly sophisticated medical technologies only partially restore patients to the normal functioning state . . . it is apparent from the cost of both treatments that adding even a few more categories for support raises a concern as to whether or not they would require a disproportionate amount of the federal health budget." According to the Panel, "The tradeoffs would be such that money funneled into the development of these technologies would not be available for important areas of research that would get at the causes of these diseases and that would result in medical intervention that both would be less expensive and would avert any long-term disability."

In summary, the Panel listed its recommendations as follows:

1. We urge the Congress and the Administration to follow closely the implementation of the hemodialysis and kidney transplantation provision of Public Law 92–603, noting the overall costs and impact on medical manpower and facilities.

2. We recommend that coverage of discrete categories of catastrophic diseases would be an inappropriate course to follow in the foreseeable future for providing expensive care on a universal eligibility basis.

3. The following studies should be considered before additional diseases are considered for coverage:

a. An assessment of technological advances that may be anticipated in the near future—how much they may cost, and how effective they may be in rehabilitating patients.

b. An examination of the capacity of the private sector to take up the costs of treatment for certain catastrophic conditions.

c. Comparison of the costs of various proposals for across-the-board catastrophic national health insurance with those of covering various specific catastrophic diseases on a categorical basis.

d. A close examination of the problems of determining the most effective allocation of funds for research and for the delivery of health services, and the benefits of both to society.

CONTRASTS IN HEALTH STATUS

Infant Death: An Analysis by Maternal Risk and Health Care is the first volume of a three-volume Institute of Medicine study of Contrasts in Health Status that began in 1969 under the aegis of the former Board of Medicine.

In developing the study, the Institute's Panel on Health Services Research focused on the concept of using identifiable health conditions as indicators, or tracers, to isolate and analyze specific components of health status. This phase of the study uses infant birth to examine differences in need for and receipt of health services by women during pregnancy where the ultimate outcome is the survival or death of the infant. The Panel based its study on records of medical care, social, and demographic characteristics, made available to them from vital statistics data on 140,000 births in New York City for 1968.

The study data, which had been coded and placed on computer tape by the city health department, included information on the mother's race and nativity; education of both parents, when available; time of first and number of subsequent prenatal-care visits; the hospital where the baby was born; the attendant at birth; status of the mother's health and the infant's health at birth; and selected details of pregnancy, labor, and childbirth. The scope of these data permitted the classification of mothers in four risk groups—one no-risk group and three at-risk groups, based on social factors, medical conditions, and combined social and medical conditions.

The infant mortality rate in New York City in 1968 was 21.9 per 1,000. More than 56 percent of the births were to white native- and foreign-born women, approximately 23 percent to black native-born mothers, and just under 16 percent to Puerto Rican women. More than three-fifths of the white native-born women were at no risk, while only about one-fourth of

the black native-born women were at no risk. The percentage of women receiving adequate and inadequate care varied greatly by race-nativity group.

Although the Panel emphasized that "further research is needed to verify some of its findings and to clarify specific complex social-medical issues, changes in the delivery of maternal and infant health services can now be made in some clearly indicated areas without waiting for the results of new research."

Specifically, the Panel recommended that:

(1) All pregnant women should be evaluated in the first trimester and classified by risks that could adversely affect the survival of their infants.

(2) Guidelines for prenatal, obstetrical, postnatal, and interconceptional care should be established that are appropriate for the management of different risk categories.

(3) Health services programs that are responsible for a defined geographic area or population should identify all pregnant women in their jurisdiction.

(4) Categorical programs that deliver obstetric and infant services should be designed so that scientifically acceptable evaluations of their impact on infant survival can be made.

(5) Updated federal regulations for the Maternity and Infant Care projects should be issued.

(6) The delivery of special infant health services, particularly neonatal intensive care, should be regionalized.

(7) Traditional obstetric and pediatric manpower roles should be redefined.

With regard to research in the delivery of maternal health services, the Panel recommended that "Systematic analyses of pregnant women of different risk receiving varying levels of maternal health services should be carried out. . . . These studies must be carefully designed," the Panel said, "so that the new information will clarify the critical social and health policy issues and establish a firm basis for determining maternal and infant health services priorities. From the results of our study we have identified five major areas with pressing needs for carefully planned studies:"

(1) "We are all aware that many different kinds of factors, such as biological, social, economic, behavioral, and medical care, influence an individual's health status. However, we cannot determine from the study of New York City births, for example, what the social, economic, and behavioral differences are between women classified at social risk who received adequate care and those of social risk who received inadequate care. Nor do we know with certainty whether there are differences between persons of various ethnic backgrounds and the severity and nature of their social risk. For example, we need to know if Puerto Rican and white native-born women at social risk should be categorized further so that the severity of the social risk can be identified and more appropriately addressed in each case. These are hard-to-fill gaps in our social-medical knowledge but ones

that can be approached, if not bridged, with carefully designed research programs.

(2) "It is necessary to clarify the relationship between categories of health services as used in this study—adequate, intermediate, and inadequate—and the actual content of delivered medical care. In attempting this, research should lead to more useful classifications of care, the identification of the important elements of care, and the ability to better define different levels of care. Implicit in this research objective is the need to study further the effect of different kinds of prenatal medical care on the outcome of pregnancy.

(3) "The analyses in this report do not address the cost or cost effectiveness of delivering maternal and infant services. Indeed, it was virtually impossible to obtain cost data for categorical programs designed to give prenatal and infant care. In carrying out such studies, an effort to assess the direct and indirect benefits of such expenditure should be made. Of paramount importance is developing some measures of the present cost of delivering these services so that comparisons with new modes of delivery can be made.

(4) "To refine the risk categories used in the analysis of the New York City infant births and deaths, more detailed studies of the relationship between infant survival and maternal characteristics are required. From such new analyses, providers of obstetric services would be able to determine the risk faced by an individual female and direct her to appropriate services that decrease her chances of producing a low-birth-weight or nonviable infant. The risk scale would complement expanding efforts to identify and provide intensive neonatal care to those who are in greatest need of those services.

(5) "Similar studies using existing vital statistics should be carried out for other U.S. populations to assess maternal risk, care, and pregnancy outcome in rural and other urban populations."

A Strategy for Evaluating Health Services is the second of the three-volume report. It describes the development of the tracer methodology for evaluating ambulatory health services. Tracers are defined as specific health problems that are treated by health-care systems. According to the report, "The tracer methodology provides a manageable approach to dealing with many intricate problems in health evaluation. By expanding the number of tracers—and combining the tracer technique with a structured and easily retrievable data base—a major step can be taken toward the development of a functional approach to health care evaluation."

The Panel pointed out that the "difficulty of evaluating health services reflects the difficulties of assessing the quality of any complex social and personal service, and is an issue that, until relatively recently, has received little attention from the medical profession, the public, or the government. As a result, the rudimentary methods available for evaluation are neither

reliable nor accurate. Yet, public expectations and proposed health legislation demanding quality health care require the evaluation of present systems of health-care delivery and quality. These evaluations, in turn, require the development of the technology, manpower, and data base needed for evaluation on a national scale. This study was designed to analyze differences in health status among different groups of people; to relate differences in health status to social, economic, medical-care, and behavioral characteristics; and to compare the effect on selected groups of people of various arrangements for the delivery of services."

The Panel pointed out that the "value and reliability of evaluating health services by tracers rests on the selection of the tracers and the development of minimal criteria against which the tracers can be compared." The following criteria for selecting health problems to be used as tracers were developed: (1) the effect of the condition must ensure that the patient will be likely to seek treatment; (2) the condition should be relatively well defined and easy to diagnose in field or practice settings; (3) the condition should be prevalent and thus afford adequate data from a limited population sample; (4) the natural history of the condition should vary with the quality and quantity of medical care; (5) the techniques of medical management should be well defined for at least one of the following processes: prevention, diagnosis, treatment, and rehabilitation or adjustment; and (6) the effects of socioeconomic factors should be relatively well understood.

Based upon these criteria, the Panel selected six health problems as tracers and described the segments of a population and health services they monitor. The tracers selected were middle-ear infections and associated hearing loss (affects children of both sexes); vision disorders (common to all ages, but especially useful for evaluative screening of persons between ages 5 and 25); iron-deficiency anemia (persons under 5 and over 25); hypertension (persons of both sexes 25 years of age and older); urinary tract infections (most prevalent in females over 25 and males over 65); and cervical cancer (women in the 25-to-64 age range primarily). When combined in sets, the Panel said, "tracers provide a means for evaluating particular health services . . ." and "by combining analyses of these tracers with census data and simple demographic information on the patients, basic strengths and deficiencies in specific aspects of a health-care program can be identified, leading where necessary, to changes in the organization and delivery of services."

The Panel recommended that the tracer method be expanded and tested in a variety of health-service programs to determine the extent to which the method provides physicians and managers of health centers with information relevant to improving medical services. They also called for restructuring national health information, particularly in the areas of sociodemographic information and medical data.

DIET AND CORONARY HEART DISEASE

The following joint statement of the Food and Nutrition Board, Division of Biology and Agriculture, National Research Council, and The Council on Foods and Nutrition of the American Medical Association, was developed under the aegis of the National Research Council and released in July 1972:

Coronary heart disease is the major public health problem in the United States and in many other countries. In 1970, for example some 666,000 Americans, of whom about 171,000 were under the age of 65, died of coronary heart disease (CHD) and many more were disabled by the same disorder. It is particularly disturbing that many relatively young Americans in their most productive years are killed or incapacitated by this disease.

Epidemiologic, experimental, and clinical investigations have identified a number of "risk factors" associated with susceptibility to CHD that can be manipulated. These include an elevation in plasma lipids, especially plasma cholesterol; high blood pressure (hypertension); heavy cigarette smoking; obesity; and physical inactivity. The evidence is not sufficient to quantitate the benefits that may be expected to come from modifying these various risk factors, but the seriousness of the situation demands that all reasonable means be used to reduce the conditions that contribute to risk of CHD.

There is abundant evidence that the risk of developing CHD is positively correlated with the level of cholesterol in the plasma. This risk, independent of other risk factors mentioned above, is relatively small at levels less than 220 mg/100 ml but increases progressively with each increment in plasma cholesterol above this level. Approximately one-third of American men, and a less definitely known proportion of women, consuming their usual diets maintain plasma cholesterol levels at or below 220 mg/100 ml. There is extensive evidence that the level of cholesterol in the plasma of most people can be lowered by appropriate dietary modification. Generally, such lowering can be achieved most practicably by partial replacement of the dietary sources of saturated fat with sources of unsaturated fat, especially those rich in polyunsaturated fatty acids, and by a reduction in the consumption of foods rich in cholesterol. Preliminary evidence suggests that faithful and continued consumption of a cholesterol-lowering diet over a period of years can reduce the coronary attack rate in middle-aged men. As would be expected in dealing with a chronic disease of this kind, early intervention appears to be more effective than intervention after the disease is evident.

Elevation of other plasma lipids (plasma triglycerides) also imposes an increased risk of CHD. The elevation of plasma triglycerides is often, but not always, associated with an elevation of plasma cholesterol. Plasma triglycerides can also be modified by dietary intervention. Although there are as yet no satisfactory epidemiologic data to support the conclusion that triglyceride-lowering diets can reduce the occurrence of CHD in persons with hypertriglyceridemia, the inference from clinical studies that such a reduction can be anticipated is strong.

In summary, the average level of plasma lipids in most American men and women is undesirably elevated. The importance of lowering the plasma cholesterol in any individual depends in large part upon his usual plasma cholesterol concentration.

The evidence now available is sufficient to discourage further temporizing with this major national health problem. Therefore the Food and Nutrition Board and the Council on Foods and Nutrition recommend that:

(1) Measurement of the plasma lipid profile, particularly plasma cholesterol, become a routine part of all health maintenance physical examinations. Such measurements should be made in early adulthood, when coronary heart disease is still rare, and repeated at appropriate intervals. The potential impact of other risk factors should also be periodically assessed.

(2) Persons falling into "risk categories" on the basis of their plasma lipid levels be made aware of this and receive appropriate dietary advice. Such advice may vary somewhat with the nature of the blood lipid profile. [Fredrickson, Levy, and Lees, N. Eng. J. Med. 276:34 (1967); Lees and Wilson, N. Eng. J. Med. 284:186 (1971); Report of Inter-society commission for Heart Disease Resources, Circulation XLII:A55 (1971); American Health Foundation Position Statement on Diet and Coronary Heart Disease, Preventive Medicine *1*:255 (1972).] As indicated above, Americans should be advised to maintain a desirable body weight by an appropriate combination of physical activity and calorie intake. In "risk categories" it is important to decrease substantially the intake of saturated fat and to lower cholesterol consumption. In practice, this entails substituting polyunsaturated fat in the diet.

(3) Care be taken to assure that the dietary advice given does not compromise the intake of essential nutrients. Desirable intakes of nutrients are indicated in the Recommended Dietary Allowances (NAS Pub. No. 1694, 1968).

(4) Since the foregoing recommendations will be effective only if they can be accomplished with relative ease, modified and ordinary foods useful for this purpose be readily available on the market, reasonably priced, and easily identified by appropriate labeling. Any existing legal and regulatory barriers to the marketing of such foods should be removed.

(5) High priority be given to the conduct of studies that will determine reliably the extent to which the modification of plasma lipids, by dietary or other means, as well as modification of other risk factors, can reduce the risk of developing coronary artery disease.

TOXICANTS OCCURRING NATURALLY IN FOODS

The public concern about organic versus chemical fertilizers, food additives, and contamination of foods by pesticide residues is "misdirected" according to the report, *Toxicants Occurring Naturally in Foods.* The report was prepared by the Committee on Food Protection of the NRC Food and Nutrition Board. It is the second edition of a study first published in 1966, and contains much new information on food safety that has been developed since that time.

The Committee pointed out that the belief that food can be free of "chemicals" and completely "safe" is false. All foods consist exclusively of chemicals. Furthermore, the Committee said: "It is well established that the beneficial or toxic effects of any given substance are identical whether it is derived from natural sources or synthesized in the chemist's laboratory."

It is equally mistaken, the Committee said, to demand a food supply containing no harmful substances as all substances have some degree of toxicity and are therefore potentially harmful. Even nutrients that are essential for life, such as zinc, copper, methionine, and vitamin A, are extremely toxic if excessive amounts are ingested.

Although relatively few of the thousands of naturally occurring chemicals present in our food have been evaluated toxicologically, and no single

food plant has been as well characterized chemically as have the air we breathe and the water we drink, many chemical components of natural food products have been identified. For example, arsenic, lead, mercury, and fluorine have high intrinsic toxicities and are present in many foods, but no hazard is associated with their natural presence in foods. Oxalate is toxic, but its presence in spinach is not a hazard. The cyanogenetic glycoside in lima beans is highly toxic, but presents no danger under the usual conditions of consumption. The Committee pointed out that about 150 distinct chemical substances have been identified in the potato, including solanine alkaloids, oxalic acid, arsenic, tannins, nitrate, and more than a hundred other substances of no recognized significance to man. The Committee stressed, however, that if one's diet contains "a reasonable diversity of foods and no extraordinary amount of any specific food, then no single chemical is likely to be consumed in a toxic amount." Further, the Committee said that the toxicity of one element is offset by the presence of an adequate amount of another. There are antagonistic interactions, for example, between cadmium and zinc; the adverse effect of manganese, due to interference with the absorption of iron, can be offset by additional iron in the diet; copper nullifies the toxic effect of high dietary levels of molybdenum; iodine inhibits the action of some goitrogens; and there is evidence of antagonism between selenium and mercury and between cobalt and iron.

The Committee pointed out that "man has added very few totally new synthetic chemicals to his food supply in proportion to the number of different chemical substances that are there naturally." Food additives, which, for the most part, are derived from natural sources or are identical to closely related chemical substances to those that occur in natural foodstuffs, comprise less than 1% of the weight of our daily diet; natural food products constitute more than 99% and natural and man-made contaminants, such as pesticide residues, contribute only trace amounts. "The essential justification for the use of an additive in food processing—or of a pesticide that leaves a toxic residue in foods—is some direct or indirect benefit to the food consumer. . . . An increased nutritional value, an increased food supply, availability or keeping quality, or a substantially decreased cost to the consumer are benefits that might be considered to justify a small degree of theoretical risk," the Committee said.

The Committee warned that there are extensive gaps in our knowledge of the identity of many natural chemical components and of their potential toxicologic significance, as well as of the significance to health of many of the known substances, especially their long-term chronic effects on health. They saw a clear obligation on the part of the food and agricultural industries in their development and production of new or modified food products to take into account the known chemical composition of the product they work with. "An awareness of the toxic properties of essential nutrients and of the amounts present in foods being processed should also be maintained by the

food industry so that it may avoid the supplementation of its product with hazardous amounts of these agents," the Committee said.

Levels of toxic substances in plant foods may be decreased, the Committee said, through selective breeding where potential hazards exist. The Committee cited the success of such work with rapeseed, cotton seed, and lima beans, but did not believe that efforts to extract or remove many known toxic components during processing would be either feasible or beneficial.

BIOLOGICAL IMPACTS OF INCREASED INTENSITIES OF SOLAR ULTRAVIOLET RADIATION

In the spring of 1971, the possible environmental impacts of a future fleet of supersonic transport (SST) aircraft had become a topic of intense national interest. Suggestions were made that emissions from jet aircraft exhausts during high-altitude flight might decrease the thin layer of ozone in the stratosphere and thus increase the amount of solar ultraviolet (UV) radiation reaching the surface of the earth. Little was known of the effects of the SST upon the atmosphere or of their consequences, and this possibility was—and remains—a matter of scientific debate.

In view of the serious implications for human health and for all living organisms of an increase in solar UV radiation, the NAS–NAE Environmental Studies Board established a panel "to review some of the known effects of ultraviolet radiation on man and other living organisms;" "to assess, as far as possible, the consequences to man and other living organisms should the amount of solar ultraviolet radiation reaching the surface of the earth increase"; and "to identify those areas where knowledge is inadequate and where further research is urgently needed."

In its report, *Biological Impacts of Increased Intensities of Solar Ultraviolet Radiation,* the panel said: "Sufficient knowledge is at hand to warrant utmost concern over the possible detrimental effects on our environment by the operation of large numbers of supersonic aircraft."

There is a delicate balance between the beneficial and harmful effects of sunlight, and life on earth is partially shielded from harmful solar UV radiation by a thin layer of ozone in the atmosphere. Because of the radiation-absorbing properties of ozone, a small decrease in ozone concentration would result in a large increase in ultraviolet radiation reaching the earth's surface in the wavelength range of 280–320 nanometers (billionth of a meter). A five percent decrease in ozone concentration, for example, would yield a 26 percent increase in the intensity of the most biologically damaging ultraviolet radiation.

This increase, the Panel estimated, would produce a minimum of 8,000 additional cases of the most common types of skin cancer per year in the United States. Perhaps even more important than an increase in skin cancers, however, would be the effects of increased levels of UV radiation on biological systems other than man, according to the report. Although definitive predictions are difficult, present information suggests that an in-

crease in terrestrial solar UV radiation might diminish the biological productivity of the ocean, interfere with mating and other behavioral patterns of insects and other lower animals, and damage plants, especially agricultural species. It was further noted that most life forms probably developed in prehistoric time after the formation of the ozone shield; the formation of this protective shield presumably was a prerequisite for the evolution and maintenance of terrestrial life.

Biochemical repair mechanisms exist in most living things and provide a means of counteracting the continuous natural damage and alteration of cells by sunlight. One molecule easily altered by sunlight is deoxyribonucleic acid (DNA), which carries an organism's genetic blueprint. Increased amounts of UV radiation may overload natural repair mechanisms, which could, in the case of simple life forms, lead to death of the organism or, in higher forms of life, to mutations in future generations.

Among its recommendations, the Panel gave highest priority to early implementation of the following:

1. Ground-level stations should be established at various latitudes to monitor the intensity and wavelength distribution of solar ultraviolet radiation. This information is needed not only as a base line for monitoring possible environmental changes, but also to properly evaluate data that are currently available on the latitudinal variations in the incidence of skin cancer in man.

2. The ability of important agricultural plants to grow and produce when exposed to additional amounts of ultraviolet radiation over the region 280–320 nm (those wavelengths expected to be most affected by changes in stratospheric ozone concentration) should be determined. These experiments should include both laboratory and field studies.

3. Because of the unique importance of plankton in the ecological food chain, their sensitivity to solar ultraviolet radiation should be studied systematically, including both laboratory and field studies. An important adjunct to these studies would be the accurate measurement of the depth of penetration into natural waters of the various wavelengths of solar ultraviolet radiation.

4. Laboratory experiments using animals are urgently needed to gain more insight into the molecular bases and dose response characteristics of ultraviolet-radiation-induced skin cancer.

5. The public should be informed that, even today, excessive exposure to solar radiation should be avoided.

The Environmental Studies Board received funds for the study from the Scaife Family Charitable Trust and the U.S. Department of Transportation.

EXPOSURE TO LOW LEVELS OF IONIZING RADIATION

Cosmic radiation, radiation from radioactive materials in the earth's crust, and dental and medical radiology for diagnostic and therapeutic applications are the major contributors to human exposure to ionizing radiation. Energy

shortages and pressures by environmentalists for cleaner fuels have led to increasing demands for the development of nuclear-powered generating plants to replace or supplement those powered by fossil fuels. According to a special studies group in the Environmental Protection Agency (EPA), nuclear capacity in the United States will probably increase from 6,000 megawatts in 1970 to 800,000 megawatts by the year 2000. There has been increasing concern that the growth of a nuclear power industry for the production of electricity could cause serious exposure of the human population to radiation.

In February 1970, therefore, the Federal Radiation Council (FRC) asked the Academy for a review and re-evaluation of existing scientific knowledge concerning radiation exposure of human populations. The task was assigned to the Advisory Committee to the Federal Radiation Council, NRC Division of Medical Sciences. A few months later, when the functions and activities of the FRC were transferred to the EPA, the Committee's name was changed to the Committee on the Biological Effects of Ionizing Radiation (BEIR).

In its report, *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation,* published in November 1972, the Committee called for standards for the major categories of radiation exposure, "based insofar as possible on risk estimates and on cost-benefit analyses which compare the activity involving radiation with the alternative options . . . These analyses should seek to clarify such matters as: (a) the environmental and biological risks of given developments, (b) a comparison of these risks with the benefits to be gained, (c) the feasibility and worth of reducing these environmental and biological risks, (d) the net benefit to society of a given development as compared to the alternative options."

Based on experience to date, the nuclear power industry's contribution to radiation exposure can remain less than about 1% of natural background radiation and the exposure of any individual kept to a small fraction of background radiation, the Committee said. This would depend, however, upon the attainment and long-term maintenance of anticipated engineering performance, adequate management of radioactive wastes, control of sabotage and diversion of fissionable material, and avoidance of catastrophic accidents.

The current Radiation Protection Guide of 170 millirems per year (or 5 rem per 30-year reproduction generation) grew out of an effort to balance societal needs against genetic risks. The Guide was based on recommendations contained in a 1956 report by the NRC Committee on Biological Effects of Atomic Radiation—the so-called BEAR Committee. The BEAR Committee pointed out that, since 1956, our knowledge of genetics has been revolutionized. The chemical structure of the gene and the nature of the mutation process are now understood in great detail, but there are still serious gaps in our knowledge, the Committee said. Among them, there is "almost

complete absence of information on radiation-induced mutation in man" and the relation between an increased mutation rate and deleterious effects on human well-being cannot be quantified. The Committee concluded, however, that in balancing societal needs against genetic risks, the current Radiation Protection Guide is unnecessarily high.

Pointing out that it was not within the Committee's scope to propose numerical limits of radiation exposure, the Committee set forth a number of general principles, as follows:

(1) No exposure to ionizing radiation should be permitted without the expectation of a commensurate benefit.

(2) The public must be protected from radiation but not to the extent that the degree of protection provided results in the substitution of a worse hazard for the radiation avoided. Additionally, there should not be attempted the reduction of small risks even further at the cost of large sums of money that spent otherwise would clearly produce greater benefit.

(3) There should be an upper limit of man-made non-medical exposure for individuals in the general population such that the risk of serious injury from somatic effects in such individuals is very small relative to risks that are normally accepted. Exceptions to this limit in specific cases should be allowable only if it can be demonstrated that meeting it would cause individuals to be exposed to other risks greater than those from the radiation avoided.

(4) There should be an upper limit of man-made non-medical exposure for the general population. The average exposure permitted for the population should be considerably lower than the upper limit permitted for individuals.

(5) Medical radiation exposure can and should be reduced considerably by limiting its use to clinically indicated procedures utilizing efficient exposure techniques and optimal operation of radiation equipment.

(6) Guidance for the nuclear power industry should be established on the basis of cost-benefit analysis, particularly taking into account the total biological and environmental risks of the various options available and the cost-effectiveness of reducing these risks. The quantifying of the "as low as practicable" concept and consideration of the net effect on the welfare of society should be encouraged.

(7) In addition to normal operating conditions in the nuclear power industry, careful consideration should be given to the probabilities and estimated effects of uncontrolled releases . . . extraordinary efforts to minimize this risk are clearly called for.

(8) Occupational and emergency exposure limits have not been specifically considered but should be based on . . . the potential somatic risk to the individual.

(9) In regard to possible effects of low-level radiation on the environment, it is felt that if the guidelines and standards are accepted as adequate

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for man then it is highly unlikely that populations of other living organisms would be perceptibly harmed. Nevertheless, ecological studies should be improved and strengthened. . . .

(10) Every effort should be made to assure accurate estimates and predictions of radiation equivalent dosages from all existing and planned sources. This requires use of present knowledge on transport in the environment, on metabolism, and on relative biological efficiencies of radiation as well as further research on many aspects.

NITRATE ACCUMULATION

The Committee on Nitrate Accumulation was established in the NRC Agricultural Board in 1970 to examine various problems associated with the accumulation of nitrate nitrogen and related nitrogenous compounds in the environment and to recommend courses of action that might mitigate these problems. Following initial funding by the NAS–NAE Environmental Studies Board, the Committee's work was supported by the U.S. Department of Agriculture and the Federal Water Pollution Control Administration (later transferred to the Environmental Protection Agency).

Although nitrogen is essential in all living things and its lack limits crop production in many parts of the world, some forms of the element can be dangerous to man and to the animals he raises for food. An excess of nitrogen in surface waters in areas where fertilization has been heavy, or where excessive leaching or water runoff occurs, leads to water pollution and eutrophication of lakes and streams. In addition, recent studies have indicated that there are hazards to human health associated with the long-standing practice of adding nitrate and nitrite to meat products as preservatives and color enhancers. It has been found that nitrate, nitrite, and secondary and tertiary amines are precursors of nitrosamines (organic compounds that are carcinogenic, teratogenic, and mutagenic). The report of the Committee's two-year study of these problems was published in August 1972.

In its report, the Committee noted that little is known about the levels of nitrosamines that may be hazardous to humans, and called for improvements in the analytical procedures generally used for detecting and measuring nitrosamine concentrations in foods. They also found an "appalling lack of information about the significance of the various sources and means of control of nitrogen in waterways; practical methods for reducing or increasing the quantity of nitrogen lost from the soil; the significance of nitrogen in limiting algal growth in lakes and rivers; the importance of nitrosamines in nature and in foods; the formation of nitrosamines in the gastrointestinal tract; and the 'subclinical' hazards, if any, to man and animals arising from the consumption of water and food containing modest concentrations of nitrate."

SICKLE-CELL DISEASES AND MILITARY SERVICE

In general the sickle-cell trait has been considered a benign and relatively harmless condition except under such conditions as exposure to significant hypoxia, dehydration, or acidosis. More serious than carrying the trait is the genetic outlook if two carriers produce offspring. The chances, then, are one in four with each pregnancy that their children will receive two sickle-cell genes and be afflicted with sickle cell anemia (SS), an often painful and chronic disease that usually manifests itself in childhood and shortens the lives of an estimated 50,000 black Americans. The sickle-cell trait, carried by an estimated two million additional Americans, does not produce symptoms under normal circumstances and should not be confused with sickle-cell disease.

In 1970, however, reports of four cases of sudden death during basic training of black military recruits who had the trait, and reports of unexplained anesthetic deaths of trait carriers led some physicians to question the harmlessness of sickle-cell trait, and others to recommend routine testing of all "high risk" recruits entering the armed forces. Subsequently, in response to a request from the Department of Defense (DOD), the National Academy of Sciences established an *ad hoc* Committee on S-hemoglobinopathies in the NRC Division of Medical Sciences to assist in establishing "wise, rational, and medically sound" guidelines for the screening and management of the sickle-cell trait carrier in military service.

Specifically, the DOD asked: Should a testing program be voluntary or mandatory? How should the tests be performed and at what point in the serviceman's career should the tests take place? What limitations of service, if any, should be placed on persons with the sickle-cell trait? What should be the content and scope of educational and genetic counseling programs for trait carriers? The Academy was also asked to consider other, related problem areas, such as glucose-6-phosphate dehydrogenase (G-6-PD) deficiency and β-thalassemia. The Committee's report, based on an analysis of current research, was published in February 1973.

The Committee found insufficient scientific information to warrant excluding sickle-cell trait carriers from the armed forces or for limiting their activities or duties except as pilots and copilots. Carriers should be permitted flight duty on a voluntary basis after having possible risks explained to them, the Committee said. Furthermore, the Committee found no scientific reason for reassigning a carrier from hazardous duty, nor for excluding a carrier from "a position as an operator in a nuclear power plant or from any position of risk in which only the carrier is at risk unless the carrier, himself, after consideration of his status, requests it or unless the performance of the carrier is essential to the successful completion of the mission."

Regardless of race, the Committee said, all candidates for admission to the armed services should be screened for sickle-cell diseases (SS, sickle-cell

hemoglobin C disease (SC), sickle-cell β-thalassemia (S-thal), and sickle-cell hemoglobin with hereditary persistence of fetal hemoglobin (SF)), and recruits found to have these hemoglobinopathies should be excluded from military service. These tests should be made at a reception center before the recruit begins basic training, and all persons accepted into the service should be given the option of receiving the results of their screening tests in confidence, regardless of the test results. It was further recommended that test results be kept separate from the subjects' medical records and be made available to military doctors only when necessary for the proper diagnosis of another illness.

The Committee urged that educational programs during the screening procedure adequately explain genetic abnormalities and distinguish clearly between the carrier and disease states of such abnormalities. These programs should point out that "people of all races carry many mutant genes, that these genes can be beneficial, and that each race carries some detrimental mutant genes in high frequency." The Committee also recommended that individual genetic counseling sessions and hemoglobin testing for service personnel and their families be carried out upon request of recruits or any active duty personnel.

Finally, the Committee pointed out that there are many unanswered questions about the "physiology, morbidity, and mortality possibly related to the carrier state of sickle-cell trait and to the person with G–6–PD deficiency. Scientifically based decisions can be made only if well-designed studies are carried out to elucidate the possible role, if any, of the sickle-cell trait. This can be accomplished by prospective multiphasic screening, study of episodes of collapse, and carefully planned review of all sudden deaths in the future."

CONTROL OF RABIES

Control of Rabies, a report by the Subcommittee on Rabies of the Agricultural Board's Committee on Animal Health, deals with the pathogenesis of the disease, with virus-wildlife interactions, and with vaccine and regulatory aspects of control programs. The report points out that, although significant progress has been made in our understanding of the epidemiologic patterns of the disease, in diagnostic techniques, and in producing more effective vaccines, there is limited understanding of the disease in wild animals.

Rabies virus—currently classified as a member of the rhabdovirus group—is believed to be pathogenic for all mammals. The disease is endemic within skunk, fox, raccoon, and bat populations, and appears to remain confined to a single reservoir species in a given area. Until recently, the Subcommittee said, it was believed that rabies was transmitted exclusively by the introduction of virus-laden saliva into a bite wound or open lesion. It has been demonstrated, however, that the virus can be ingested and can be inhaled in contaminated air, such as that found in bat caves. It appears

likely that its prevalence among carnivores can be attributed, in part, to the ingestion of infected animals.

The Subcommittee cited the success of the vaccination program for dogs, which has reduced laboratory-confirmed cases of rabies from more than 8,000 in 1946 to only 235 in 1971. Control of rabies in wildlife is much more difficult; its sole purpose is to prevent the spread of the disease to domestic animals and thereby lessen the chance of human exposure. Selective reduction of the population of the wildlife species involved is the only technique currently available. According to the Subcommittee, "Persistent trapping or poisoning campaigns as a means to rabies control should be abolished. There is no evidence that these costly and politically attractive programs reduce either wildlife reservoirs or rabies incidence. The money can be better spent on research, vaccination, compensation to stockmen for losses, education, or public warning systems." Efforts should be made, the Subcommittee said, to identify characteristics in isolates that can serve as markers. "The identification of such markers would greatly facilitate epidemiological studies, and the development of a satisfactory oral vaccine for wildlife is at least partially dependent on the recognition of such a system."

Additional research called for in the report includes studies of the pathogenesis of rabies infection in species that are important in the epidemiology of the disease, studies of the antigenic components of rabies-related viruses and group relationships, and research to elucidate the nature of the host-parasite balance in rabies. More precise information on local epidemics is needed, as are epidemiologic studies into the nature of these outbreaks, using ecological and virological techniques in order to understand what is happening, the Subcommittee said.

"There is increasing evidence," according to the Subcommittee, "that—at least in animals—recovery from rabies may be more common than is generally accepted." Research is needed on the magnitude and parameters of this recovery. Research was also recommend to resolve the question of a carrier state in animals and to identify early sites of infection.

From the standpoint of regulatory control of rabies, the Subcommittee pointed out that there is no federal legislation dealing with rabies control and few states have adopted legislation necessary for implementing comprehensive control programs. In the Subcommittee's opinion, "The role of the state or federal government is to provide needed legislation and leadership to extend uniform rabies-control measures over the large geographic areas necessary to ensure success. The role of local government is to enforce the rabies-control measures within their respective jurisdictions."

COMMUNITY COORDINATED CHILD CARE PROGRAM

Study of the federal government's Community Coordinated Child Care ("4–C") program by a panel operating under the Advisory Committee on Child Development, Division of Behavioral Sciences, led to recommenda-

tions for new national, state, and local steps to make more widely available a variety of child-care and other related services for children. The study was made at the request of the Office of Child Development, U.S. Department of Health, Education, and Welfare.

The 4–C was intended to "help eliminate overlap and duplication and to maximize the use of national, state, and local resources in the interest of improving and expanding child-care services," the panel said. Although the panel found the concept to be sound, the 4–C program was characterized by weaknesses in staffing, in interagency coordination, in clarity of purpose, in assignment of responsibility, and in leadership. Moreover, the panel said, competition among local agencies for scarce federal money "impeded effective community coordination" of child-care services. However, the panel said, "For the federal government to abandon its role in this area would seriously set back such coordinative efforts as have emerged and are, in a significant number of communities, proving effective."

To provide an effective delivery system for child-care, preschool, and other services, the panel said, at each governmental level there must be both administrative machinery for carrying out programs and advisory structures "to assure that programs are shaped and policies made to conform with parental and community preferences, within the framework of governmental policy."

The panel suggested that a small proportion of all federal funds for child-care and related programs be earmarked for allocation to states, urban counties, and cities that establish offices of child development or their equivalents for coordination of "the full range of child care and development, early education, and related health and family service programs." Also, at each level, the panel said, there should be advisory policy councils made up of parents and other concerned citizens and of public and private agency representatives.

Within the U.S. Office of Child Development, the panel said, there should be a clearinghouse to provide information on funding sources and procedures for obtaining funds. This office would also keep federal agencies informed of fund allocations to states and local agencies and would report on their use.

PHYSICS IN PERSPECTIVE

The Physics Survey Committee completed a two-year study that examines the current status and future directions of U.S. physics, its traditional subfields, and the interfaces between physics and such other disciplines as chemistry, biology, earth and planetary physics, and astronomy. The report, *Physics in Perspective,* deals with education in physics and physics in education, manpower supply and demand, the institutions and support of physics, and dissemination and use of the information of physics. A relative priority rating of 69 different program areas of physics is presented, together with four detailed budget programs.

The study, one of the most comprehensive examinations of a major scientific discipline yet undertaken by the Academy, was conducted under the auspices of the NAS Committee on Science and Public Policy, with support from the Atomic Energy Commission, the Department of Defense, the National Aeronautics and Space Administration, the National Science Foundation, the American Physical Society, and the American Institute of Physics.

In its approach to the establishment of priorities and program emphases, the Committee evolved and used three sets of complementary criteria—intrinsic (internal logic and impact on science), extrinsic (impact on technology and resolution of human problems), and structure (impact on the national capability to do physics). These were applied in a jury rating of the program elements or scientific groupings into which each subfield was divided (10 in each). On this basis, 15 high-leverage program elements having growth potentials that warrant high priority for incremental support were selected. The Committee emphasized, however, that the increased support recommended for these program elements should not be at the expense of other activities in the subfields, and that readjustments will be necessary as various program elements attain different levels of scientific maturity.

"Small changes in funding—either increases or decreases—can sometimes be reflected in disproportionately large changes in scientific productivity," the Committee observed in its report. These are critical, "high-leverage situations," in the Committee's view. Illustrative of these situations are the 15 key programs identified by the Committee: macroscopic quantum phenomena, quantum optics, scattering in solids and liquids, heavy-ion interactions, higher-energy nuclear physics, National Accelerator Laboratory, Stanford Linear Accelerator, controlled fusion, turbulence, nonlinear optics, lasers and masers, atomic and molecular beams, biophysical acoustics, very large radio array, and x- and gamma-ray astronomy.

Pointing out the importance and great intrinsic and extrinsic potential of these "high-leverage" programs, the Committee observed: "In the present state of ignorance, it would be as presumptuous to dismiss the possibility of useful application as it would be irresponsible to guarantee it . . . The great thing about fundamental scientific knowledge is that it is an indestructible public resource . . . The full value of a scientific discovery is concealed in its future."

PART II: ON-GOING PROGRAMS AND STUDIES

THE ACADEMY FORUM

On May 15, 1973, the National Academy of Sciences convened the first of a series of public forums designed to identify major scientific and technological questions inherent in public-policy issues. The subject chosen for the initial forum was "How Safe Is Safe? The Design of Policy on Drugs and Food Additives." Announcements were sent to representatives of the legislative, executive, and judicial branches of government, to the press, the legal profession, scientists, economists, consumer groups, and the general public; more than 400 people attended the one-day session. Although the Academy had no expectation of "solving" the subject in this limited time, it was hoped that the forum might lead to increased understanding of divergent points of view and to creative new approaches to the decision-making process.

The format of the meeting provided for a group of speakers representing the points of view of the consumer, the producer, the scientist, and the regulator, as well as a system-analytic viewpoint, followed by a panel of inquiry made up of members of the Academy, interrogators of a general competence with no particular prejudice in the field under examination, a group of invited discussants, and a general audience of concerned citizens.

As the Forum progressed, it became clear that the term, "safe,'" has different meanings for different people, and a wide range of emotional reactions was revealed during the discussions of the concept of safety: The consumer, for example, concerned with the safety of individuals consuming a new drug or food additive, wants to be "certain" that it is "safe." The scientist points out that all human activities require a weighing of risks against benefits. The producer, although he accepts the needs for controls, is impatient with delays and would like laws with greater emphasis on creativity. The legislator, who is caught between the consumer and the producer, must nevertheless operate in the political arena. The regulator, who plays the most difficult role, must make decisions, based on science, but on a time scale that does not permit time-consuming data collection, and that must take both societal needs and political realities into account.

This Academy Forum was supported by the Academy's Project Initiation and Development Fund, the Peter C. Cornell Trust, the Charles F. Kettering Foundation, and the Alfred P. Sloan Foundation. Publication of the proceedings is planned.

CLIMATIC IMPACT COMMITTEE

For several years, scientists in various countries have been studying the composition, chemistry, and dynamics of the stratosphere in atmospheric processes. Discussions of the potential atmospheric effects from large-scale operation of supersonic transports (SST) in the stratosphere, however, have brought to light specific areas where uncertainties exist in present knowledge. For example, the natural concentrations, variability in time and space, sources, sinks, and removal rates of such gases as NO_x, H_2O, and CO suggest that these substances may influence ozone depletion processes. There is a thin layer of ozone that protects the earth from ultraviolet radiation and it is estimated that depletion of as little as 15 percent of this layer could lead to a 30 percent increase in the solar radiation reaching the earth. Little is known about the ambient concentrations of these constituents or about the injection rates from high-altitude aircraft or from man's other activities.

In 1971, the Department of Transportation (DOT) initiated a Climatic Impact Assessment Program (CIAP) to support research in meteorology, climatology, chemistry, biology, engineering, medicine, economics, and related areas. CIAP is designed to provide a necessary part of the knowledge required to support federal policy decisions concerning the operation of supersonic aircraft and other activities of man that can affect the atmosphere.

In response to a DOT request, the National Academies of Sciences and of Engineering organized the multidisciplinary Climatic Impact Committee (CIC) to carry out the following tasks: (1) advise on research priorities; (2) follow the progress of research sponsored by CIAP and others, as it may bear on the CIAP, review the results, and advise on the significance of the investigations; and (3) consider a possible summer study in 1974 that would assess the state of knowledge developed by CIAP, as well as the other knowledge available at the time, and arrive at a set of conclusions regarding the likely effects of a fleet of SST's on the earth's climate and the biosphere.

In March 1973, a Steering Panel of CIC developed a list of possible topics for cost-benefit sensitivity analysis studies relevant to CIAP. The group, consisting of experts in ecology, agriculture, sociology, management analysis, economics, political science, medicine, engineering, physics, photochemical effects on materials from ultraviolet radiation, and air transportation systems and routes, provided guidance to CIC for dealing with the assessment of socioeconomic questions related to CIAP.

The CIC will conduct a workshop in August 1973 in preparation for a major summer study in 1974. The 1973 workshop will concentrate on the methodology required to achieve the results needed to make a realistic assessment of social and economic aspects of the problem in 1974.

COMMITTEE ON MINERAL RESOURCES AND THE ENVIRONMENT

In the spring of 1971, the Division of Earth Sciences convened a Conference on Mineral Resources and the Environment—Toward an Acceptable Balance. As the conference report pointed out, "Practices that have been harmful, or even destructive, to the environment have been all too common in the past history of the extractive industries." Yet, projected increases in our population and growing demands for energy and other resources—as well as the unpredictable impact of foreign political developments—point strongly to the need to find and develop new sources of minerals and fuels. As a result of the conference, two studies were recommended: (1) to develop bases for the establishment of environmental standards for mineral exploration and exploitation, and (2) to identify mechanisms for actively encouraging the search for new mineral deposits and the development of new technologies for extraction and processing that would be environmentally acceptable.

The standing Committee on Mineral Resources and the Environment was subsequently established in the Division of Earth Sciences. The Committee's charge is (1) to provide a continuing overview of all aspects of non-renewable resources (including supplies, reserves, research exploration and exploitation, recovery and reuse, development of substitutes, and management); (2) to initiate studies; (3) to recommend courses of action to governmental agencies and industry; (4) to recommend needed research on related topics; and (5) to make an annual report to the National Academy of Sciences on status and needs. These tasks are directed toward establishing criteria for assuring the United States of adequate supplies of non-renewable resources in the near, intermediate, and long-range future.

The Committee has organized Panels on Needs and Demands, Environment, Resource Assessment, and Technology to consider various aspects of the mineral resource-environment dilemma. The Panel on the Environment, for example, is considering the environmental, social, economic, and medical aspects of coal extraction. Site visits have been made to active and reclaimed strip-mining areas north of Pittsburgh. The Panel is preparing its comments on coal extraction for the Committee.

REHABILITATION POTENTIAL OF WESTERN COAL LANDS

In January 1973, the NAS–NAE Environmental Studies Board began a study of rehabilitation potential of western coal lands. The study was commissioned by the Ford Foundation as one of a series of studies under the Foundation's Energy Policy Project.

During the past 20 years, the coal mining industry in the United States has shifted from deep mining operations to surface, or strip, mining. Almost all of these operations have taken place in the Eastern United States, partic-

ularly in the Appalachian region where more than half of the nation's coal is mined. The environmental impacts of strip mining in Appalachia have been enormous and have led to widespread public outcry against the practice.

On the other hand, the energy shortage and alleviation of air pollution by the use of low-sulfur coal have made the mining of beds of low-sulfur coal near the surface in the American West more and more attractive, and pressures to exploit this large source of fossil fuel are expected to intensify.

The Environmental Studies Board's committee will first examine the problems of environmental changes, waste disposal, and land management; they will review land-rehabilitation experiences in other regions and then will focus on related problems peculiar to the West where water is in short supply. Participants in the study include hydrologists, meteorologists, geologists, mining engineers, ecologists, soils scientists, botanists, zoologists, and economists and other social scientists.

The study is expected to yield an assessment of land-rehabilitation methods that have been or might be applied to western lands, and is expected to be useful in "assessing the practical availability of the large, near-surface deposits of low-sulfur coal and oil shales in the western states, considering societal demands for successful restoration to acceptable productivity and aesthetically pleasing condition."

INTEGRATED UTILITY SYSTEMS

In 1972, the National Academy of Engineering established the Integrated Utility Systems Board to conduct a study for the Department of Housing and Urban Development (HUD) to evaluate various concepts for combining residential utility services into a single, on-site integrated system. These services include electrical power, space heating and cooling, domestic hot water, water supply, wastewater treatment, and solid waste processing. The objective of integrating these separate utilities is to conserve energy and natural resources by using traditional "wastes" from utility processes. Reject heat from power generation, liquid sewage from homes and businesses, and garbage and trash are the principal wastes involved. Successful integration means that the material and energy residuals from one utility process would be used for inputs for other utility services to the maximum practical extent.

The Board's study includes consideration of the technical feasibility and desirability of combining these separate utilities into integrated systems and an examination of the estimated costs and the potential benefits. Also included is a study of the possible institutional problems that might arise. The Department of Housing and Urban Development may participate in one or more large-scale demonstration projects within the next few years.

An especially noteworthy family of integrated utility systems concepts being developed by a team of federal agencies, with HUD serving in the lead agency role, is the Modular Integrated Utility System (MIUS). The NAE Board will provide HUD with an impartial review and evaluation of MIUS, as well as related promising integrated utility concepts, such as the well-

known Total Energy system and the Wainwright Alaskan Village demonstration in which laundries, showers, saunas, and other facilities are provided in a single, central building that serves a village of approximately 400 persons.

MARITIME TRANSPORTATION RESEARCH BOARD

The research advisory services provided by the Board are directed toward a long-range view of trends and developments that appear to mark significant forces for change in the maritime industry.

A major current study is entitled "Opportunity for Growth of the U.S. Merchant Marine." Panels have been established under four general headings: Technology (Panels on Metrication in the Maritime Industry and Strategy for Development of a Nuclear U.S. Merchant Marine); Systems and Economics (Panels on Bulk Imports, Maritime Trade Practices and Policies, Future Port Requirements of the U.S., Effective U.S. Controlled Fleet, and Essential Trade Routes); Human Factors (Panels on Human Resources in the Maritime Industry and Human Errors in Maritime Casualties); and National Defense (Panels on Effects of Overseas Troop Reductions on the Merchant Marine and Competitive Results of Sealift Readiness Program).

The Panel study, Strategy for Development of a Nuclear U.S. Merchant Marine, resulted from the increasing demand for diminishing supplies of fossil fuels and the need to look at the merchant fleet's energy requirements for the next generation of ships. The Metrication study was undertaken because conversion to the use of metric units and international standards has special significance to an industry whose major product is world trade. The Panel is looking at ways to make the change in the least costly way.

The interplay between national defense requirements and the ability of the privately owned U.S. merchant marine to compete in world trade is being examined in two studies. The first will examine the consequences of military diversion of berth line ships from their commercial trade for defense contingencies. Loss of business to foreign flag lines and the problems of recapturing the trade are being evaluated. The second study will weigh the effects of troop reductions in the major overseas theatres on the various components of the merchant marine.

Economics and transportation systems design play a large part in the competitive environment of ocean transportation. In that context, the Board is examining the needs for maintaining shipping capacity to import the necessary bulk products to support U.S. industry and provide for national security needs. Also related to the support of industry and to national security is the reliance on the "effective U.S. control fleet," the U.S.-owned ships operating under foreign flags. Recent changes in the composition of the fleet suggest a need to examine the relevance of current policy to the capabilities of the fleet as well as to its availability.

U.S. ports, which have traditionally been the concern of local authorities, are becoming a focal point for federal decisions. The need for federal funds to provide the facilities and channels to accommodate very large crude-oil carriers and large fast container ships places many choices at the federal level that will affect the growth of ports. The Board is examining the requirements for ports in the future on broad coastal ranges as an aid to federal planning.

Recent changes in foreign trade practices, in which government participation is a factor, suggest that transportation arrangements may become an integral part of many trade agreements, with radical departures from customary ways of doing business. The Board will examine some of these trends for their compatibility with the Shipping Act of 1916 to identify policy areas that must be given consideration if the U.S. merchant marine is to benefit from the changing trade patterns.

In this industry, as in any other, the people who work in it are the most important influence for success or failure of the enterprise. Discussion of personnel is frequently subjective, rather than objective. The Board will therefore examine objectively some of the problems in making use of the human resources in the maritime industry. Work organization and life aboard ship will be the first areas explored.

Another human factor affecting the ability of a fleet to compete is the safety record of its crews; human error is generally believed to be the major cause of maritime casualties. The Board has undertaken a study to gain a greater understanding of the underlying causes of the events, classified as personnel error, that lead to accidents or near accidents.

These studies are being conducted under a contract between the Academy and the Office of Naval Research.

ATOMIC BOMB CASUALTY COMMISSION

Since 1947, under a Presidential directive, the Academy, through the Atomic Bomb Casualty Commission (ABCC), has been conducting a long-range study of the late radiation effects of atomic bombs on the survivors of Hiroshima and Nagasaki, the only sizable population ever exposed to large amounts of whole-body radiation. The program is based upon a fixed population sample of more than 100,000 persons drawn from the 1950 census—those exposed within 2,000 meters and matched groups of persons who were present at greater distances or were not in the cities at the time of the bombing.

Death certificates are obtained for nearly all who die in Japan, and mortality patterns are analyzed every few years. Intensive efforts are made to receive permission for autopsy of all who die in or near the cities, as well as to study surgical or biopsy specimens. A subsample of 20,000 is offered physical examinations every two years; the offers have been accepted by about 85 percent. This program makes it possible to conduct

intensive studies of particular diseases or organs for varying periods and to repeat them later, so that effects that are related to aging or that have long latent periods will not be overlooked. A cytogenetics program has been established to study chromosomal aberrations, not only in survivors, but also in children conceived after the bombing. Records of mortality and cause of death are also kept for a large sample of these children. A continuing leukemia survey, not limited to the fixed sample, is maintained. Information is also sought on socioeconomic and environmental factors, including X rays, that might influence the findings.

Among the early findings were lenticular opacity and a sharp increase in leukemia, which peaked in the 1950's, but is still detectable among the more heavily exposed. Later, there was a general increase in cancer, and recently an increase has been observed among those exposed as children.It has been estimated that the number of "excess" (radiation induced) deaths from solid cancers has already equaled those from leukemia. Exposure during early fetal life resulted in a definite increase in microcephaly and mental retardation, both related to dose. The mature body height and weight of those who were exposed under the age of 12 are definitely reduced, especially in those who were exposed before they were six years old.

On the other hand, examination of more than 71,000 newborn children between 1948 and 1953 failed to reveal an increase in genetic defects. To date, studies of mortality, cause of death, and chromosomal aberrations have revealed no effect of parental radiation.

Japanese and U.S. scientists agree that the studies should be continued for at least another 20 or 25 years, especially in view of the growing evidence that the youngest of the survivors are the most susceptible. Continuation will also permit more definitive testing of the hypothesis that radiation has generalized aging and life-shortening effects, apart from increased cancer mortality.

INBORN ERRORS OF METABOLISM

The Committee for the Study of the Inborn Errors of Metabolism was established in the Division of Medical Sciences in June 1972 to attempt the development of an effective program for dealing with inborn errors of metabolism as a single, identifiable health problem of national importance. Nearly 2,000 genetic diseases of various levels of severity have been identified by medical investigators to date, and there are indications that genetic factors may exist in a number of other diseases. Support for the Committee's work is being provided by the Research Applied to National Needs (RANN) program of the National Science Foundation. To fulfill its charge, which is to formulate the best possible model for the management of inborn errors of metabolism, the Committee is multidisciplinary, with members drawn from genetics, pediatrics, obstetrics, biochemistry, law, economics, political science, psychology, and social psychology.

During the first year of its study, the Committee reviewed various categories of screening—prenatal, neonatal, and family screening—and identi-

fied some problems that need evaluation. The Committee also considered the interplay of genes and environment (ecogenetics) and drugs (pharmacogenetics). It is carefully examining the phenylketonuria (PKU) program to determine the problems of this screening program in both small and large states, the cost effectiveness (including the total burden on the family and on society), the effects of legislation, and problems of false diagnosis and lack of controls for evaluating treatment. PKU is one of about 40 hereditary diseases that can now be treated or alleviated by diet or drugs. It is caused by low levels or the lack of the enzyme phenylalanine hydroxylase, which oxidizes phenylalanine, an essential ingredient in food protein. If untreated, the victims of PKU suffer severe mental retardation.

The Committee has studied the medical, legal, sociopsychologic, and economic aspects of screening for PKU, and has identified the kinds of data that must be collected. Data will be collected through personal interviews, site visits, and mail and will include legislative practices and procedures in a sample of states (to learn the history of legislation related to PKU, sickle-cell disease, and sickle-cell trait, and to reveal different states' attitudes with regard to legislation for screening in the future). The information will include costs of screening for PKU, the attitudes of families with PKU children, and the attitudes of physicians. An essential aspect of a screening program is the educated cooperation of practicing physicians, and the Committee will assess the state of readiness of pediatricians, obstetricians, and other doctors for screening in the future.

DIMETHYL SULFOXIDE

Dimethyl sulfoxide (DMSO), a by-product of the paper manufacturing industry, has been widely used as a commercial solvent since the 1940's. In 1959, it was found to be useful in the preservation of tissues by freezing, and in 1962 it was observed that industrial workers who accidentally spilled DMSO on their skin developed a garlic-like odor on their breath very soon thereafter, indicating that the chemical was rapidly absorbed topically. It was reported to possess local analgesic activity, to reduce swelling, and it appeared to promote healing of injured tissue. In 1964, extensive clinical investigations were undertaken using the drug for everything from sprains to senile psychosis. Because of media reports of its effectiveness in treating a wide variety of disabilities, DMSO was hailed as a new "miracle" drug.

In 1965, the Food and Drug Administration (FDA) learned that prolonged use of DMSO in animals was associated with adverse effects on the lens of the eye, and clinical testing on humans was discontinued by voluntary agreement of the sponsoring pharmaceutical firms and the FDA. Testing was later permitted, after preclearance by the FDA Commissioner, for applications in such serious conditions as scleroderma, persistent herpes zoster, and severe rheumatoid arthritis, for which no satisfactory substitute therapy was available. Later, clinical testing on man was permitted for

treatment of acute and chronic arthropathies, acute strains, sprains, and bursitis, for use as a carrier for other drugs in the treatment of cancer and other conditions, and in processing frozen blood and cryoprecipitates.

Considerable pressure has been brought to bear upon the Food and Drug Administration over the years to approve the drug for prescription purposes. In May 1971, therefore, the Commissioner of FDA asked the National Academy of Sciences to establish a group to examine all information on DMSO to determine whether or not the available information supported the FDA's position on the drug. The *ad hoc* Committee on Dimethyl Sulfoxide was established and began its deliberations in June 1972. A ten-year bibliography comprising more than 1,000 citations has been developed during the past year, chiefly with the resources of the National Library of Medicine. The FDA supplied some 200 volumes of material submitted by pharmaceutical companies. The review was undertaken by 35 specialists who were organized in subcommittees dealing with toxicology, dermatology, musculoskeletal conditions, diseases of connective tissue, and general medical and surgical conditions.

The Committee's report, which is now being prepared for publication, will assess the efficacy of DMSO as a therapeutic agent in a wide variety of clinical conditions, assess the toxicity of DMSO, and—in weighing these assessments against each other—determine whether the drug should be released for general practice.

JOJOBA OIL UTILIZATION

In response to a request from the Director of the Office of Economic Opportunity, the NRC Division of Chemistry and Chemical Technology established the Committee on Jojoba Utilization to review plans for subjecting to industrial-scale tests the oil from a 1972 harvest of seeds from jojoba (*Simmondsia* chinensis), a desert plant indigenous to the Sonoran desert region of Southwestern Arizona, Southeastern California, and adjacent areas of Mexico. The purpose of the large-scale tests is to determine the possibility of developing the oil as an economic resource for the Indian tribes occupying the regions where the plant is found and might be cultivated.

Jojoba oil, of which the seeds contain about 50% by weight, is a practically colorless, odorless product consisting mainly of non-glyceride esters of straight-chain, mono-unsaturated C_{20} and C_{22} aliphatic alcohols and acids. It resembles sperm whale oil in chemical composition and physical behavior, and is remarkably stable toward thermal and oxidative chemical change. The liquid can be hydrogenated to a hard, colorless solid resembling carnauba wax, with an uncommonly high melting point (for a wax) of about 70°C. Considerable research has been done over several decades, but never until now has there been a large enough supply for commercial-scale testing for such potential uses as in cutting oils specialized for high-temperature, high-pressure applications, or in cosmetic emollients. The 1972 harvest,

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hand-picked by Indians on the San Carlos Apache Reservation under the supervision of the University of Arizona's Office of Arid Lands Studies and, to a lesser extent, of the University of California at Riverside, brought in about 30,000 pounds of cleaned, dried seeds.

The Committee met in March 1973 in Tucson to review what is known about the chemistry of the oil and about methods of improving the harvesting, both of wild stands of jojoba and of cultivated plants. An interim draft report, prepared in May, recommends uses to be made of the present stock of oil and steps to be taken for long-range development of jojoba as a uniquely valuable natural resource of potential economic advantage to the Indians of the Southwest where the plant thrives and is indigenous.

Governmental responsibility for the project has been transferred to the Office of Native American Program, Department of Health, Education, and Welfare, and interest in it is shared by the Bureau of Indian Affairs of the Department of the Interior.

PART III: INTERNATIONAL ACTIVITIES

Through the Foreign Secretary and his office, the National Academy of Sciences maintains relations with other academies, with the International Council of Scientific Unions (ICSU) and its constituent Unions, and with scientific societies in countries abroad. The Office of the Foreign Secretary (OFS) is also responsible for arranging for participation by American scientists in the activities of international scientific organizations and programs, and for the exchange of scientists and scientific information with other nations. As the adhering body to ICSU and the scientific Unions, the Academy supports the ICSU resolution for freedom of research in the sea and the free movement of scientists. The Academy's long-standing interest in the applications of science and technology to problems of less-developed countries is reflected in the bilateral programs of the OFS Board on Science and Technology for International Development.

In cooperation with other academies and scientific institutions abroad, the U.S. Academy helped in the creation of the International Centre for Insect Physiology and Ecology in Kenya, and played a key role in the creation of the International Institute for Applied Systems Analysis (IIASA). The NAS Foreign Secretary is a member of the Executive Committee and chairman of the Finance Committee of IIASA. In addition to the U.S. National Academy of Sciences, the IIASA founding members are institutions from Bulgaria, Canada, Czechoslovakia, Federal Republic of Germany, France, German Democratic Republic, Great Britain, Italy, Japan, Poland, and the Soviet Union. Austria has been invited to become a member.

SUPPORT OF INTERNATIONAL SCIENTIFIC ORGANIZATIONS

The National Academy of Sciences and the National Research Council are involved with a wide array of international scientific organizations, including the International Council of Scientific Unions (ICSU), its 17 constituent unions, and the 11 international unions not affiliated with ICSU. The Academy's participation and support ranges from adherence as a member to providing advice to U.S. governmental agencies on the content of the programs of some of the United Nations family of agencies. The primary mechanisms for the Academy's participation in the activities of the international unions are the U.S. national committees, which, for the most part, are administered by appropriate divisions of the National Research Council.

A U.S. national committee for a union generally performs the following functions under terms established by its constitution, which is presented to

the NAS-NRC Governing Board for approval upon formation of the U.S. national committee and whenever it is amended: The U.S. national committee serves as: (1) A link between the organizations of the U.S. community and the international body; (2) A link between the academic, governmental, and industrial elements of the U.S. community; (3) A transmission mechanism for collaborative program proposals and information exchanges; (4) A mechanism for transmitting substantive information within the discipline; (5) A monitor of the international affairs of the union (finances, management, elections, budgets, dues, organization); and (6) A training ground for leadership both within the U.S. scientific community and the international union.

EXCHANGE PROGRAMS

USSR and Eastern Europe

The past year was marked by promising developments in scientific relations between the United States and the USSR. At the summit meeting between President Nixon and General Secretary Brezhnev in May 1972, agreements were signed for U.S.-Soviet cooperation in environmental protection, in medical science and public health, in the exploration and use of outer space, and in science and technology. Of particular interest to the Academy is the intergovernmental agreement of May 24 on cooperation in science and technology, which is being implemented through a Joint Commission headed on the U.S. side by H. Guyford Stever, Director of the National Science Foundation and Science Adviser to the President.

In October 1972, Academician M. V. Keldysh, President of the Soviet Academy, made a three-week visit to the United States as guest of the National Academy of Sciences. He was accompanied by four Soviet Academy members, and met with the NAS Council for discussions about future scientific cooperation, as recorded in a Protocol signed by Presidents Handler and Keldysh in New York on November 4, 1972.

In the Protocol, agreement was reached regarding several aspects of the formal inter-Academy Exchange Program: (1) that the program be expanded, contingent upon the availability of funds; (2) that the sending Academy would be receptive to suggestions from the receiving Academy as to which scientists might be included in the program for long-term research; (3) that the Academies would seek to facilitate opportunities for research in high-energy physics at appropriate institutions not covered by the existing exchange agreement between the U.S. Atomic Energy Commission and the USSR State Committee for Utilization of Atomic Energy; (4) that the Academies would continue to facilitate consultation between U.S. and Soviet scientists and others on future large accelerators; (5) that the Academies would continue planning the bilateral symposium on arid land agriculture; (6) that consideration would be given to cooperative research in the earth sciences; (7) that exchanges of young scientists for research visits in the

field of computer software would be encouraged; and (8) that the Academies would facilitate implementation of worthy proposals for joint research developed independently by U.S. and Soviet scientists.

From April 1972 through March 1973, during the regular exchange program with the Soviet Academy, 25 American scientists visited the USSR for a total of 62 months, while 36 Soviet scientists visited the U.S. for a total of 80.5 months. The emphasis in both directions continued to be in physics, engineering, and the life sciences. During the same period, a total of 92 Americans visited the various East European countries in the inter-Academy exchanges for a total of 228 months; 69 East Europeans came to the United States for visits of 211 months. These exchange arrangements exist with Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and Yugoslavia.

The People's Republic of China

Scholarly exchanges with the People's Republic of China have expanded greatly during the past year. More than a hundred American scholars have traveled to China and visited universities, research institutes, factories, and communes. Many gave lectures and discussed work in the United States with their Chinese colleagues. Their visits have sparked the interest of both U.S. and Chinese scholars for further communication.

In October 1972, the Institute of Medicine and the American Medical Association were hosts for the U.S. visit of a Chinese physicians' delegation, the first such visit to this country by a professional delegation from the People's Republic of China in more than 20 years. The ten Chinese physicians toured medical and health facilities in Washington, D.C., New York, Boston, Kansas City, Chicago, and San Francisco. The visit was in response to an invitation to the China Medical Association from Dr. John R. Hogness, President of the Institute of Medicine, and Dr. Wesley W. Hall, immediate past President of the American Medical Association, on behalf of four American physicians who visited China in 1971.

This initial Chinese delegation was followed by visits of a Chinese hydrotechnical study group in April 1973, and, in June, by six specialists in insect hormone research. In May, the OFS Committee on Scholarly Communication with the People's Republic of China visited China at the invitation of the Scientific and Technical Association of the People's Republic of China. The Committee discussed future exchanges in the natural and medical sciences, social sciences, and humanities between PRC and the United States.

International Fellowship Programs

The NRC Office of Scientific Personnel (see page 135) administers several international exchange programs: The National Aeronautics and Space Administration International University Fellowships in Space Sciences, the Senior Fulbright-Hays Program, and the United States com-

ponent of the International Atomic Energy Agency (IAEA) Fellowships in Peaceful Uses of Nuclear Energy.

NASA International University Fellowships in Space Sciences.—During FY 1973, 79 Fellows from 14 countries studied at 26 U.S. universities under the NASA Program. For budgetary reasons, NASA has decided to terminate its program in 1974. At the end of FY 1973, 39 Fellows were on tenure. Although no renewal appointments are being made, 17 of these Fellows have obtained financial support from the sponsoring agencies in their countries or from their U.S. universities to remain in the United States after the termination of their NASA Fellowships to complete their research programs.

International Atomic Energy Agency (IAEA) Fellowships in Peaceful Uses of Nuclear Energy.—The IAEA in Vienna, Austria, sponsors a fellowship program that provides a variety of training opportunities relating to the peaceful uses of nuclear energy. It is aimed specifically at the developing countries with a view to helping them acquire capabilities in the use of nuclear energy and the use of radiation and radioactive materials for medical, biological, agricultural, and industrial purposes. The IAEA Fellowship Program is financed by the General Fund of the International Atomic Energy Agency, contribution of fellowships from member states of the IAEA, and funds received from the United Nations Development Program. The selection of individuals to receive awards is made by the IAEA from a list of candidates submitted by the governments of the eligible member states.

Under contracts with the Agency for International Development and the U.S. Atomic Energy Commission, the Office of Scientific Personnel makes arrangements for the study programs of the Fellows for whom the United States is designated host. In this task, the NRC cooperates with colleges and universities, hospitals, private corporations, and governmental agencies. Many fellows train at several institutions during their visits.

During FY 1973, 64 United States-supported Fellows and 66 IAEA- and United States-supported Fellows from 34 countries studied in the United States. Of these, 76 were at universities, 35 at U.S. Atomic Energy Commission installations, 25 at other government facilities, 7 at university hospitals, and 22 were trained in private industry.

Senior Fulbright-Hays Program.—The Academy has the administrative and contractual responsibility for the Senior Fulbright-Hays Program under the general sponsorship of the Conference Board of Associated Research Councils (American Council on Education, American Council of Learned Societies, National Research Council, and the Social Science Research Council). The program is administered by the Office of Scientific Personnel, but its policy and program direction are supervised by the Conference Board's Committee on International Exchange of Persons (CIEP).

The CIEP nominated 1,149 U.S. nationals for Senior Fulbright awards, on the basis of which 498 awards were made. The Committee also sponsored 608 foreign scholars at institutions throughout the United States during the year, sponsored several evaluative conferences, and responded to requests from the Department of State for assistance in several other areas of international exchange.

Two major program developments of the year related to Eastern Europe. One was an agreement signed by the governments of the United States and the USSR in the spring of 1972 to initiate an exchange of visiting lecturers. The second is an agreement with Romania for the exchange of teams of university officials for short-term visits, to be followed by joint conferences in the United States and Romania on some mutually agreed upon aspects of education. A five-member team of Americans has been selected and is slated to visit Romania for two weeks in November 1973.

SCIENCE AND TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT

In an effort to assist more of the poorer countries to strengthen their scientific and technological capabilities for economic and social development, the OFS Board on Science and Technology for International Development plans to extend its bilateral workshop and study group programs. The workshop program has included Ghana, Nigeria, Zaire, India, Indonesia, the Philippines, Taiwan, Thailand, Argentina, Brazil, Chile, Colombia, and Peru. Study group programs have included Africa, Korea, Thailand, East Pakistan, Singapore, Guyana, and Central America. Discussions of participation in these programs have been held with scientists and officials in Guatemala, Ethiopia, Sudan, and Afghanistan.

During the year, workshops were held in Indonesia, Thailand, and Ghana. In Colombia, a study group on graduate education and research in Colombian universities recommended that advanced training capabilities be strengthened in physics, biology, mathematics, chemistry, geology, and engineering. Colombian educators and the USAID Mission in that country are implementing this recommendation. A similar joint study, specifically on geology training and research needs in Zaire, has been completed.

The long-standing cooperative program between the Academy and the Brazilian National Research Council (CNPq) was continued during the year. Two study groups, on the improvement of advanced training in computer sciences and on the strengthening of agricultural-engineering education at Brazilian universities, completed their reports and their recommendations are being implemented. The Chemistry Program, in which the first group of NAS Overseas Research Fellows are working with their Brazilian colleagues to develop centers of excellence in teaching and research in organic chemistry at the Federal University of Rio de Janeiro and the University of Sao Paulo, has not proceeded as quickly as anticipated because of

the initial difficulty in attracting suitably qualified students. The quality of the research carried out has been extremely high, however, and a number of papers have been published in international journals. Because the number of graduates produced has fallen short of early goals, a two-year extension of the program has been recommended. By the end of that period, it is expected that the approximately 40 Ph.D.s produced will make Brazil self-sufficient in chemistry teaching and research.

Follow-up activities to the Central American Workshop on the Environment and Development are leading to an economic and environmental study of the use of pesticides in cotton production in Central America.

To ensure continuity in the OFS collaborative programs, continuing committees are being established that will be responsible for defining and overseeing workshop and study group activities of the Korea and Brazil programs, and will probably be established to serve similar functions for the programs with Ghana, India, Indonesia, Singapore, and Thailand.

The Advisory Committee on Technological Innovation was established in the Office of the Foreign Secretary during fiscal year 1972 "to attempt to generate ideas and assess the validity of innovative applications of known technologies and new technological advances to immediate problems of developing countries and to identify areas of research where concerted effort can substantially shorten the time-lag characteristics of the normal progress of scientific advances from the laboratory to field application." Reports by two of the Committee's special panels were published during the year: *Ferrocement: Applications for Developing Countries* (see page 55) and *Mosquito Control: Some Perspectives for Developing Countries* (see page 57). The report of a third project, *Unsolved Problems in Food Science of Interest to Developing Countries,* is being prepared for publication.

Several advisory studies conducted for the Agency for International Development were completed, including a report that recommended the establishment of an International Industrialization Institute. If acted upon by the international development community, such an independent research institution should fill the many gaps in our understanding of the processes of industrialization and help both developing and developed countries to achieve the optimum contribution of industrialization to their economic and social development, and to share equitably in its benefits.

INTERNATIONAL STUDIES

OCEAN SCIENCE FREEDOM STUDIES

Freedom of the seas for scientific research is a major concern of the Ocean Affairs Board of the NRC Division of Earth Sciences. The Board formed a Task Group to make recommendations regarding United States positions on scientific research in the oceans and on other Law-of-the-Sea issues as they relate to scientific research. The Task Group was charged with providing

ocean-science experts to assist the United States delegation at meetings of the United Nations Seabeds Committee and the Law-of-the-Sea Conference, and with evaluating these meetings and recommending additional actions to further the interests of ocean science.

The Task Group has been assisting in the development of a rationale for a United States policy on freedom of ocean science. A major effort of the group resulted in the proposed United States position on freedom for science in the oceans, transmitted to the U.S. Department of State and to the presidents of foreign academies by NAS President Philip Handler in July 1972.

In February 1973, this study was intensified to ensure that the interests of ocean science would be taken into account during the Law-of-the-Sea negotiations. During the March Law-of-the-Sea Preparatory Meetings in New York, Dr. Handler urged the continuation of "the freedom oceanographers have enjoyed to explore the oceans beyond narrow national limits." Stressing the need for mutual trust as well as adequate safeguards, Dr. Handler said:

"Happily, the vast stretches of the ocean are available in which to start a new experiment in the political behavior of mankind. International cooperation has not been the principal characteristic of most historical agreements and treaties concerning the land portion of the earth—except for the noble example of Antarctica. But it can and must be the basis of man's use and enjoyment of the oceans. Let us investigate the oceans together and let us promote the resultant knowledge as rapidly and in as many ways as possible for the benefit of all men, everywhere."

FERROCEMENT: APPLICATIONS IN DEVELOPING COUNTRIES

Throughout the world, the use of ferrocement as a material of construction is increasing rapidly in applications ranging from fishing craft to agricultural and commercial facilities. Ferrocement was patented in France in 1847, but had remained virtually unused until its resurrection a few years ago. In Thailand the process provides a cheap and easy method of building excellent silos for storage of grains, other foods, salt, fertilizer, and even drinking water. Communes of the People's Republic of China use the same construction process for mass-producing the sampans that are a major means of transportation on the network of rivers and canals in the marshy flatland near Shanghai.

A form of reinforced concrete, the process consists of several layers of chicken-wire mesh covered with a thin layer of concrete applied by hand or with a trowel. The ingredients for ferrocement are widely available in developing countries, and, under supervision, it can be applied by unskilled labor. Although ferrocement is not economically competitive in developed countries because of high labor costs, it is ideally suited to developing, labor-intensive areas from the standpoint of economics, ease of repair, and imperviousness to rot and insect damage.

In view of the potential impact of ferrocement construction in developing countries, the Board on Science and Technology for International Development, in the NAS Office of the Foreign Secretary, convened the *ad hoc* Panel on the Utilization of Ferrocement in Developing Countries to evaluate the current state of the art of ferrocement as an engineering material and to evaluate the principal areas of its application on both land and water. The Panel's study was supported by the Agency for International Development.

According to the Panel's report, *Ferrocement: Applications in Developing Countries,* food storage facilities are extremely adaptable to ferrocement construction. Since most of the storage needs of developing countries are for on-farm storage for individual farmers, ferrocement's almost unlimited range of curved design shapes and adaptability to local conditions are especially important, particularly in areas where the acceptance of a new material is dependent on that material's ability to reproduce traditional designs. Ferrocement can also be fabricated into tanks or vats for water storage or fermentation of local beverages. This is a popular application in New Zealand, the Panel said, where such tanks are mass-produced and then distributed to local residents.

The Panel also suggested that ferrocement could be used for food-processing equipment and housing construction. Noting that the world food problem is caused in part by poor distribution and inadequate protection of available foodstuffs, the Panel noted that "The use of ferrocement, even on a modest scale, could influence the creation of food industries in developing countries and contribute to the improved nutrition of the inhabitants." Before being used in these applications, however, the Panel said that "extensive preliminary laboratory research is needed" to answer questions about the effect of a ferrocement surface on the foods it touches, its ability to meet local sanitary requirements, its pressure and thermal tolerance, and its moisture vapor transmission rate. Among the suggested applications are tanks, vats, pipes, trays, drying tables, cold storage and freezing chambers, ovens, water-product sewage treatment facilities, butchering facilities, and dairies.

Housing construction also presents an excellent opportunity for ferrocement use. Developing countries already have acute housing shortages, and the problem is expected to become even more critical within the next few years. Especially urgent is the need for a suitable roofing material. The report points out that the roof of a dwelling is the major building expense in developing countries, often amounting to 60 percent of the total cost. Consequently, a long-lasting roof is too expensive for most people, and they are forced to use cheaper local materials such as grass or reeds or earth products that are short-lived and dangerous in earthquakes, floods, or fires.

Ferrocement is particularly suitable for roofing, but this application, too, must undergo research to determine the shapes and types of roofing mem-

bers to be manufactured, and to explore designs and methods for anchoring and bolting these various shapes to supporting walls.

In considering the use of ferrocement in water-related applications, the Panel pointed out that small, smooth-water boats made from ferrocement enjoy several advantages over their wooden counterparts. They are resistant to such natural pests as ship worms, are lighter in weight, more flexible in design, and strong enough to be powered by outboard motors. In addition to boats, ferrocement could be used for floating construction platforms that could be ferried along waterways to other building sites. Other potential uses include buoys, docks, houseboats, pontoons, floating bridges and shelters, offshore tanker terminals, and floating and submerged oil reservoirs.

In view of all these potential applications, the Panel recommended that disaster-relief organizations give careful consideration to ferrocement as a building material. They pointed out that "After fires, floods, droughts, and earthquakes, the needs for food, shelter, and public health facilities are urgent," and that supplies of conventional building materials are often stranded by disrupted transportation routes. But "the basic ingredients of ferrocement may be available on site or easily transported" to insure quick relief to disaster victims. The Panel also pointed out that ferrocement structures built for an emergency "will last long after the emergency is over"' and provide continuing aid to depressed areas.

In the Panel's opinion, there is no doubt that ferrocement has the potential for helping developing countries to solve their materials problem. The question is the coordination of efforts on an international level to carry out the necessary research and disseminate the information gained. The report contains a blueprint for such actions and suggests creating several regional training centers for ferrocement construction supervisors. The Panel also recommended the establishment of an international referral service on ferrocement science, possibly at an academic or research institution that already has competence and ongoing programs in ferrocement technology.

MOSQUITO CONTROL

One of the world's greatest public health needs is for safe and effective control of mosquitoes to curb the tranmission of such mosquito-borne diseases as malaria, filariasis, yellow fever, and dengue. Because mosquitoes are becoming more and more resistant to chemical insecticides and because suitable alternative chemicals are scarce, the U.S. Agency for International Development asked the Academy to study alternative methods for mosquito control that might be employed in developing countries where these diseases are endemic. The study was undertaken by an *ad hoc* panel of the OFS Board on Science and Technology for International Development.

In its report, *Mosquito Control: Some Perspectives for Developing Countries,* the panel called for a careful shift toward biological and ecological control methods. The panel pointed out that biological control "remains a

well-publicized but under-supported approach," and is a "complex and challenging" problem. According to the panel, biological methods for mosquito control are the most promising of any methods now available, and—within five years—given adequate support and sustained research efforts, "significant breakthroughs in biological control can be expected." They emphasized, however, that no particular control method should be used exclusively, and suggested that chemical and biological methods be combined with traditional source-reduction techniques.

Among the biological controls described in the report are the use of minnow-sized fish that eat mosquito eggs, larvae, and pupae; various parasitic organisms that attack and kill mosquito larvae; chemical growth regulators that interrupt mosquito development and maturation; plants that poison larvae by releasing toxins into the water; plant seeds that trap larvae with their sticky mucous coatings; non-biting mosquitoes that prey on the larvae of the biting, disease-carrying species; and genetic controls that produce sterile mosquitoes or mosquitoes with erratic, lethal behavior patterns. According to the panel, all of these control mehtods are suitable for use in low-income countries.

INTERNATIONAL SCIENTIFIC PROGRAMS

The National Academy of Sciences is involved in some 20 international scientific collaborative programs of various types, sponsored by ICSU or by an agency of the United Nations. As with ICSU and its unions, the principal mechanism for involvement in an international collaborative program is the U.S. national committee. The NAS Foreign Secretary is an *ex officio* member of the U.S. national committees, which are administered by appropriate divisions of the National Research Council.

These programs vary widely, ranging from those which require comparison of observations from various parts of the planet (e.g., Global Atmospheric Research Program, International Geological Correlation Program, Solar-Terrestrial Physics) to those where a sharing of data in an interdisciplinary field simply is beneficial scientifically and economically (e.g., International Hydrological Decade, Scientific Committee on Water Research, International Biological Program, Scientific Committee on Antarctic Research). Other programs are applicable to all branches of science and render broad services to both the scientific community and other sectors of society (e.g., science information, science and technology for development, teaching of science). Still other programs, such as the Scientific Committee on Problems of the Environment, concentrate on areas of human problems, anticipate them, and recommend research or other action oriented toward remedy. Most programs serve combinations of these purposes. In addition, most of the non-governmental programs also serve as sources of scientific advice to inter-governmental programs or bodies.

GEOPHYSICS RESEARCH

The Geophysics Research Board (GRB) in the Division of Physical Sciences encourages U.S. participation in the activities of international geophysical organizations and stimulates research interest in the United States in geophysics and related fields. Operating primarily through its committees and panels, the Board develops and coordinates U.S. contributions to international geophysical programs such as those of the Inter-Union Commission on Solar-Terrestrial Physics (IUCSTP) and the Inter-Union Commission on Geodynamics (ICG). Close liaison is maintained with government agencies actively participating in the execution of such domestic programs as data exchange. World Data Center A and its Coordination Office operate under the aegis of the Board. The Board's committees include the Committee on Solar-Terrestrial Research, the U.S. Geodynamics Committee, and the Committee on Data Interchange and Data Centers.

Committee on Solar-Terrestrial Research

This Committee is closely affiliated with the Inter-Union Commission on Solar-Terrestrial Physics, which is now reorganizing its program under four major discipline areas: solar physics, interplanetary medium, planetary atmospheres, and magnetospheric research. Provisions are being made for the scientific direction of data collection and distribution in these areas.

In 1969, IUCSTP proposed international coordination of long-term magnetospheric experiments. Plans are under way for an International Magnetospheric Study (IMS) for the years 1976–1978, that will coordinate the efforts of several countries in an attempt to understand cause-and-effect relationships in the magnetosphere. Early in 1973, the Committee and the Academy's Space Science Board (Division of Physicial Sciences) formed a panel to conduct a joint study on the IMS, which resulted in the publication in May of *International Magnetospheric Study: Guidelines for United States Participation.*

As explained in the report, "The IMS affords a unique opportunity to perform coordinated research on well-defined problems of the magnetosphere." The group recommended that the "United States endorse the International Magnetosphere Study (IMS) and participate with a coordinated research program of ground-based, balloon, rocket, and satellite observations that include the NASA/ESRO [European Space Research Organization] Mother-Daughter Heliocentric missions (International Magnetosphere Explorers)." They further recommended: "To carry out the United States program for the IMS, . . . that a program office be set up within the National Science Foundation with a representative designated in each participating government agency to coordinate IMS-related projects of these agencies."

The report points out that "The magnetosphere exerts a subtle but significant influence in several domains that directly affect man and his interaction with his environment." The IMS is therefore of interest both for reasons intrinsic to physics and for reasons of more general interest, such as the possibility of magnetospheric effect on climate, the problems of magnetospheric disruption of power transmission and communications, and general exposition of the nature of the field of planets.

"We have reached a state of knowledge such that we can now ask the right fundamental questions to attack many of the still unresolved problems of the magnetosphere," the panel said. "There now exist competent researchers around the world, many working effectively in teams, who have the theoretical knowledge and expertise in experimental techniques needed to solve many of the yet unanswered questions; and . . . the space technology both hardware and software, needed to answer many of the questions that we could not attack earlier is now within reach."

Geodynamics Project

In March 1972, the U.S. Geodynamics Committee met with some 40 consultants to develop a draft statement of the scope of the U.S. contribution to the Geodynamics Project, the scientific problems, and directions for solution. A summary of the themes under consideration for the U.S. program was subsequently submitted to the Inter-Union Commission on Geodynamics. They included: (1) American Plate; Pacific Margin, Basin and Range—Colorado Plateau—Rocky Mountain Region, San Andreas Fault System, Pacific Margin of Alaska, Eastern U.S. and the Continental Interior, (2) Small Plates and Plate Margins; Caribbean, Mid-Atlantic Ridge, Nazca Plate, Arctic Geodynamics, Antarctic Plate, (3) Internal Properties and Processes; Dynamical Models, Geophysical Observations of Internal Processes, Physical and Chemical Properties of Minerals and Mineral Assemblages, Geological Constraints, (4) Boundaries, Movements and Structure of Lithospheric Plates; Present Plate Boundaries, Present Motion of Plates, Plate Boundaries and Rates of Movement During the Past, (5) Deep Drilling, and (6) Data Exchange and Compilations for the Geodynamics Project.

The objectives of the U.S. Program are: (a) to develop further the basic model of plate tectonics; (b) to test and demonstrate its ability to explain and predict geological phenomena; (c) to determine the degree to which it can be extended, its limitations in scale, in time, and in the phenomena it will explain; (d) to investigate whether apparently unrelated geodynamic phenomena are independent or are in some way related to the model; (e) to examine the implications of the findings with regard to basic and applied research.

Committee on Data Interchange and Data Centers

This Committee was established in 1967 to meet the current and future problems of international exchange of geophysical data through the World Data Centers and to advise the Geophysics Research Board and the Director of WDC–A (the World Data Center in the United States) on policies and effectiveness of the service to the U.S. scientific community.

The Committee reviewed the statistics from the WDC–A subcenters on Geomagnetism, Glaciology, Longitude and Latitude, Meteorology, Oceanography, Rockets and Satellites, Tsunami, and Solar-Terrestrial Physics. They concluded that adequate utilization of data was clearly demonstrated, and proposed a new survey to evaluate the significance of utilization of data from the WDC's.

INTERNATIONAL BIOLOGICAL PROGRAM

The International Biological Program (IBP), which began in 1965, is scheduled to end in mid-1974, and the U.S. National Committee for the IBP, in addition to continuing its coordination of the various components of the U.S. contribution to the program, has taken steps to provide for an assessment of the program and to plan for a synthesis of IBP accomplishments in the United States. The Committee was also concerned with providing advice on mechanisms for managing those programs that, reoriented, might extend beyond the date of termination of the IBP.

The U.S. National Committee for the IBP has approved the following post-IBP recommendations: (1) that the Institute of Ecology should assume post-IBP coordination of the Biome Programs; (2) that the National Research Council should explore the desirability of development of proposals for an urban ecosystem program; (3) that the Biomes programs should give more attention to Man in the Ecosystem; (4) that the feasibility of study of managed ecosystems be explored; (5) that the Conservation of Ecosystems program remain under the American Institute of Biological Sciences; (6) that the Integrated Pest Control program remain under the sponsorship of the University of California, Berkeley, and perhaps eventually become part of the managed agriculture program; (7) that Conservation of Plant Genetic Materials program remain under the U.S. Department of Agriculture.

In addition to the above, the Committee recognized the following: (1) The Marine Mammal and Aerobiology programs would probably terminate by the end of fiscal year 1974; (2) The current method of coordinating the Human Adaptability programs would probably not continue beyond the termination of IBP; (3) Programs on Population Genetics of South Ameri-

can Indians and the Nutrition Programs would continue under their present sponsors; (4) Programs on the Biology of Human Populations at High Altitudes and Biosocial Adaptations of Migrant and Urban Peoples would be related to the objectives of the Man and the Biosphere (MAB) program (the U.S. National Committee/MAB has been formed by the State Department); (5) Coordination under sponsorship of the National Academy of Sciences for continued IBP programs would probably not be necessary if the planned arrangements for sponsorship and coordination seem practicable. The U.S. National Committee for the IBP emphasized that continued coordination between the National Research Council and the U.S. National Committee on Man and the Biosphere, the Institute of Ecology, and the International Environmental Programs Committee is essential.

PART IV: A SUMMARY OF THE ACTIVITIES OF THE NATIONAL ACADEMY OF ENGINEERING

AEROSPACE ENGINEERING

The Aeronautics and Space Engineering Board (ASEB) was established in 1967 to provide counsel to federal agencies on plans and programs relating to their aerospace engineering efforts. In its role as advisor to the National Aeronautics and Space Administration on the problems and implications of aeronautical developments, the Board this year continued its consideration of the nation's civilian space shuttle program, through an *ad hoc* committee formed in 1971 for this purpose. The Board contributed also to the preparation of the Aeronautics and Space Report of the President as it has done annually in the past.

The Council of the NAE established the Space Applications Board (SAB) in December 1971 to advise NASA and other government agencies on the application of space technology to national needs, emphasizing ways to augment its positive effects on society. The Organizing Committee for the SAB completed its work in February, 1973. The Organizing Committee's recommendations to the NAE dealt with such matters as guidelines to be established for the Board, identification of applications areas for initial examination, the composition of the Board and its mode of operation. The SAB was subsequently appointed and following its first meeting in May, has concentrated its effort on development planning.

BIOENGINEERING

Organized in 1967, the Committee on the Interplay of Engineering with Biology and Medicine completed its work this year and has been discharged. Five reports summarizing the committee's work have been prepared: *Federal Agency Development in Biomedical Engineering*; *Research on Aids for the Hearing Impaired*; *Final Report of the Pulmonary Care Ad Hoc Group*; *Final Report to National Institutes of Health*; and, *Final Report to the National Aeronautics and Space Administration on Technology Transfer*. The committee was charged with the examination of the application of engineering concepts and theories to the development of health-care delivery systems, and the identification of engineering technology as it relates to biomedical requirements. It acted in an advisory role to the National Institutes of Health, the National Aeronautics and Space Administration, and other federal agencies concerned with the support and encouragement of engineering in biology and medicine.

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COMMUNICATIONS

The Committee on Telecommunications was established in 1968 to provide advisory services to federal agencies on telecommunications technology and its relationship to national policies and programs. The committee this year issued a report of its Advisory Subcommittee on Telecommunications to the Office of Telecommunications (OT), Department of Commerce, which noted OT initiatives directed toward the subject areas of broad bandwidth, land mobile, and data communications. In an effort to provide increased telecommunications support services to the Department of Commerce and to other government agencies with regard to new programs in these areas, the subcommittee suggested that OT should closely couple its efforts with those of other interested federal agencies. Two other subcommittees completed their work this year also. The Cable Television Technology Task Force reviewed a handbook on cable television prepared elsewhere for the National Science Foundation (NSF). The Panel on Telecommunications Research, which was formed at the request of the NSF, published a report on the status of telecommunications research in the U.S. and selected foreign countries.

ENGINEERING EDUCATION

The Academy's Commission on Education continued to direct its attention to the integration of digital computation into the chemical engineering curriculum, and to consideration of projects and programs to meet the present and future needs in engineering education.

In this connection, the commission issued the reports *CACHE—Physical Properties Data Book* and *CACHE Guidelines for Large-Scale Computer Programs.* The Commission is currently involved in a study relating to a systematic approach to the continuous development of technical manpower which was the subject of a workshop held in June of 1972. Workshop discussions included consideration of the definition of technological education, the provision of improved career guidance, real-time manpower forecasting, special group needs and accreditation. It also expects to publish the proceedings of a Symposium on Increasing Minority Participation in Engineering, which was held under the Commission's aegis in connection with the 1973 Annual Meeting of the Academy.

ENGINEERING MANPOWER

The NAE formed the *Ad Hoc* Committee on Engineering Manpower Policy in the summer of 1971 to study the effects of the underemployment of scientists and engineers, and to identify the major factors affecting their utilization. The Committee completed its study concerning national policies associated with the effective utilization of engineering manpower, and published its final report presenting recommended actions that the federal government might consider.

ENGINEERING POLICY

The Committee on Public Engineering Policy (COPEP) was established in 1967 to aid the interdependence between the federal government and engineering, to study and advise on the needs of the engineering community, and to initiate studies dealing with major policy questions in all fields of engineering. In an advisory capacity to the Council of the Academy, COPEP also reviews Academy reports and comments on their public policy aspects, and recommends NAE studies in areas affecting public policy. The Committee continued in these functions. Another ongoing COPEP activity is its "Monthly Digest of Congressional and Presidential Activities", which reports on developments concerning technology and public policy. The Committee also published an interim report of its study for the National Science Foundation (NSF) of the NSF program of Research Applied to National Needs (RANN), entitled *Priorities for Research Applicable to National Needs.*

ENVIRONMENTAL ENGINEERING

The Committee on Environmental Engineering (CoEE) was established in 1970 to pinpoint critical environmental problems and set in motion mechanisms for clarifying and defining the issues to be resolved. During the year CoEE initiated an *ad hoc* study project concerned with developing explicit criteria for power plant siting decisions by public, approving agencies. This is a related and an analogous study to that completed by the Committee on Power Plant Siting in 1972, which the CoEE was instrumental in launching.

During 1973 the Committee also gave preliminary consideration to undertaking a study of a proposed program of the Navy concerned with reduction of pollution.

INDUSTRIALIZED HOUSING

The *Ad Hoc* Committee on Industrialized Housing was established in 1971 and charged with surveying the current state of the art in industrialized housing, and with exploring ways of bringing together major manufacturers in a new approach to improved housing technology. The Committee was discharged this year upon completion of its report, *Industrialized Housing: An Inquiry into Factors Influencing Entry Decisions by Major Manufacturing Corporations* (see page 8.)

INTERNATIONAL AFFAIRS

The programs of the Office of the Foreign Secretary of the NAE and those of the NAS are closely integrated. During this activities year two studies were completed: one on the role of U.S. firms in industrial research, development, and engineering capabilities in developing countries, initiated in March, 1971; and the report of the *Ad Hoc* Panel To Study the Need and Feasibility for an International Industrialization Institute.

MARINE RESOURCES

The Marine Board serves as a principal focus for the Academy's interest in marine matters. Established in 1965, its responsibilities include reviewing the state of the art, and projecting the future needs and capabilities of marine-related engineering, especially as these pertain to national goals. The Board also serves as the U.S. National Committee for the International Engineering Committee on Oceanic Resources. The Board has completed an examination of safety in off-shore resource development, a study performed at the request of the Department of the Interior, and has issued its report on the subject entitled, *Outer Continental Shelf Resource Development Safety: A Review of Technology and Regulation for the Systematic Minimization of Environmental Intrusion from Petroleum Products* (see page 14).

TRANSPORTATION

The Committee on Transportation was established in 1970 to provide critical engineering review and evaluation of national transportation needs and programs, and to provide advisory services to federal agencies upon request. In furtherance of these objectives the Committee organized a Symposium on Transportation and the Prospects for Improved Efficiency, which was held in connection with the Eighth Autumn Meeting (1972) of the Academy. The purpose of the symposium was to focus attention on the relationships between urban transportation and the associated modal interface problems; on urban development and renewal as related to transportation; and on institutional barriers to the realization of improved transportation. Proceedings were subsequently issued.

The Academy this year undertook another activity in the area of transportation—the Bay Area Rapid Transit Impact Program Advisory Committee (BART). This Committee is to provide advisory services to the Department of Transportation and Department of Housing and Urban Development in the program design phase of the series of research studies to determine the effects on the San Francisco Bay Area which may be attributable to the BART System.

MINING

The NAE formed the *Ad Hoc* Advisory Committee to the Bureau of Mines in mid-1972 at the request of the Bureau of Mines to review and evaluate the research programs and mineral information activities of the Bureau with particular emphasis on their timeliness, effectiveness, and adequacy of financial support. The Committee's report, now in the final stages of preparation, is based on its deliberations following briefings by the Director and other officials of the Bureau, as well as on visits to 17 of the Bureau's research centers around the country. A general consensus of the Committee was that there is a need to increase the understanding of the public-at-large, legislators, industry, labor, and the academic community of the minerals

situation and its impact upon the security and economic well-being of the country; and of the role, activities, and responsibilities of the Bureau of Mines in coping with the minerals and energy resources problem.

UTILITY SYSTEMS

The newly formed Integrated Utility Systems Board is charged with reviewing studies of the integrated utility systems concept and analyzing data on various implemented and conceptual integrated utility systems. It is expected that the Board's work will be designed to assist the Department of Housing and Urban Development and other government agencies in evaluating the practicality of developing processing plants capable of serving all the utility needs of future community development.

RESEARCH AND DEVELOPMENT

The purpose of the *Ad Hoc* Study of the NSF Experimental R&D Incentives Program, formed this year, is to review the organization, planning, and proposed direction and development of the National Science Foundation (NSF) Experimental R&D Incentives Program. The Committee is to report to the NSF on the subject areas and experimental solutions selected by the NSF for possible funding.

PART V: A SUMMARY OF THE ACTIVITIES OF THE INSTITUTE OF MEDICINE

NATIONAL CANCER PROGRAM PLAN

A special Institute committee, appointed in the fall of 1972, undertook a review of the five-year plan for a "targeted" program of research against cancer. The review, contracted by the National Cancer Institute, was limited to the first two of the plan's three volumes. It included an evaluation of the way in which scientific priorities had been determined and the proposed techniques for managing the program. The report was presented to the National Cancer Institute in December 1972.

CONFERENCE ON EDUCATION

More than 120 educators in medicine, dentistry, nursing, and allied health fields met in October 1972 in a first national conference to explore curricular collaboration toward preparing students to function as members of a health-care "team." A report of the conference, including recommendations of the steering committee, is being prepared.

CONTRASTS IN HEALTH STATUS

See page 21.

MANDATED HEALTH INSURANCE

A seminar on some principal issues of any mandated national health insurance was held in November 1972 at the request of the Department of Health, Education, and Welfare. Questions of financing and particularly the rating systems that might be used to establish premiums were discussed. A report of the seminar's conclusions was published in February 1973.

DISEASE BY DISEASE TOWARD NATIONAL HEALTH INSURANCE

See page 20.

BUDGET ANALYSIS

In April, Institute staff members conducted an analysis of the Administration's 1974 Budget and its potential effects on federal health programs. The analysis was a first step in a continuing Institute assessment of government budget practices, designed to furnish a background for evaluation of proposed legislation. It was published as a staff paper of the Institute.

MECHANISMS OF QUALITY CARE ASSURANCE

Under examination by a special Institute panel are such matters as data requirements, management and control, evaluation mechanisms, effect of quality control on physician and patient behavior, and possible counter-productive aspects of the Professional Standards Review Organizations created by recent federal legislation.

HEALTH MAINTENANCE ORGANIZATIONS

An Institute committee is reviewing evidence for the effectiveness of HMO's in reducing hospitalization and costs, and is identifying the economic, legal, and professional barriers that might prevent a "fair market test" of the HMO approach to organizing and financing health services in competition with existing methods.

SUPPLY OF HOSPITAL BEDS

A committee of Institute members is considering the factors thought to influence the number of hospital beds maintained for the acutely ill, and will propose ways to adjust the supply in order to achieve the best use of existing facilities and appropriate planning for future hospital construction.

SACCHARIN AND OTHER NON-NUTRITIVE SWEETENERS

A two-part study for the Food and Drug Administration is being conducted jointly by a committee of the National Research Council and a panel of the Institute. The former is to assess whether or not ingested saccharin is carcinogenic in animals, and thus whether or not its use as a food additive for human beings would be denied by the so-called Delaney amendment to the Food, Drug, and Cosmetic Act. The Institute's role, if saccharin is to be ruled out by the Delaney clause, is to evaluate the benefits of non-nutritive sweeteners generally as prescription agents in the management or prevention of such conditions as obesity, diabetes, dental caries, and cardiovascular disease.

COST OF EDUCATION

A study to ascertain annual costs per student for education in medicine, dentistry, nursing, optometry, osteopathy, pharmacy, podiatry, and veterinary medicine continued during the year under a contract with the Department of Health, Education, and Welfare. The study group is taking a variety of approaches to determine educational costs and now is engaged in field work to gather supporting information from scores of schools and teaching hospitals. An interim report of the study, containing a legislative history of the support of health professions education and a description of the methodologies to be used, was submitted to Congress on March 30, 1973. The final report, which is to propose uniform national standards of cost-finding and reporting, is due in January 1974.

MEDICAL ETHICS

A program to describe the dimensions of a new system of medical ethics was initiated in November 1972. The Committee on Human Values in Health Care has considered the ethical problems attending today's decisions in health care, and has identified five subject areas in need of additional analysis. Scholars will be commissioned to assess ethical issues in these areas and prepare papers for presentation at a conference planned in November 1973.

VISIT OF CHINESE PHYSICIANS

See page 51.

FELLOWSHIP PROGRAM

A program to acquaint young health professionals with the methods of government in arriving at decisions on issues of medical care, research, and education was approved by the Institute's Council in March 1973. A grant of $710,000 was obtained from the Robert Wood Johnson Foundation to underwrite the program in its first three years. The program of Robert Wood Johnson Fellowships in Health Policy is being conducted in cooperation with the American Political Science Associaton (APSA). First awards are expected to be made for the 1974–1975 academic year.

Fellows will be selected on a competitive basis from among mid-career faculty members at health science centers. The one-year program in Washington will begin with six to eight weeks of orientation sessions on health policy conducted by the Institute of Medicine. Fellows then will be incorporated into the APSA Congressional Fellow Program, through which they will be assigned as staff members to congressional offices active in health matters. Those assignments will be supplemented by a variety of seminars and eventually by annual meetings of present and past Fellows. During the early years of the program, about six candidates will be selected annually.

PART VI: A SUMMARY OF ACTIVITIES OF THE NATIONAL RESEARCH COUNCIL

This section of the report briefly summarizes the committee activities of the National Research Council during fiscal year 1973. Selected completed studies and on-going work are reported in greater detail in Parts I and II of the report. International activities will be found in Part III.

DIVISION OF BEHAVIORAL SCIENCES

ADVISORY COMMITTEE ON THE ASSESSMENT OF EXPERIMENTAL MANPOWER R&D LABORATORIES

Organized in 1972 with support from the Manpower Administration, Department of Labor, its task is to assess four of the Experimental Manpower Laboratories funded by the Office of Policy, Evaluation, and Research of the Department of Labor. It will advise on the results of the assessment and recommend ways in which research and development objectives might better be achieved by either improving the operations of the laboratories, redesigning them, or replacing them with some alternative capability.

COMMITTEE ON HEARING, BIOACOUSTICS, AND BIOMECHANICS (CHABA)

Provides advisory services to the Armed Forces, the Department of Transportation, the Environmental Protection Agency, the Federal Aviation Agency, the National Aeronautics and Space Administration, the National Institute of Neurological Diseases and Stroke, and the Public Health Service.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL UNION OF THE HISTORY AND PHILOSOPHY OF SCIENCE (IUHPS)

Serves as U.S. adherent to the International Union.

COMMITTEE ON VISION

Provides advisory services to the Armed Forces, the Department of Transportation, the Environmental Protection Agency, the Federal Aviation Agency, the National Aeronautics and Space Administration, the National Institute of Neurological Disease and Stroke, and the Public Health Service.

COMMITTEE ON FEDERAL AGENCY EVALUATION RESEARCH

Organized in 1971 with support from the Office of Economic Opportunity, its task is to provide advice on issues related to the areas of evaluation and social experimentation. The Committee will undertake to identify key issues

relating to federal evaluation policy, study these issues, and recommend ways of dealing with them. The Committee will, in effect, constitute a capability within the NAS–NRC for providing scientific and technical advice in the areas of evaluation and social experimentation to which other federal agencies may also turn for assistance.

Panel on Welfare Reform Evaluation

Organized in 1972 with support from the Department of Health, Education, and Welfare, its task is to comment on and propose alternative strategies for the design of the evaluation of the Family Assistance Plan, Opportunities for Families, and the Adult Assistance Program. The Panel will be responsible for providing scientific and technical advice on the plans currently being developed for the evaluation of the proposed Welfare Reform legislation (H.R. 1).

PANEL ON THE IMPACT OF INFORMATION ON DRUG USE AND MISUSE

Organized in 1971 at the request of the National Institute of Mental Health, the Panel will: (a) determine the feasibility of conducting impact studies on current information programs; (b) advise NIMH on the design of such studies, if their feasibility is confirmed; (c) assist in identifying qualified performers of the studies, monitoring their conduct, and assessing their results; and (d) advise on the design of evaluative research on future information programs on drug use and misuse.

ADVISORY COMMITTEE ON CHILD DEVELOPMENT

Organized in 1971 with support from the Office of Child Development of the Department of Health, Education, and Welfare, the Advisory Committee will deal with such problems as: (a) the goals and essential features of an integrated national policy for child development; (b) the combination of unmet needs of and the unrealized opportunities for child development up to age eight, from which these goals are derived; and (c) the federal programs, the child care services, and the resources required, both in the proximate and more remote future, for achieving these goals.

The Committee prepared a report on the Coordinated Community Child Care Program during the year (see page 35).

STATEMENT ON FEDERAL PROGRAM EVALUATION POLICY

Requested by the Office of Science and Technology late in 1970, the Statement, prepared by the Executive Committee of the Division of Behavioral Sciences, will: (a) clarify the variety of meanings now associated with "evaluation"; (b) describe the several forms of and techniques for evaluation activities, their purposes, and their applications and utilities; (c) give particular attention to the different requirements for evaluating social experi-

ments, contemplated new program alternatives, and on-going programs, as well as the bearing of such evaluations upon policy modification and formulation; (d) deal with the issues involved in assessing the design, data, and findings of completed research projects; (e) delineate the state of the art of the several modes of evaluation, indicating the critical problems embedded in each, their weaknesses and strengths, and their susceptibility to misapplication or misuse; (f) warn against the dangers of ill-conceived evaluations; (g) indicate the areas in which research on problems of methodology is called for; and (h) suggest the ways in which departments and agencies can encourage the participation and cooperation of academic scientists in advancing the state of the art of evaluation research.

DIVISION OF BIOLOGY AND AGRICULTURE

COMMITTEE ON PEST MANAGEMENT STRATEGIES

The Committee was established in fiscal year 1973 to address problems in the management of pests, including insects, pathogens, weeds, and vertebrates, but excluding human or animal pathogenic microorganisms and surface contaminants of material or foodstuffs. Shortly after the close of fiscal year 1973 the Committee was renamed the Committee on Biology of Pest Species.

POPULATION DYNAMICS OF THE YELLOWSTONE GRIZZLIES

The grizzly bears in Yellowstone National Park, in the opinion of some, have been adversely affected by a change in garbage disposal policy by the park authorities. The NAS has undertaken a study of population dynamics that will review the impact of management practices on the grizzly population and will provide, if possible, guidance that will insure integrity of the Yellowstone population. The study was undertaken in response to a request from the Secretary of the Interior.

COMMITTEE ON THE EFFECTS OF HERBICIDES IN VIETNAM

The Committee was established in the spring of 1971 to make a comprehensive study and investigation of the ecological and physiological dangers inherent in the use of herbicides and the ecological and physiological effects of the defoliation program carried out by the Department of Defense in South Vietnam. The study was scheduled for completion by August 1973. Owing to the complexities of the problems involved, however, the Army awarded additional funds and extended the completion date to December 1973.

INTERNATIONAL BIOLOGICAL PROGRAM

(See page 61 for a report of the current status of the program.) The Division plans an evaluation of the IBP, to include the research accomplished

and the management mechanism used in the United States program. A synthesis series that will summarize the achievements of the U.S. participation in the IBP will be prepared under the auspices of the Institute of Ecology.

U.S. NATIONAL COMMITTEE OF THE INTERNATIONAL UNION OF BIOLOGICAL SCIENCES

USNC/IUBS representatives were nominated and appointed for the following international congresses: First International Congress of Bacteriology, Fourth Protozoology Congress, Second Plant Pathology Congress, Eighth Congress Plant Growth Substances, Seventh Congress of the International Union for the Study of Social Insects, International Colloquium on Invertebrate Pathology, Fourth International Conference on the Global Impacts of Applied Microbiology, 13th Ethological Congress, First Congress on Systematic and Evolutionary Biology, and the 13th Congress on Genetics. In addition, an official delegation was appointed for the XVIII General Assembly of the IUBS, to be held in Norway, September 27–October 2, 1973. The NRC Governing Board authorized the Committee to accept funds to assist the travel of the delegates to the General Assembly.

The 16th International Ornithological Congress, sponsored by the IUBS, will be held at Canberra in August 1974. A panel of the U.S. National Committee will review travel grant applications for partial support of U.S. participants in this Congress.

U.S. NATIONAL COMMITTEE OF THE INTERNATIONAL UNION OF NUTRITIONAL SCIENCES

The Ninth General Assembly of IUNS was held in Mexico City in September 1972. Significant research was reported from both developed and developing countries and there was also opportunity for interchange of information on problems related to nutritional labeling. The proceedings will be published by S. Karger, Basel. The proceedings of the meetings of committees and commissions of the IUNS, held prior to the Congress, were published under the auspices of the American Institute of Nutrition.

The Committee discussed the current effort by the National Institutes of Health to formulate guidelines on the proper use of human subjects in nutritional research, and decided to lend any assistance appropriate to the resolution of this problem, especially in regard to "informed consent." It was recognized that regulatory procedures must be established with great care in this area, and that other countries may follow the U.S. example.

U.S. NATIONAL COMMITTEE ON PHOTOBIOLOGY

The final draft of the study on "Benefits to be Derived from U.S. Participation in International Activities in Photobiology" was forwarded to the Office of the Foreign Secretary.

The American Society for Photobiology was incorporated as a nonprofit organization. Considerable time was spent on plans for the first annual meeting of the Society and the accompanying scientific symposia. The meeting, held in Florida in June 1973, included special lectures, seven symposia, and a photobiology school.

AGRICULTURAL BOARD

The Board's report, *Genetic Vulnerability of Major Crops*, was published during the year (see page 4). The Board also published reports on *Accumulation of Nitrate* (see page 32), and *Control of Rabies* (see page 34). Other reports issued during the year were *Degradation of Synthetic Organic Molecules in the Biosphere: Natural, Pesticidal, and Various Other Man-Made Compounds* and two reports by subcommittees of the Board's Committee on Animal Nutrition, *Nutrient Requirements of Dogs* and *Nutrient Requirements of Horses*. The report of a symposium on "Alternative Sources of Protein for Animal Production" was also published during the year. The symposium was jointly sponsored by the Committee on Animal Nutrition and the American Society of Animal Science.

A new Subcommittee on Genetic Variance in Animal Nutrition was established during the year.

Beginning on July 1, 1973, the functions of the Agricultural Board will be incorporated in a new Board on Agriculture and Renewable Resources in the Commission on Natural Resources. The new Board will also undertake activities in range, forests, aquatic resources, and natural areas.

FOOD AND NUTRITION BOARD

Committee on Aquatic Food Resources

At the request of the National Oceanic and Atmospheric Administration, a task force reviewed NOAA's Marine Resources contaminants program to determine factors affecting safety of the fish supply and the effects of contaminants on fish and shellfish life processes. The task force's report and recommendations were transmitted to the Associate Administrator for Marine Resources, NOAA, in May 1973.

Committee on Clinical Nutrition

The Committee and its panels are preparing a handbook for the practicing physician for use in the diagnosis and treatment of nutritional disorders.

Committee on Dietary Allowances

The Committee completed the eighth edition of *Recommended Dietary Allowances.* A table of the revised RDA's was released in November. The tentative plan to publish joint U.S.-Canadian RDA's was not realized because of unexpected delays in the Canadian revision schedule.

Committee on Food Protection

The Subcommittee on Food Microbiology is identifying microbial problems in food processing and will present suggestions for their solution. Their report will review processing procedures for a number of categories of commercially processed foods and identify those steps in the processes intended to control microbiologic contamination.

The Subcommittee on Naturally Occurring Toxicants prepared a revised edition of *Toxicants Occurring Naturally in Foods* (see page 26).

The Subcommittee on Food Technology is revising the 1961 publication, *The Use of Chemicals in Food Production, Processing, and Distribution.*

The Subcommittee on Nonnutritive Sweeteners is conducting a continuing review of saccharin to evaluate the scientific validity of all available laboratory findings, and to determine when these findings are sufficient to judge whether or not saccharin is carcinogenic when administered orally to test animals. The Subcommittee expects to complete its report to the Food and Drug Administration in early 1974.

The second edition of *Food Chemicals Codex,* prepared by the Subcommittee on Specifications—Food Chemicals Codex, was published in August 1972; approximately 3,300 copies have been distributed. The Subcommittee is planning a symposium or workshop on food additive specifications to be held in 1974.

In response to a request from the Food Chemicals Codex Subcommittee, the Subcommittee on Toxicology developed a policy statement and established guidelines regarding levels of fluoride impurities in food-grade chemicals. The Subcommittee is planning to review the FAO/WHO "tolerable weekly intakes" for mercury, lead, and cadmium, and will evaluate the applicability and relevance of these guidelines for various sectors of the U.S. population. If the guidelines are found to be inadequate, the Subcommittee will attempt to develop others appropriate for U.S. population groups.

Committee on International Nutrition Programs

In addition to the activities of its subcommittees, the Committee is preparing statements on protein/calorie relationships in nutrition and on chronic disease prevalence related to changing food consumption patterns in developing countries. A small conference is being planned on the relationship between iron deficiency anemia and work performance. The Committee is also evaluating and indicating priority ratings of AID's proposed nutrition research programs for the mid-1970's.

The Subcommittee on Interaction of Nutrition and Infections is completing a report on the design and feasibility of a controlled pilot study of the effectiveness of low-level antibiotic feeding for control of intestinal enteropathies and consequent malnutrition in young children. With the cooperation and support of the U.S.-Japan Program, a workshop on latent effects of malnutrition and infection during pregnancy as determinants of the growth and development of children is being planned for January 1974.

The Subcommittee on Nutrition, Brain Development, and Behavior prepared a position paper on "The Relationship of Nutrition to Brain Development and Behavior." The Agency for International Development plans to have the paper translated into French and Spanish.

The Committee on Iron Nutritional Deficiencies submitted its report to the U.S. Department of Agriculture in March 1973.

The Committee on Maternal Nutrition prepared a report on the Workshop on Nutritional Supplementation and the Outcome of Pregnancy; it was distributed in March 1973 throughout the United States and several foreign countries. A task force has prepared a report on *Physiological and Biochemical Norms for Pregnant Women.* The Committee co-sponsored and participated in a National Workshop on Nutrition in Maternal Health Services in April 1973.

The Committee on Nutrition Advisory to CDC has established two panels to provide guidance in interpreting data obtained in the Ten-State Nutrition Survey. One panel is developing a statement to aid in utilizing anthropometric data for screening groups of children in the United States with respect to nutritional status; the other is formulating a guide on iron levels and their interpretation and meaning in the pediatric population.

INSTITUTE OF LABORATORY ANIMAL RESOURCES (ILAR)

ILAR surveys the existing and potential laboratory animal resources, materials, and methods, and promotes the effective, humane, and scientific utilization of these resources. The Institute also furthers the general interests of scientific animal research by cooperating with other organizations on national and international levels.

Two new committees were formed on July 1, 1972—the Committee on Standards for Birds and the Committee on Standards for Cats—and several committees and subcommittees completed their assigned tasks during the year and were discharged at the end of fiscal year 1973. They covered the following fields: standards, amphibian standards, large (domestic) laboratory animals, fish standards, procurement standards for defined rodents and rabbits, procurement standards for nonhuman primates, laboratory animal ethology, and laboratory animal ecology.

The Committee on Laboratory Animal Diseases is preparing guides to infectious diseases in the rabbit, hamster, gerbil, and guinea pig. The guides are scheduled for completion during fiscal year 1974.

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The Committee on Revision of the Guide for Laboratory Animal Facilities and Care completed its revision of the *Guide,* which was published in December 1972. The Commitee was reorganized July 1, 1972, as the Committee on Guide for the Care and Use of Laboratory Animals, and is currently exploring the use of animals for multiple surgical procedures and the problems arising from discrepancies in recommended cage sizes for nonhuman primates (ILAR Standards and the Guide).

The Committee on Conservation of Nonhuman Primates was organized in 1970 to examine the distribution and abundance of the eight most commonly used species of nonhuman primates and to assess the effect of harvesting on indigenous population levels. Field studies are being conducted of selected South American primates in Colombia and Peru through a subcontract with the Pan American Health Organization. A staff primatologist, working under the guidance of the Committee, is conducting a survey of biomedical research institutions in the United States to determine the number of nonhuman primates either purchased or bred that were utilized by them during the period October 1972 to October 1973. Upon completion of the survey, the existing scientific literature relative to population dynamics will be reviewed and those data extracted and assembled that provide a realistic picture of nonhuman primate populations in the wild. Based upon the assembled data, the Committee will select an appropriate area of the world for field surveys of those species considered to be the most critical for research purposes.

Plans are under way by the Committee on Animal Models and Genetic stocks and the Advisory Committee of the Registry of Comparative Pathology, Armed Forces Institute of Pathology, for a jointly sponsored exhibit delineating the importance of animal models to be shown at scientific meetings.

The ILAR offices served as an information center on various aspects of the laboratory animal and answered more than 6,000 inquiries on laboratory animal topics. *ILAR News,* the Institute's quarterly newsletter, was distributed to 4,200 investigators and institutions in the United States and 57 foreign countries. During 1973, approximately 9,500 copies of laboratory animal standards were distributed. ILAR-sponsored symposia and workshops held during the year include the Symposium on Animal Models for Biomedical Research, V-Invertebrates and the Workshop on Research in Zoos and Aquaria.

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY

ADVISORY CENTER ON TOXICOLOGY AND THE COMMITTEE ON TOXICOLOGY

The Committee, with the support of the Advisory Center, continued to provide scientific and technical advice to the Atomic Energy Commission, Air Force, Army, Navy, Coast Guard, Federal Aviation Administration,

Environmental Protection Agency, and National Aeronautics and Space Administration.

Two new tasks were undertaken for the EPA. The first is an in-depth study, jointly with the Environmental Studies Board, of the principles of assessing the environmental effects of chemicals. The second task is to assist in developing specific test procedures for evaluating the potential environmental effects of fuels and fuel additives.

The Committee has issued Guides for Short-Term Exposure of the Public to Air Pollutants for Ammonia, Carbon Monoxide, and Chlorine. The Guides for Hydrazine Propellants and for Beryllium and its Oxides are nearing completion. Ozone is expected to be the next topic. The Committee is also becoming involved with pesticide problems because pesticides raise basic toxicology issues, such as teratogenicity, mutagenicity, and carcinogenicity.

OFFICE OF BIOCHEMICAL NOMENCLATURE

This Office coordinates, in collaboration with the IUPAC-IUB Joint Commission on Biochemical Nomenclature, efforts to develop, disseminate, and utilize systematic biochemical nomenclature. During the year, the Joint Commission completed a comprehensive revision of Enzyme Nomenclature, published by Elsevier Scientific Publishing Company. Work is in progress on nomenclature for iron-sulfur proteins, peptide hormones, non-enzyme proteins, polysaccharides, unsaturated sugars, branched sugars, and cytochromes. Nomenclature for sterochemistry of tocopherols and for conformations of mono- and oligosaccharides, polysaccharides, and polynucleotides is also under study.

Collected Tentative Rules and Recommendations of the Joint Commission have been compiled in a publication issued in 1973 for sale at a nominal price by the American Society of Biological Chemists, Inc.

COMMITTEE ON HAZARDOUS MATERIALS ADVISORY TO THE U.S. COAST GUARD

The Committee revised two of its earlier reports during the year. The new edition of *Evaluation of the Hazard of Bulk Water Transportation of Industrial Chemicals* includes 335 chemicals. The revised report, *Pressure Relieving Systems of Marine Bulk Liquid Cargo Containers,* first published in 1971, includes a comprehensive review of the 56 formulas for calculation of pressure-relieving devices proposed since 1925, and focuses on gaps or uncertainties in existing knowledge, including the need for well-instrumented, large-scale fire tests of vessels containing volatile or gaseous substances.

The Panel on Risk Analysis and Hazard Evaluation is studying the methodology and techniques used in technology assessments, with a view to applying those techniques to evaluating the risk involved in bulk water transportation of hazardous materials.

The Panel on Chemical Reactions, which is especially concerned with the possible consequences of accidental mixing of cargoes, is progressing with a design of a simple system for distinguishing materials that can safely be shipped in adjacent containers from those that are unsafe if accidentally mixed.

A subcontract with Underwriters' Laboratories for experimental tests to provide data on electrical characteristics of materials relevant to their hazard when exposed to electrical equipment has yielded a final report for the 21 substances evaluated. A panel is now reviewing the current understanding of electrical hazards classifications of over 200 chemicals, according to the National Electrical Code, Article 500.

NUMERICAL DATA ADVISORY BOARD

On the national level, the Board provides counsel on policy and on technical matters for government-sponsored programs of data evaluation and compilation under the National Standard Reference Data System (NSRDS) administered by the Office of Standard Reference Data (OSRD) of the National Bureau of Standards. The Board promotes active participation in data compilations by private institutions and industries and coordination of such efforts with those of OSRD.

On the international level, the Board provides liaison and participates in international activities related to data evaluation, including the adoption of sets of recommended values of the fundamental natural constants and adoption of rules for international usage of symbols, units, and terminology.

Committee on National Data Programs

Among the activities of this Committee and its panels was the preparation of a report giving a tentative listing of types and sources of data needed in developing a technology of coal gasification; development of a plan for a short course on "Treatment and Critical Evaluation of Experimental Data," which was offered for the first time at the Pennsylvania State University in June 1973 with support from the National Science Foundation; completion of tentative recommendations on the nomenclature and conventions for reporting Mossbauer Spectroscopic Data; and advice to the National Bureau of Standards concerning appropriate Standard Reference Materials for use in connection with Mossbauer measurements. An *ad hoc* Panel on Thermodynamic Properties of Aqueous Electrolyte Solutions studied the program and plans of the Electrolyte Data Center at the National Bureau of Standards, and transmitted a report to NBS. Another *ad hoc* panel prepared a position paper for the National Commission on Materials Policy, summarizing the ways in which availability of evaluated data influences the formulation and implementation of national policies concerning the procurement, utilization, and disposal of materials.

U.S. National Committee for the Committee on Data for Science and Technology of the International Council of Scientific Unions (CODATA)

In 1972 CODATA's scope was broadened to include the biosciences and geosciences—a step that has resulted in proposed constitutional changes, enlargement of the Bureau, reduced frequency of Bureau and General Assembly meetings, and restructuring of the Central Office to serve as a secretariat.

The National Science Foundation has provided funds for the United States contribution toward annual dues for CODATA for the period October 1972 through September 1973.

Committee on Fundamental Constants

Members of this Committee, serving on a CODATA task group, have completed a suggested revision of the currently recommended list of numerical values for the fundamental constants. The recent development of techniques for the measurement of optical frequencies in the visible spectrum, which permit significantly improved accuracy in measurements of the speed of light, also present possibilities for improved accuracy in the standard of length. It has been suggested that a suitably stabilized laser be adopted both as a new basic standard of length and secondary standard of frequency. An alternative suggestion is that the speed of light be taken as a defined constant, so that the wavelength of a stabilized laser could be known to the same accuracy with which its frequency can be measured. The Committee is considering the advantages and limitations of both suggestions.

Committee on Symbols, Units, and Terminology

This Committee serves on behalf of the American National Standards Institute as U.S. National Committee for Technical Committee 12 (Quantities, Units, Symbols, Conversion Factors, and Conversion Tables) of the International Organization for Standardization. ISO/TC12 will convene in Washington, D.C., in September 1973 to consider revision of its major document, ISO/R31, on quantities and units for the various fields of science and technology.

COMMITTEE ON RADIOACTIVE WASTE MANAGEMENT

The Committee was established in 1968 to advise the Atomic Energy Commission on long-range radioactive waste management plans and programs for an expanding nuclear energy industry. *Ad hoc* panels are established to deal with specific problems as they arise. At present, the following *ad hoc* panels are active: Panel on Transportation, Panel on Foreign Activities, and a newly organized Panel on Engineered Storage. The Panel on Bedrock Disposal was discharged following publication of its final report, *An Evaluation of the Concept of Storing Radioactive Wastes in Bedrock below the Savannah River Plant Site,* in fiscal year 1972.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL UNION OF BIOCHEMISTRY

The Committee has sponsored a travel award program totaling $117,000 for 344 participants selected from 848 applicants from the United States to attend the 9th International Congress of Biochemistry, to be held in Stockholm in July 1973. The Committee nominated as delegates to the General Assembly of IUB Konrad Bloch (Delegation leader) and I. C. Gunsalus.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

The Committee nominated a delegation to the IUPAC Council at the XXVII biennial Conference of IUPAC in Munich in August 1973, as follows: C. G. Overberger (leader), E. M. Beavers, V. C. Boekelheide, E. Campaigne, T. B. Owen, and Cheves Walling. R. W. Carnes was nominated as a candidate for election as Vice President of IUPAC and P. M. Arnold for reelection as a Bureau member, both subject to the vote of the Council. The XXIV International Congress of Pure and Applied Chemistry will take place in Hamburg in September 1973. The U.S. National Committee administered a travel grant program for U.S. participation in the Congress.

U.S.A. NATIONAL COMMITTEE FOR CRYSTALLOGRAPHY

The Committee is providing support from the interest on funds residual from the VIII International Congress of Crystallography for an Intercongress Symposium on Intra- and Inter-molecular Forces, to be held in connection with the national meeting of the American Crystallographic Association (ACA) in August 1974. The Committee is also planning a travel award program for the X International Congress of Crystallography, to be held in Amsterdam, August 7–15, 1975.

The Committee discussed plans of the International Union of Crystallography for a 5th edition of *World Directory of Crystallographers*. In view of possible utility of the project to the secretariat of ACA, the project was referred to the ACA council for approval and financial support by the membership.

COMMITTEE ON ANALYTICAL CHEMISTRY

Strengthening the quality of measurements in the important area of national health continues to occupy the attention of the Committee. The Committee took an active part in a symposium on "Interfacing Analytical Chemistry and Clinical Chemistry," sponsored by the Division of Analytical Chemistry of the American Chemical Society.

COMMITTEE ON CHEMICAL CRYSTALLOGRAPHY

The Committee held a Conference on Critical Evaluation of Chemical and Physical Structural Information at Dartmouth College in June 1973, with support from the National Science Foundation.

COMMITTEE ON CHEMICAL INFORMATION

The Committee is working on a comprehensive evaluative report on significant developments and pressing needs in the handling of chemical information. Another report—on the status of chemical information—is soon to be published.

COMMITTEE ON COLLOID AND SURFACE CHEMISTRY

A subcommittee was appointed to draft a detailed plan for setting up a data collection program on particulate atmospheric pollutants. Much of the data is collected in regional studies and a special effort is needed to compile them.

The Committee also considered the need for reference samples of well-characterized surfactants for research purposes. The possibility of cooperation on such a project with the Office of Standard Reference Materials of the National Bureau of Standards will be explored.

COMMITTEE ON COMPUTERS IN CHEMISTRY

The report of the April 1972 Conference on Computational Needs and Support for Crystallography was completed and published, and the feasibility study of a National Center for Computation in Chemistry is nearing completion.

The Committee has begun a new project to develop standards for storing and representing quantum chemical-generated data and notation. They are also considering a proposed conference on chemical laboratory automation.

COMMITTEE ON FATS AND OILS

The Committee cooperates with the IUPAC Oils and Fats Section on the study of edible fats and oils, especially the development of analytical methods needed for food standards and for international commerce. Recently completed are studies of methods for melting-point range, for determination of trans octadecenoic acids, for determining composition of fatty acids by gas chromatography, for determining the p-anisidine value of fats, for determining antioxidants, and for determining tryglycerides of palmitic acid at the beta position by use of pancreatic lipase.

COMMITTEE ON HIGH TEMPERATURE SCIENCE AND TECHNOLOGY

The Committee fosters meetings and symposia on high-temperature technology, identifies technical problems in need of attention, and coordinates activities with the counterpart IUPAC Commission. A symposium on "High-Temperature Chemistry—Aspects Related to Ceramics" is being organized as part of the Spring National Meeting of the American Ceramic Society. A symposium on "High Temperature Materials Problems in the Energy Field" is also being planned.

A suggestion for simplifying and improving the nomenclature of high-temperature thermodynamics has been transmitted to the IUPAC Commission on Thermodynamics and Thermochemistry for study.

The Committee continues close rapport with the IUPAC Commission on High Temperatures and Refractory Materials, and is currently helping to organize and publicize a symposium on "Techniques in High-Temperature Measurements, sponsored by IUPAC and scheduled for September 1973.

COMMITTEE ON JOJOBA UTILIZATION

(See page 47.)

COMMITTEE ON KINETICS OF CHEMICAL REACTIONS

The Committee is organizing a symposium on "Changing Concepts and Changing Techniques in Chemical Dynamics" to be held at the national meeting of the American Chemical Society in Chicago in August 1973.

COMMITTEE ON MACROMOLECULAR CHEMISTRY

The Committee organized part of the program of a symposium on "Polymers and Ecological Problems" at the August 1972 national meeting of the American Chemical Society. Plans are under way to cosponsor the Second International Symposium on Cationic Polymerization, which will be held at the University of Akron in 1975.

NATIONAL CENTER FOR COMPUTATION IN CHEMISTRY

A study group is exploring the feasibility and desirability of a national center dedicated to computational chemistry. The study is an outgrowth of a Conference on Computational Support for Theoretical Chemistry, held in 1970 with support from the National Science Foundation. A draft report has been prepared and will be distributed widely for comment before the final report is released before the end of 1973.

COMMITTEE ON SPECIFICATIONS AND CRITERIA FOR BIOCHEMICAL COMPOUNDS

In July 1972, the Academy published the Committee's report, a new (third) edition of *Specifications and Criteria for Biochemical Compounds,*

containing specifications for 521 compounds. The new edition has sections on amino acids, carbohydrates, carotenoids, co-enzymes, enzymes, lipids, nucleotides and related compounds, and porphyrins.

A symposium, "Problems in the Purity of Biochemical Compounds and Reagents," was organized on behalf of the Committee by the Chairman of the Subcommittee on Nucleotides and Related Compounds, and held at the 164th National Meeting of the American Chemical Society in August 1972.

A newly organized Subcommittee on Biogenic Amines is gathering data on more than 25 different compounds and will publish the data.

DIVISION OF EARTH SCIENCES

COMMITTEE ON THE ALASKA EARTHQUAKE

Three volumes in the series of reports entitled *The Great Alaska Earthquake of 1964* were published during the year: *Engineering, Seismology and Geodesy,* and *Oceanography and Coastal Engineering.* Previously published reports in the eight-volume series include: *Hydrology, Human Ecology, Biology, and Geology;* the final volume, *Summary and Recommendations,* will be published in the fall of 1973.

COMMITTEE ON MINERAL RESOURCES AND THE ENVIRONMENT

(See page 41.)

COMMITTEE ON REMOTE SENSING PROGRAMS FOR EARTH RESOURCE SURVEYS

The Committee is conducting a comprehensive review of remote sensing and its possible uses in assisting the operations of resource managers and environmental monitors. The results of investigations using ERTS–I aircraft and other imagery and data sources will provide the basis for the Committee's conclusions and recommendations.

The Committee advises the Departments of Interior, Commerce (NOAA), and Agriculture, the Environmental Protection Agency, the U.S. Army Corps of Engineers, and the Office of Naval Research under a contract administered by the National Science Foundation.

COMMITTEE ON SEISMOLOGY

During the year, the Panel on Seismological Instrumentation recommended stations of the World-Wide Network of Standard Seismographs that would be most suitable for upgrading for scientific purposes, should financing become available for additional instrumentation at selected stations.

The Panel on Strong-Motion Seismology prepared a report entitled *Strong-Motion Engineering Seismology: The Key to Understanding and Reducing the Damaging Effects of Earthquakes.* The report describes the

merits of strong-motion seismology as a means of mitigating earthquake effects and stresses the desirability of establishing additional accelerographs.

OCEAN AFFAIRS BOARD

Evaluating man's effects on the ocean was a major concern of the Board during the year. Two results of this concern were the organization of a workshop on petroleum in the ocean and development of a study to identify materials that may be affecting the marine environment.

The Workshop on Inputs, Fates, and Effects of Petroleum in the Marine Environment was held in May 1973. Its purpose was to quantify more precisely the inputs of petroleum in the marine environment; to compare and establish reliability criteria for different analytical techniques, both chemical and biological; and to develop more specific knowledge concerning the fates of petroleum in the ocean as a result of weathering, dispersion, biodegradation, and biological uptake. The group also evaluated effects of high-level catastrophic oil spills on coastal biota, low-level effects on marine resources, and effects on human health. A workshop report is being prepared.

In the study, Predicting Ocean Pollutants, information was collected and evaluated on representative man-produced materials which are entering the marine environment, but are not commonly thought to be affecting it, and to evaluate their possible effects. The substances being studied were chosen on the basis of their production, persistence, toxicity, and abundance in the marine environment. They are transuranic elements (products of nuclear reactions, such as neptunium, plutonium, and ferium), synthetic organics, common marine litter, inorganic processing wastes from industrial operations, organic sludges, and medical and agricultural pharmaceuticals. After data on these substances are assembled, a workshop will be held to attempt to identify any unanticipated effects that might arise from changing material usage.

Among the Board's other activities were: (1) Evaluation of a report on *The Environmental and Financial Consequences of Oil Pollution from Ships* for the Environmental Protection Agency. (2) Organization of a study and workshop on civil manned undersea activity. (3) Review of the programs of the National Science Foundation's International Decade of Ocean Exploration Office. (4) A symposium on Numerical Models of Ocean Circulation, organized by the Ocean Science Commtitee (OSC) at the request of the Office of Naval Research. (5) Formation of a Panel on Biological Oceanography under OSC. (6) OSC is assembling information for a new U.S. directory of marine scientists. (7) Met to evaluate the findings of the 1971 report, *Chlorinated Hydrocarbons in the Marine Environment.* In the light of recent data, an up-dated report is being prepared. (8) An OSC Task Group identified biological programs that would utilize the large number of meteorological and physical oceanographic observations to be

made in the Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment (GATE). (9) *A Preliminary Oceanographic Program for GATE,* the report of an OSC Task Group, was published in the fall of 1972. (10) The Board's International Marine Science Affairs Panel (IMSAP) reviewed and endorsed the summary and conclusions of the March 1972 American Society for International Law (ASIL)-IMSAP Ocean Dumping Workshop. The summary was published by ASIL. IMSAP also reviewed the status of the U.N. Law-of-the-Sea Conference problems and positions and maintained a close liaison with the Task Group on Freedom of Ocean Science (see page 54). IMSAP was also concerned with technical assistance, marine affairs, international organizations, and international fisheries management.

SCIENCE AND ENGINEERING COMMITTEE ADVISORY TO THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

This NAS–NAE Committee advises NOAA on its overall program in the sciences, engineering, and services; it reviews NOAA programs as to the quality of the engineering, technical, and scientific content, the nature of the environmental services needed by various groups, the kind of services NOAA should provide, and how NOAA can provide them most effectively and efficiently.

U.S. NATIONAL COMMITTEE FOR GEOCHEMISTRY

The Chairman, Vice Chairman designate, and Executive Secretary of the Committee met with the President of the International Association of Geochemistry and Cosmochemistry at its Council and General Assembly meetings in Montreal in August 1972. Officers elected by the International Association were Dr. Louis Ahrens of South Africa, President (succeeding Professor Earl Ingerson); Dr. W. B. Shcerbina (USSR) and Dr. K. H. Wedepohl (West Germany), Vice Presidents; Dr. Klaus Keil (USA), Secretary; and Dr. John Lovering (Australia), Treasurer.

A Panel on Orientations for Geochemistry was established at the request of the National Science Foundation to conduct an overall survey of the science.

The Committee is exploring the possibilities of an exchange of visits with geochemists of the People's Republic of China.

The Subcommittee on the Geochemical Environment in Relation to Health and Disease held a workshop in May 1973. Elements considered were beryllium, magnesium, manganese, nickel, silicon, strontium, tin, and vanadium. Plenary sessions were held on the interaction of trace elements, sample banks, the consequences of soil imbalances, interpretations of analytical survey data from several existing groups and several points of view.

U.S. NATIONAL COMMITTEE ON GEOLOGY

The Committee is attempting to raise funds for the International Commission for the Geological Map of the World for furthering its technical program.

In August 1972, the International Geological Congress and International Union of Geological Sciences met in Montreal. The U.S. National Delegation took part in the Council meetings of both organizations, and proposed that the People's Republic of China be admitted to the Union if it applied for membership, but that the Republic of China, Taiwan, not be expelled. The proposal for a joint IUGS–UNESCO venture to conduct an International Geological Correlation Program was approved by the Union. The U.S. nominee for President of the Union, Dr. Philip H. Abelson, was elected for a four-year term. The Congress will meet in Australia in 1976.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL GEOGRAPHICAL UNION

Major changes have been made in the Committee Constitution, which reduce the size of the membership and enable the Committee to review proposals pertaining to geography in general, in addition to the activities of the International Geographical Union.

U.S. COMMITTEE FOR THE INTERNATIONAL HYDROLOGICAL DECADE

During the year, the Committee began to concentrate on bringing its various activities to a close by the end of the Decade, December 31, 1974, or shortly thereafter. The International Field Year for the Great Lakes (IFYGL) was the principal activity. It was a joint activity with the Canadian National Committee involving the comprehensive synoptic collection of hydrological and chemical information from Lake Ontario and its basin, and was completed in March 1973. A few special studies will be continued through 1973.

The Committee's Steering Committee drafted U.S. position papers, subject to approval by the Department of State, for use by the U.S. Delegation to the 8th Session of the IHD Coordinating Council, held in Paris in May 1973. Principal topics for discussion were the completion of the Decade and the initiation of a new international program in hydrology. At the request of the Division of Earth Sciences, the U.S. National Committee is establishing a panel to recommend ways of determining U.S. interest in proposed international hydrological programs, to respond on an *ad hoc* basis to international suggestions, and to develop a mechanism for continuing response if necessary.

In cooperation with the Universities Council on Water Resources (UCOWR), the Work Group on Education and Training arranged for 58 graduate fellowships and assistantships in hydrology for the sixth year of the UCOWR/IHD Assistantship and Fellowships and Fellowships in Hy-

drology Program. The current program for academic year 1973–1974 will be the last in the series because of the forthcoming end of the Decade. The Work Group's volume, *Hydrology and Water Resources—A Syllabus of References for Teaching Introductory Courses in the Water Environment,* has been well received and plans are being made for a second printing in 1973. In cooperation with the International Association for the Exchange of Students for Technical Education, the Work Group is continuing to develop a program of on-the-job training in water resources for foreign undergraduate students.

The Work Groups on Snow and Ice, Nuclear Techniques in Hydrology, and Remote Sensing in Hydrology are organizing an interdisciplinary Symposium on Advanced Concepts and Techniques in the Study of Snow and Ice Resources, to be held in December 1973 at Asilomar Conference Grounds, Monterey, California. The Work Group on Snow and Ice is also preparing recommendations for expanded hydrological research in the Arctic Basin.

The Work Group on Remote Sensing Techniques in Hydrology is preparing two reports—the first, *The Role of Remote Sensing in the International Hydrological Program* (IHP), indicates, to some extent, our present capability for the use of remote sensing in hydrology. The second report deals with the current applicability of remote-sensing techniques to actual problems in hydrology, in contrast to the more theoretical presentation of the first report.

The Work Group on Hydrological Maps has been working closely with its UNESCO counterpart on the preparation of a Guidebook on the Preparation of Hydrological Maps. The report is expected to be published by UNESCO in 1974.

The Work Group on Hydrology of Carbonate Terranes has assisted in the organization of both local and national symposia on carbonate hydrology. The Group is also cooperating with the FAO/IHD Working Group on Hydrology of Carbonate Rocks in the Mediterranean Basin and with the Karst Commission of the International Association of Hydrologists.

Reports of progress during eight years of the Decade have been collected from the 60 representative and experimental Decade watersheds in the United States. They will be summarized in a report by the Work Group on Representative and Experimental Basins.

The Work Groups on Groundwater Studies, Floods and their Computation, Exchange of Information, Water Balances, and the Influence of Man on the Hydrological Cycle have responded to international requests on an *ad hoc* basis. The subgroup on Effects of Urbanization on Hydrology is organizing an International Conference on the Hydrological Effects of Urbanization in cooperation with the Polish Academy of Sciences, the Polish Hydrological Agency, and the National Science Foundation. The conference is expected to take place late in 1973.

U.S. NATIONAL COMMITTEE FOR ROCK MECHANICS

The U.S. National Committee's Panel on Science and Technology Information is compiling an annotated list of foreign and domestic sources of information in rock mechanics, preparing listings of meetings, short courses, and other events in rock mechanics, and compiling a volume of fundamental papers and books in rock mechanics. A study is planned on the use of audio-visual aids in teaching rock mechanics.

The Panel on High Energy Effects and Rapid Excavation of Rock Materials has prepared a draft report on research and development of high-energy techniques for rapid excavation of rock materials. The Panel is studying the field of high-energy effects to focus attention on opportunities for promising research on more effective excavation of rock. Technology-transfer ideas that may be productive in this field will receive constant attention.

In July, the Panel on Awards will review papers received for the 1973 Rock Mechanics Award. Awards will be presented at the 15th Symposium on Rock Mechanics.

The Panel on Organization of the Third ISRM Congress, which will be held in Denver, Colorado, in September 1974, is proceeding with preparations for the Congress. The objectives of the Congress are to assess on an international scale advances in rock mechanics during the past several years, and to indicate directions for the future.

Reports of several conferences were completed during the year, including the report of the Advisory Conference on Excavation Technology, held in March 1972; the proceedings of the 13th Symposium on Rock Mechanics, entitled *Stability of Rock Slopes,* published by the American Society of Civil Engineers; and the proceedings of the 14th Symposium on Rock Mechanics, held in June 1972. The South Dakota School of Mining and Tunneling will be host for the 15th Symposium on Rock Mechanics in September 1973. The theme of the Symposium will be Applications of Rock Mechanics.

The U.S. National Committee for Rock Mechanics represents the United States in the International Society for Rock Mechanics (ISRM); it processes ISRM individual memberships and subscriptions to the ISRM journal, *Rock Mechanics.* Committee members and other U.S. members participate in the work of the ISRM Commissions on Terminology, Symbols, and Graphic Representation; Teaching of Rock Mechanics; Standardization of Site Investigation Techniques; Standardization of Laboratory and Field Tests; and Definition of the Most Promising Lines of Research.

U.S. NATIONAL COMMITTEE OF THE INTERNATIONAL UNION FOR QUATERNARY RESEARCH

The Committee is preparing for the IX International Congress to be held in December 1973 at Christchurch, New Zealand.

U.S. NATIONAL COMMITTEE ON TUNNELING TECHNOLOGY

The Committee serves as the national organization for stimulating advances in tunneling technology and effective use of the subsurface by promoting the coordination of assessment, research, development, education, training, and collection and dissemination of information. The Committee represents the United States in the International Tunneling Association (ITA). The first issue of the quarterly *Tunneling Technology Newsletter* was published in April 1973.

DIVISION OF ENGINEERING

HIGHWAY RESEARCH BOARD

The Highway Research Board is supported by several state highway departments, the Bureau of Public Roads, and many private organizations, industries, and individuals interested in the improvement of highway technology and transportation. Established in 1920, HRB has been concerned with the planning, design, construction, operation, maintenance, and safety of highway facilities, and their components and the economics, financing, and administration of the systems and their interactions with the physical, economic, legal, and social environment they are designed to serve. In recent years, HRB has broadened its scope to include a number of environmental problems related to transportation as well as urban transportation systems.

More than 100 committees and task forces, encompassing almost 2,000 administrators, engineers, social scientists, educators, and others concerned with transportation conduct the work of the Highway Research Board. Numerous conferences, symposia, and workshops are held throughout the year and the Board's reports are widely disseminated. The Board's Annual Meetings are attended by transportation professionals each year, providing a forum for the exchange of information and ideas.

More than 3,400 of the world's leading highway researchers, engineers, educators, and administrators took part in the 52nd Annual Meeting in January 1973. Featured at the meeting were the Fifth Annual Human Factors Workshop and the Conference-Workshop on Soil Erosion. Papers were presented at 65 technical sessions during the meeting. Papers presented at the annual meetings and accepted for publication generally appear in the Board's *Highway Research Record* series.

The Board's publication program also includes the monthly *Highway Research Abstracts* and the quarterly *Highway Research News*. The work of special committees is often disseminated through the Board's *Circular* series. In addition, the Board publishes a *Bibliography* series, indexes to HRB publications, the Highway Research Information Service's annual publication, *Highway Research in Progress,* and a quarterly *HRIS Abstracts.*

The Board's special project on Right-of-Way and Legal Problems is staffed by the HRB Counsel for Legal Research and his assistant to conduct

legal research and prepare papers on highway problems, including, but not limited to, those involving right-of-way acquisition and control. Individual state experiences are compared and made available for possible assistance to other states. Current research is being conducted on papers dealing with personal liability of highway department employees and liability of highway departments for design and maintenance defects.

HRB Research Information Services

Highway Research Information Service (HRIS)

The HRIS file now contains more than 50,000 references to on-going research (11,000) and published documents (39,000). About 40 percent of the HRIS document records are from sources in 71 foreign countries. Magnetic tape of highway research information is exchanged with the Transport and Road Research Laboratory of the United Kingdom, the English-language center for the International Road Research Documentation scheme. Magnetic tape is also used to exchange on-going highway transportation research project information with the Smithsonian Institution's Science Information Exchange (SSIE). Each month nearly 200 IRRD selections of abstracts of foreign published works and summaries of foreign on-going research projects are made available to HRIS. The SSIE tape adds about 100 summaries of U.S. on-going research projects to the HRIS file each quarter.

HRIS provided a camera-ready printout of document records of research projects in progress in Canada to the Roads and Transportation Association of Canada, which published the information in its 1973 issue of *Transportation in Canada.* HRIS also compiled records of documents published by the Urban Mass Transportation Administration into a bulletin, *Transit Research Abstracts,* containing 433 abstracts of reports available from the National Technical Information Service.

Maritime Transportation Information Service (MRIS)

This project is carried out in cooperation with the NRC Maritime Transportation Research Board. The MRIS storage and retrieval service includes semiannual publication of the *MRIS Bulletin.* The file now contains nearly 6,000 records of interest to the maritime transportation research community.

Transportation Noise Research Information Service (TNRIS)

The objective of TNRIS is to develop storage and retrieval services for information on transportation noise, including the publication of semiannual bulletins. The TNRIS file contains approximately 4,000 records to date.

Highway Safety Information Service (HSIS)

This project created and maintains a file of highway safety literature abstracts. The file now contains more than 13,000 abstracts that have been published by the National Highway Traffic Safety Administration.

Transportation Research Activity Information Service (TRAIS)

This HRB-initiated project developed an information system containing records of all U.S. Department of Transportation research and development activities; it has now become an in-house DOT activity. The service is useful both as a management tool and as a source of information for the technical community. In addition to file development and batch-mode retrieval, the project provides on-line access to the TRAIS file. A Committee for Transportation Research Information Systems prepared a report covering background, needs, and recommendations for the implementation of a national network of transportation information services.

Railroad Research Information Service (RRIS)

The RRIS is being developed to serve the Federal Railroad Administration and the railroad research community. A special bibliography was published in early 1973, and an *RRIS Bulletin* will be published semiannually beginning in fiscal year 1974. The RRIS file contains 4,000 records at the present time.

International Enquiry on Transportation Research Information Transfer

A survey was made to identify information services that serve the transportation research community and to determine the information resources, capabilities, and transfer practices of these services. Data were received from 126 respondents, including 8 international organizations, 80 European organizations, and 38 North American organizations. The survey conclusions were reported to the Steering Committee of the OECD Road Research Program, and the published report was distributed to respondents.

BUILDING RESEARCH ADVISORY BOARD

The Building Research Advisory Board (BRAB) was established in 1949 to promote the orderly development and application of science and technology in the field of housing, building, and related community and environmental design and development.

Through its standing committees, the Federal Construction Council (FCC), the Building Industry Manufacturers Research Council (BIMRC), and the Building Research Institute (BRI), BRAB maintains a cooperative relationship with agencies of the federal government, with individuals and organizations interested in building research and technology, and with the manufacturing segment of the building industry. Committees and other working groups are established by BRAB, as needed, to carry out its various undertakings.

Building Research Institute

The membership of BRI includes 106 Organizational Members (represented by 213 individuals) and 264 Individual Members. Its program is

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designed to provide an open forum for the discussion of current matters of building research and technology by means of conferences, workshops, and seminars. BRI publishes the quarterly journal, *Building Research,* a publication of current and significant research and research-related activities, not necessarily related to BRI conferences, as well as special reports of conferences and other BRI activities. A periodic newsletter, basically published for BRI members, is also selectively distributed to government officials and others interested in new developments in research and technology.

Topics of BRI-sponsored conferences during the year included: Solid-Waste Management in Buildings, The Use of Elastomeric Construction Adhesives, and Air Structures in Education. BRI also cooperated with the Producers' Council and other organizations in the development of the second annual Building Team Conference held in Chicago in April.

Federal Construction Council

The FCC serves as a planning, coordinating, and operating body to encourage continuing cooperation among federal agencies in advancing the science and technology of building as related to federal construction activities. FCC work is performed under contracts between the National Academy of Sciences and ten supporting agencies: the Atomic Energy Commission, the Bureau of Reclamation, the General Services Administration, the National Bureau of Standards, the National Aeronautics and Space Administration, the Army Corps of Engineers, the Air Force, the Naval Facilities Engineering Command, the Department of Health, Education, and Welfare, and the Veterans Administration.

During the year, one technical report—*Impact of Air-Pollution Regulations on Design Criteria for Boiler Plants at Federal Facilities*—was published and five informal reports were completed. The informal reports were "Heating Season Humidification in Federal Buildings," "Proposed Program for Development of an Interagency Building Cost Information System," "Fluorescent Lighting Fixtures," "Control of Water Pollutants from Federal Construction Projects," and "Polarized Lighting." Studies under way include a system engineering approach to fire-safe design, minimizing the effect of weather on construction, elevators for emergency evacuation, underground heat distribution systems, expansion joints in buildings, feasibility of establishing a federal computer access system, and phased design and construction. FCC's continuing programs deal with federal construction guide specifications and cost engineering.

A special FCC project is the promotion of the development and use of the subsystem concept of building construction. While this program was designed primarily to benefit federal agencies responsible for large construction programs, the FCC believes that the successful development and implementation of the precoordinated subsystem concept should change the way that various segments of the building community function, both public and private.

Building Industry Manufacturers Research Council

BIMRC, which is funded through grants to the National Academy of Sciences from private industry, is investigating the following: human needs and desires in relation to housing, building, and community design and development; technology forecasting; the changing nature of the building industry as it attempts to meet national needs and its effect on research and development; the changing relationship between public and private building research and technology programs and ways to make the total more effective; research needs relevant to housing for low- and moderate-income families; conversion to the metric system and the steps that building industry manufacturers can take to facilitate such change; the role of warranties in providing consumer protection; factors contributing to fire hazard in buildings; structural criteria, with emphasis on drift in high-rise structures and the potential for progressive collapse; heat loss criteria; plumbing criteria; and acoustical criteria.

Advisory Committees

Special Advisory Committee for Analysis of the Operation Breakthrough Guide Criteria and Industry Comments

The Department of Housing and Urban Development requested an analysis and recommendations concerning near-term use of the Operation Breakthrough Guide Criteria and HUD-invited industry comments. The advisory committee has transmitted the first of two reports to HUD; the final report is to be completed by the fall of 1973.

Research in the Application of Onsite Solid-Waste-Refuse Storage, Collection, and Reduction Systems for High-Rise Residential Structures

This three-phase study, which began in 1967, is now in its final phase, the actual analysis of all data collected on alternative methods that have been developed for handling onsite solid-waste refuse. Findings, conclusions, and recommendations will be presented in the final report, which is scheduled for completion in early 1974.

Fire Loads in Buildings

This effort includes a large-scale physical survey of the combustible contents (movable contents and interior finishes) of two types of buildings—office buildings and schools—to determine existing fire-load values from which potential fire severity can be determined more accurately. A secondary objective will be to collect the information on movable contents in a manner that will permit the expeditious updating of occupancy live loads and, thus, lead to safer and more cost-effective structural design of buildings. It is planned, eventually, to survey hospitals and multifamily residences as well. The survey will be conducted by the National Bureau of Standards, and BRAB's Special Advisory Committee on Fire Loads will review and monitor

the survey and interpret the data to identify new areas of application beyond those normally considered in building-related fire technology.

Building Skills Career Training and Development

This program was initiated in 1971 to explore and encourage new and improved means for achieving more effective utilization of human resources in the building community. Particular emphasis is being given to future employment needs and opportunities as indicated by projected technological change in the building process, with first priority being building trade skills and career development and reorientation.

A pilot program at the secondary school level is being developed in Chicago to provide a realistic setting for problem identification and training concept experimentation. A curriculum will be developed to provide students with an overview of the construction industry and to impart multicraft, special craft, and noncraft skills. Trainee relationships to existing industry institutions, such as trade unions, contractors, producers, and local employers will be essential considerations in providing a new type of training-work experience. The long-range objective is to make a significant contribution to improving the adequacy and effectiveness of the professional and nonprofessional labor force and to make employment within the building industry more rewarding to the individual.

Performance Characteristics for Powder-Actuated Fastener Systems

Since 1966, a BRAB special advisory committee has been engaged in a study to develop minimum acceptable fastening and safety requirements for powder-actuated fastener systems. The Powder Actuated Tool Manufacturers Institute undertook a long-term research program through its member companies to develop and substantiate the information and data requested by the committee as the study progressed. The Institute has now submitted its final report to the committee, which, in turn, will complete its study and develop its final report.

Housing Technology Alternatives for Use in Planning Post-Disaster Housing Assistance Programs

In response to a request from the Office of Emergency Preparedness, BRAB undertook a study to identify alternatives that could be used to house victims made homeless as a result of natural disasters. Natural disasters considered were earthquakes, floods, hurricanes, tornados, and other high-wind conditions; the impact of such factors as type and size (number left homeless) of disaster, geographic location (urban or rural), and climatic conditions on the applicability of housing alternatives also was assessed. The committee's final report was transmitted to OEP in January 1973.

Building Inventory Survey Feasibility

This study is designed to determine the feasibility of establishing survey procedures and data-handling systems to assess the physical characteristics

and performance of the nation's inventory of housing, buildings, and related facilities and the means for doing so. The special advisory committee will investigate the amount and kind of past and current survey work; define the breadth and scope of information desired by federal, state, and local government agencies and private organizations; and assess the degree of commonality of interest (including information needs and survey techniques and procedures) among agencies and organizations.

Assistance to NAS–NAE Advisory Committee to HUD (ACHUD)

BRAB assisted ACHUD in its project to evaluate the Operation Breakthrough program of the Department of Housing and Urban Development by defining the elements of an evaluation program; nominating individuals to serve on a technical panel, subpanels, and task groups; reviewing and commenting on advice from ACHUD and its Technical Panel to HUD; and providing staff services for carrying out specific Technical Panel activities. A report will be prepared of the Panel's broad overview of Operation Breakthrough, but will not contain recommendations that HUD accept or reject Breakthrough housing systems.

Joint ACHUD—BRAB Task Force on Indicators of Community Vitality

The Task Force explored the feasibility of isolating key indicators of the health of communities or segments of metropolitan areas. For example, is it possible, by monitoring certain data, to ascertain when an area is headed for trouble, such as housing abandonment? The effort is based upon the premise that, given early knowledge of an undesirable trend, it would be possible to seek remedial measures when they might be most effective. Conversely, such knowledge might lead to a better understanding of successful community patterns. The Task Force report was submitted to ACHUD for action in April 1973.

BRAB–BOSTID Advisory Committee for an Exploratory Program to Establish Feasibility of Initiating a Major Effort to Develop New Technology Solutions to Roofing Problems in Developing Nations

The disastrous typhoon that struck West Pakistan (now Bangladesh) in 1971 virtually destroyed the housing of an entire nation. Although the Agency for International Development (AID) responded quickly to assist the disaster victims, it was recognized that West Pakistan and other developing nations urgently need alternative roofing material to galvanized iron or thatch, which are the only roofing materials used in any great quantity in these countries. Therefore, at AID's request, a joint BRAB-Board on Science and Technology for International Development (BOSTID) advisory committee was established to assess the "feasibility of initiating a major effort to develop new technology solutions to roofing problems in developing nations."

The committee's recommendations should be particularly significant because the development of alternative roofing materials and techniques, using

locally available raw materials, would enhance the technical expertise of the developing nations and would make use of local labor, indigenous materials, and local research facilities. When fully developed, these solutions would create profitable industries and valuable skill training in developing countries.

NATIONAL MATERIALS ADVISORY BOARD

The National Materials Advisory Board (NMAB) provides advisory services on behalf of the Academies and the National Research Council and defines materials technical problems and opportunities of national concern and relevance to government, industry, or academia, attempting thereby to stimulate appropriate action. It also provides a forum for discussing national materials issues and policies and for planning, coordinating, and guiding comprehensive programs to achieve defined goals.

Advisory studies are conducted for the Director of Defense Research and Engineering (ODDR&E), the National Aeronautics and Space Administration (NASA), the Office of Naval Research (ONR), the Naval Ordnance Systems Command (NOSC), the Naval Ship Systems Command (NSSC), the General Services Administration (GSA) on behalf of the Office of Preparedness (OP), Department of Commerce (DOC), the Department of the Interior (DOI), the U.S. Army Materiel Command (AMC), the National Commission for Materials Policy (NCMP), the Bureau of Mines (BuMines), and the National Science Foundation (NSF).

The Board also assists in a variety of areas that involve materials, such as cooperation among materials-oriented technical societies, transfer of technology, prevention of fracture failure, corrosion, data storage and retrieval, pollution control, waste disposal and recycling, and formulation of the issues and elements of national materials policy.

High-Performance Castings (ODDR&E/NASA)

In many primary structure applications, the use of reliable high-performance castings can provide advantages over forgings or welded assemblies from the standpoints of both cost and performance. Such castings are now used to a limited degree, but many designers are hesitant to use them because of unfamiliarity with the technology and the difficulty of finding adequate sources of supply in the required quality. The Committee report, *High-Performance Castings* (NMAB–291), delineates the factors influencing the characteristics, design, and properties of high-performance castings and the outstanding problems that must be resolved to increase their reliability and use. Programs and methods for improving the integrity and acceptance of such castings are suggested.

The Application of Fracture Prevention Principles to Aircraft Design (ODDR&E/NASA)

The problem of brittle fracture in aircraft has become more serious in recent years because of efforts to attain higher structural efficiency through

the use of higher strength materials and monolithic structural configurations. Although there is a considerable body of knowledge about the factors involved—materials, design, testing, manufacturing methods, service stresses and environment, stress corrosion, maintenance practices, and nondestructive evaluation—little has been done to consider all of these factors in a unified and systematic manner. The Committee report, NMAB–302, identifies specific areas for research and development in the fracture-related technologies.

High-Performance Steel and Titanium Castings (*ODDR&E/NASA*)

The Committee on High-Performance Steel and Titanium Castings is conducting a study to determine the equipment and procedures, such as vacuum melting and deoxidation, required for a facility to make relatively large, high-performance castings of steel (HY–100, HY–130, and HY–180) and titanium in production for use in systems projected five or more years in the future. The Committee foresees minimal problems in the production of large HY–130 steel castings using present foundry facilities and procedures. In the case of HY–180 castings, however, considerable development work is required. Extensive development work is necessary to extrapolate titanium melting furnace capacities by an order of magnitude. Thick-section titanium castings also require development of reliable mechanical property data, possibly new alloy systems, and solution of mold and other foundry problems inherent in process scale-up. The Committee's report, NMAB–296, is scheduled for publication in mid-July.

Welding High-Strength Steel Structures (*ODDR&E/NASA*)

This Committee has completed an assessment of the welding processes that have promise in the fabrication of engineering structures, such as submarine hulls, from HY–180 steel and titanium alloys of 100–120 ksi yield strength. The Committee is preparing a report that will outline a program to achieve the necessary advances in technology.

High-Pressure Technology (*ODDR&E/NASA*)

The Committee evaluated recent activities in the field of high-pressure research, particularly those that might lead to new, useful materials. The report, NMAB–303, identifies applications of high-pressure technology, with particular reference to Department of Defense needs.

Directional Solidification (*ODDR&E/NASA*)

In its report, NMAB–301, the Committee reviews the state of the art of eutectic composites and recommends research and development, as well as specific alloy systems, to advance the technology. The Committee concluded that there has been insufficient work on alloy systems, protective coatings, joining, and inspection, and that mechanical and physical testing has not been conducted under a wide enough range of conditions. Also, additional alloy systems (e.g., silicides because of their potential for oxidation resist-

ance) as well as off-axis properties, thermal and mechanical stability, section size and geometry effects, and other problem areas warrant further investigation.

The Committee also prepared a critique of the September 1972 Conference on *In Situ* Composites, which is contained in the conference report, NMAB–308.

Yield of Electronic Materials and Devices (*ODDR&E*)

A Panel on Yield of Electronic Materials and Devices prepared a report, NMAB–290, that identifies ways to improve the economics of DOD procurement of electron devices through improvement in yield of reliable parts.

Materials for Radiation Detection Devices (*ODDR&E*)

The Committee has surveyed materials for radiation detection devices in the range of wavelengths from 10^{-10} cm. to 1.0 cm., and has drafted a report that will define needs, opportunities, fundamental limitations, and problems involved in advancing current technology.

Structural Adhesives for Aircraft Use (*ODDR&E/NASA*)

This Committee has conducted a survey of adhesives for structural use in aeronautical and space vehicles. Its report will set forth a comprehensive program of research and development for upgrading the technology and accelerating applications where advantages would accrue in performance or economy.

Fire Safety Aspects of Polymeric Materials (*ODDR&E/NASA*)

The original purpose of this study was to survey fire-suppressant polymeric materials for use in aeronautical and space vehicles, and to define research and development necessary to improve the technology. The scope of the project has now been broadened to include the interests of other government agencies.

Materials for Wet Oxidation Reactors (*ODDR&E*)

This Committee will study the materials problems inherent in the design and construction of a shipboard pressure vessel to be used for processing (in slurry form) various waste materials.

Adhesion of Rubber to Steel (*NSSC*)

The Committee report, NMAB–295, recommends research to enable an optimized system for shipboard installation.

Treatment and Disposal of High Energy Materials and Related Components (*NAVORD*)

This study is to provide the Navy with evaluations of technical options for disposal of a wide variety of high-energy materials, and components and equipment containing such materials, including the probable consequences, advantages, and disadvantages of each, particularly in relation to detriment to the environment.

Shell Steel (AMC)

In its report (NMAB–307), the Committee assessed the impact on production readiness of the conversion in shell manufacture to a new class of "fragmenting" steels.

Artillery Fuze Pinion Gears (AMC)

The purpose of this study is to explore material fabricating methods that might be used to produce pinions similar to those used in mechanical artillery fuzes, and recommend changes that could lead to the economical production of fuzes without requiring the use of imported machine tools.

Technical Aspects of Critical and Strategic Materials (GSA, OP, DOI, DOC)

Studies are under way on substitutability of aluminum and copper; catalysts for automotive emission devices and petroleum refining; trends in usage of cordage fibers; processes for using tungsten; rutile substitutes; and direct reduction processes for production of titanium metal.

The panel report, *Substitutability of Aluminum and Copper* (NMAB–286), was issued in April 1973. The panel report, *Catalysts for Automotive Emission Devices and Petroleum Refining* (NMAB 297), assesses the technological potential of base-metal catalysts as economic and efficient substitutes for platinum in the areas of petroleum refining and automobile emission control for the near future. Another report, issued during the year—*Usage of Natural Cordage Fibers* (NMAB–298)—assesses the implications of technological change on the requirements for these fibers in emergency periods. *Processes for Using Rutile Substitutes* (NMAB–293) identifies a number of processes that use ilmenite to produce a material that is high in titanium dioxide (TiO_2), is free of most contaminating elements, and has many of the physical characteristics of rutile. *Usage of Tungsten* (NMAB–309) contains recommendations concerning the future development of tungsten statistics necessary for estimating tungsten requirements more accurately. Government stockpile specifications are reviewed. A panel has been organized to study the potential of new technology for producing pure titanium metal.

Materials Policy (NCMP)

This is the first of two studies conducted by NMAB to assist the National Commission for Materials Policy in preparing its report to Congress under Title II of Public Law 91–512. The report, NMAB–294, addresses seven major areas considered as central to the formulation of a coherent and durable national materials policy. They are: abundances of mineral commodities and problems affecting future primary supplies; implications of environmental protection policy for national materials policy; recycling, substitution, synthesis, and design; extractive metallurgy and mineral processing; government incentives and controls; international implications of materials policy issues; and manpower and facilities.

Materials Science Application and Coordination (NCMP)

The report, NMAB-299, contains recommendations for improved technology transfer, interaction of government laboratories with industry for improved utilization, and strengthening the role and utilization of voluntary standards activities in the development of government regulations.

MARITIME TRANSPORTATION RESEARCH BOARD

The Maritime Transportation Research Board (MTRB) keeps abreast of water-transportation problems; advises its government sponsors and the maritime industry on programs for improving the U.S. flag merchant marine; stimulates, coordinates, and guides research directed toward improving the maritime-transportation capability of the United States, provides an objective forum for discussion of industry problems; identifies scientific and technical problems of national importance in maritime transportation and undertakes special research projects to aid in their solution; promotes cooperation in maritime research at home and abroad; examines urgent social problems related to maritime transportation that involve science and technology; and functions as a bridge between the maritime industry and the technical community.

The MTRB's work is performed under three contracts: (1) With the Office of Naval Research (ONR) (supported financially by the Maritime Administration of the Department of Commerce, the Navy, and the U.S. Coast Guard); (2) With the U.S. Navy Ship Systems Command as contractor for the Interagency Ship Structure Committee; and (3) With the Maritime Administration, which supports the Board's Maritime Information Committee and the Maritime Research Information Service.

Shipbuilding R. & D. Panel

This Panel was formed to determine what government- and industry-sponsored research will enable the maritime industry to achieve the goals of the shipbuilding program set forth in the Merchant Marine Act of 1970. The Panel examined techniques above the production level, assessed the capability of the industry to finance its own research, and determined how government research funds can be used to improve the competitive position of the U.S. shipbuilding industry on a worldwide scale. The Panel's report, *Shipbuilding Research and Development,* published in March 1973, contains a priority list of research and development projects appropriate for Maritime Administration sponsorship. It also contains limited and more general recommendations concerning research and development expenditures in the private sector.

Maritime Research and Education Panel

This Panel was formed in response to a request from the sponsors that the Board examine the requirements for the amount and type of support for maritime research and education that should be provided to universi-

ties and institutional research organizations by the government and the maritime industry. The Panel's report was published in January 1973.

Nuclear Ship Study Panel

The Panel has examined the impact of changes in technology, availability of resources, economics, and politics on the feasibility of using nuclear power for U.S.-flag merchant ships. The Panel devoted its efforts to three general areas: comparative costs of nuclear-powered versus conventionally powered ships, fuel availability and costs, and an examination of trade forecasts to determine world aggregate demand for high-horsepowered ships for which nuclear propulsion would be relatively attractive. The report will assess the comparative position of the United States in operating nuclear-powered ships in world trade, constructing nuclear-powered ships for the world market, and manufacturing marine reactors for domestic and foreign applications. The Panel also has made a broad assessment of the problems of subsidy considerations, entry of nuclear ships into world ports, and government support of research, with emphasis on the economic, environmental, health, and safety considerations.

Ship Research Committee

In responding to the general requirements set forth by the Interagency Ship Structure Committee, the Ship Research Committee prepares prospectuses for research, evaluates proposals submitted by others, provides technical liaison and guidance between sponsor and researcher, reviews project reports, and suggests productive avenues for future research. The detailed work of the Ship Research Committee is carried on through three advisory groups and individual project advisory committees functioning in the areas of ship response and load criteria; ship structural design procedures; and ship hull materials, fabrication, and inspection.

Merchant Marine Casualty Data Panel

During the last quarter of fiscal year 1972, a panel was formed to evaluate present methods utilized by major maritime nations for gathering and analyzing safety statistics. The results of the study are being reviewed and will be reported to the sponsors in July 1973.

Panel on Human Error in Merchant Marine Safety

MTRB's 1970 study, *Merchant Marine Safety,* urged the sponsors to initiate research to define human error and its special relationship to maritime accidents and to recommend a program of research and training to reduce personnel errors as one of the primary causes of casualties to U.S. commercial vessels. The Panel on Human Error in Merchant Marine Safety was formed as a result of that recommendation, and has submitted an interim report, *Human Error In Merchant Marine Safety,* that calls for a major data collection project by the National Maritime Research Center and proposes a program for obtaining useful information. The Panel stated

that "Until sufficient data are available, recommendations on a program for research cannot be formulated."

Organization of Human Resources in the Maritime Industry

Now that marine technology has reached a stage where it is technically possible to operate a ship with crew sizes varying from zero on up, it is recognized that more attention must be paid to the economic and social constraints affecting technical choice. At the same time, technological improvements in cargo handling methods have radically altered the work of longshoremen and changes on a comparable scale are being introduced into the shipbuilding industry. Related to these changes is the social structure involving the worker, union, and management. As a result of these developments, the sponsors felt that study was needed of the man-machine and worker organization at all levels in order to make intelligent use of technical advances in the maritime industry. The Panel on Organization of Human Resources in the Maritime Industry was formed to examine the work that has been done in the labor-management and worker-organization fields for their relevance to the maritime community. The Panel will also examine potential new relationships and worker-organization patterns in order to recommend specific areas of study that might be undertaken to improve the working environment and intergroup association in the industry.

Metrication in the Maritime Industry

The Department of Commerce has recommended to the Congress that the United States convert to the use of the measurement system of the International System of Units (SI), with each industry making its own plans for conversion within ten years. This Panel was formed to develop for the U.S. maritime industry and government agencies concerned with maritime matters a comprehensive plan for orderly metrication. The Panel's conversion plan will include a recommended mechanism for a continuing resource and information center to assist the industry during the conversion period.

The Panel has prepared a tentative "organization/function/matrix" that classifies the activities of the various elements of the U.S. maritime industry under six functional headings and categorizes each type of organization in terms of its involvement in the conversion to metric units. This information has been used to develop a "metrication time sequence" bar chart, showing the sequence and duration of metrication activities under each functional heading for key organizations in the maritime industry. This is being expanded into a comprehensive time bar chart for all segments of the industry, and is now in draft form.

Future Port Requirements of the United States

Technological advances in maritime and intermodal cargo transportation, exemplified by containerization and super-ships—notably oil tankers—pose

major problems for U.S. ports and increase the national concern for port development.

The MTRB has formed a study panel to examine the changing pattern of demand for ocean port services and to develop criteria for estimating future port needs in the United States. The study will provide tools for evaluating regional port needs of the United States to the year 2000 and will identify issues and problems of national concern that may arise as a result of port development, taking into consideration advances in technology and the expected volume of domestic and international waterborne commerce.

Maritime Information Committee

The Maritime Information Committee was formed in 1970 to guide the operations of the Maritime Research Information Service (MRIS). This Committee was made a part of MTRB in October 1972. Operational procedures for the MRIS are based on those of the Highway Research Information Service and other transportation-research information services under current development within the National Research Council. Data processing is being handled by the Highway Research Board's staff (see page 94). The Committee and MTRB are funded by the U.S. Maritime Administration.

ADVISORY BOARD ON MILITARY PERSONNEL SUPPLIES

The Board reviewed and commented on parts of the plan of the U.S. Army Natick Laboratories (NLabs) Panel for Technical Achievement, 1974–1990, entitled "Sustaining the Combat Soldier."

After an evaluation of the progress and status of the overall DoD Food Program, the General Committee on DoD Food Program endorsed the balance of planned projects. Specifically, the Committee considered the primary functions of the Program to be the in-depth study and definition of existing military feeding systems from supply line to consumer and the development of new improved food-service systems. It advocated continued attention to the nutritional aspects of these new systems. For better communication and coordination, a sabbatical program for the exchange of scientists and technologists between NLabs and other government laboratories was recommended.

A symposium on "Flexible Packaging for Heat-Processed Foods" was held in November 1972 to discuss the technical feasibility of using a flexible packaging system for heat-processed foods of commercial sterility, and to view the production line and testing facilities for the system. Food processed in the plastic-aluminum foil-plastic pouch, protected by a cardboard folder, needs no refrigeration. The food may be eaten hot (package immersed in boiling water for 3–5 minutes) or cold.

In October 1972, the Advisory Board and NLabs cosponsored the Fifteenth Annual Conference on Organic Chemistry. Approximately 250 in-

dustrial, academic, and government scientists attended. The guest speaker was Dr. Alan R. Battersby of Cambridge University, who spoke on structure, stereochemistry, and biosynthesis.

The Committee on Helmets reviewed the Army's program to develop a new infantry helmet, and prepared a report covering physiological studies, suspension systems, casualty criteria, sizing, human factors, transient deformation, and bump protection. It was recommended that criteria for internal head injury assessment of ballistic transient deformation be developed.

Several of the Board's committees and task groups advised NLabs on its programs related to feeding military personnel. The Committee on Food Stability is assisting NLabs in its plan and program for the Symposium on Objective Methods for Food Evaluation, to be held in the fall of 1974; the Committee on Animal Products made recommendations regarding roasts and steaks, intermediate-moisture foods, reversibly compressed products, freeze-dried meat products, and improvement of canned meats; the Committee on Cereal and General Products advised the Bakery Section and General Product Section of the NLabs Food Laboratory; and the Task Group on Wholesomeness of Irradiated Beef of the Committee on Radiation Preservation of Food reviewed an NLabs experimental study using rodents, in which a semi-purified diet was used to feed the rodents in the negative control group. The Task Group recommended the use of a modified semi-purified laboratory diet and the feeding of commercial rodent food to another group of rodents for an additional control in the study.

The Committee on Food Service Systems reviewed and commented on the NLabs programs for the development of new or improved military feeding systems. The Committee recommended that the central preparation-satellite feeding system experiment being conducted at Fort Lewis, Washington, be extended to other installations.

COMMITTEE ON MOTOR VEHICLE EMISSIONS

(See page 11.)

COMMITTEES ON POLLUTION ABATEMENT AND CONTROL

The Committees on Pollution Abatement and Control (COPAC) consist of the Committee on Air Quality Management, Committee on Noise, Committee on Water Quality Management, the Committee on Solid Waste Management, and the recently formed Committee on Processing and Utilization of Fossil Fuels. The five committees and their panels advise on the feasibility of implementing recommendations stemming from pertinent studies on environmental pollution as they relate to air, noise, and solid wastes from urban, industrial, and agricultural sources.

Committee on Air Quality Management

The Committee's report, *Abatement of Particulate Emissions from Stationary Sources,* was published in August 1972.

The *ad hoc* Panel on Evaluation of Coal-Gasification Technology was formed in response to a request from the Office of Coal Research of the U.S. Department of the Interior for an evaluation of current coal-gasification research and development efforts directed toward the production of pipeline-quality gas and to assess these methods in terms of their commercial application. In November 1971, the study was broadened to include low-Btu fuel gas. The Panel's report, *Evaluation of Coal-Gasification Technology: Part I—Pipeline-Quality Gas,* was published in December 1972 (see page 7) and *Evaluation of Coal-Gasification Technology: Part II—Low- and Intermediate-Btu Fuel Gases,* will be published during fiscal year 1973–1974.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL INSTITUTE OF REFRIGERATION

The U.S. National Committee for the International Institute of Refrigeration (USNCIIR) assists the National Academy of Sciences and the National Research Council by effecting appropriate U.S. participation in the International Institute on behalf of American scientists, engineers, and technologists interested in refrigeration and cryology.

On August 4, 1972, a round-table conference on "A Review of Problems Associated with Biological Integrity at Low Temperatures" was held at the National Academy of Sciences. The six papers presented at the conference were published and are available from the office of the Committee.

COMMITTEE ON NATURAL DISASTERS

The Committee is the outgrowth of a committee established in 1966 as the Committee on Earthquake Engineering, which was formed to conduct site investigations after destructive earthquakes. In 1970, the scope of the Committee's investigations was expanded to include "winds and other natural disasters," and the following year the Committee's name was changed. In December 1972, a team of investigators was sent to Managua, Nicaragua, to examine the site of the earthquake in order to determine how engineering might be applied to improve public safety and welfare. Arrangements were made for a report on the Hilo, Hawaii, earthquake of April 26, 1973.

The Committee published a report in December 1972 on *Failure of Dam No. 3 on the Middle Fork of Buffalo Creek near Saunders, West Virginia, on February 26, 1972.*

COMMITTEE ON FIRE RESEARCH

The Committee's chief concern during the year concerned smoke toxicology and hazards. Symposia were planned and the Committee is formulating a proposed program of research on smoke and toxicology as a guideline for the National Science Foundation in funding research proposals. The

sixth edition of the *Directory of Fire Research in the United States* was published in July 1972, and the report of an April 1972 symposium, *An Appraisal of Halogenated Fire Extinguishing Agents,* was published in December. Three issues of *Fire Research Abstracts and Reviews* were also published during the year.

CONFERENCE ON ELECTRICAL INSULATION AND DIELECTRIC PHENOMENA

The Conference provides an opportunity for research workers and engineers in the fields of dielectrics and electrical insulation to present papers and exchange information at an annual meeting. Summaries of the papers presented are published in the *Annual Report of the Conference on Electrical Insulation and Dielectric Phenomena* and in the annual publication of the *Digest of Literature on Dielectrics.*

DIVISION OF MATHEMATICAL SCIENCES

COMMITTEE ON NATIONAL STATISTICS

The Committee, which held its first meeting in January 1972, was formed in response to a recommendation by the President's Commission on Federal Statistics for "a continuous review of federal statistical activities." The Committee is attempting to select issues of national importance that give some promise of immediate results, are of concern to specific federal agencies, and are of interest to the Committee members and staff.

The Committee has prepared a project statement for an exploratory survey of the statistical program of the Department of Health, Education, and Welfare. Other suggested projects include studies of statistical issues related to information required for revenue-sharing; the statistics of crime-victimization surveys; the impact of the contracting process used by the federal government on the quality of the statistical products obtained through contracts, and issues of statistical exposition, such as problems of explaining to the general public the meaning of "statistically significant."

COMMITTEE ON APPLICATIONS OF MATHEMATICS

At a meeting in August 1972, the Committee discussed the possibility of holding a summer conference in 1973 to take advantage of the recent upsurge of interest in societal problems by mathematicians. It was felt that conferences could be organized in particular fields by specialists in those fields along with an interested mathematician. Four fields were selected—epidemiology, weather, thermonuclear energy, and the environment. The Committee's role would be to prepare proposals to appropriate government agencies, to assist in the selection of conference chairmen, and to promote the concept of such conferences as a means of educating and interesting mathematicians in applications.

UNITED STATES NATIONAL COMMITTEE FOR MATHEMATICS

The Committee advises the National Academy of Sciences in all matters pertaining to the International Mathematical Union (IMU). It may also advise the NAS on affairs of other international organizations of the mathematical sciences.

The IMU has asked the Committee to prepare an updated list of U.S. mathematicians for inclusion in the fifth edition of the *World Directory of Mathematicians;* the Committee has been contributing the U.S. entry for this directory since 1958.

At a meeting in May, discussions were held about broadening the Committee's membership to make it more representative of mathematical subfields; a draft revision of the Committee's constitution was reviewed; it was agreed that current efforts to establish regular contact with Chinese mathematicians should be continued; and it was proposed that a travel grant program should be established to assist mathematicians to attend the 1974 International Congress of Mathematicians in Vancouver.

UNITED STATES COMMISSION ON MATHEMATICAL INSTRUCTION

The Second International Congress on Mathematical Education, sponsored by the International Commission on Mathematical Instruction (ICMI), took place in England from August 20 through September 2, 1972. About 1,400 full members and 300 associate members representing 66 countries were in attendance, including an estimated 400 from the United States. At a meeting of the U.S. Commission on Mathematical Instruction in November, it was unanimously recommended that the Third International Congress (to be held in 1976) be invited to the United States by the National Academy of Sciences. An invitation was sent by NAS President Handler to ICMI President Sir James Lighthill on March 1, 1973.

FELLOWSHIP BROCHURE

Each year, in September, the Division of Mathematical Sciences issues the brochure, *Fellowship and Research Opportunities in the Mathematical Sciences.* Supplies of the 1972 edition were exhausted by March 1973. The 1973 edition will be further expanded in an effort to make it significantly more useful to the mathematical community.

DIVISION OF MEDICAL SCIENCES

COMMITTEE ON EMERGENCY MEDICAL SERVICES

The Committee completed two studies during the year—the training of emergency medical technicians in prehospital cardiac care and on emergency medical communication (now being revised)—and is completing its review

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and recommendations concerning the classification and training of emergency medical technicians.

COMMITTEE ON REGIONAL EMERGENCY MEDICAL COMMUNICATION SYSTEMS

A program to fund the establishment of regional emergency medical communication systems in 30 to 50 areas around the country arose from the concern of the Robert Wood Johnson Foundation for the improvement of medical-care delivery in the United States, and was a result of recommendations by the Committee on Emergency Medical Services that regional medical systems be established. Applications were invited from any organization interested in establishing, or in further developing, such a system. The Committee on Regional Emergency Medical Communication Systems reviewed 256 applications, and recommended to the Foundation the funding of 44 projects in 32 states and Puerto Rico. During the next two years, the Committee will monitor the funded projects and report to the Foundation.

COMMITTEE ON UNDERWATER PHYSIOLOGY AND MEDICINE

The Committee was established in January 1972 at the request of the Surgeon General of the Navy. The Committee was charged with providing assessments to the Surgeon General concerning emerging biomedical research and technical problems related to man's activity in underwater environments. The Committee designed a study entitled, "Development of a National Cooperative Program of Pressure and Underwater Biomedical Research and Operational Development," to (1) identify the most important biomedical problems that impede the orderly attainment of national goals in manned underwater programs, both civilian and national defense, and (2) recommend practical steps for solving these problems through collaborative, cooperative, and independent basic research and operational development undertaken by the scientific community, public and private.

POLICY COMMITTEE FOR THE STUDY OF INSTITUTIONAL DIFFERENCES IN POSTOPERATIVE MORTALITY

In the course of a 1969 study that assessed potential hazards of the anesthetic halothane, it was noted that there was an unexplained threefold to sixfold variation among hospitals in postoperative mortality rate associated with relatively homogeneous diagnosis-treatment categories of patients. The Policy Committee was established in May 1971 to conduct a study that involves analysis of approximately 20 hospitals in various geographic locations and of various types—teaching, community, research, etc., in an attempt to explain the inter-hospital variations discovered in the earlier study. A report of the study is expected in January 1975. The study may continue until September 1975 or later.

ATOMIC BOMB CASUALTY COMMISSION

See page 44.

MEDICAL FOLLOW-UP AGENCY

Since 1946, in response to requests from the Veterans' Administration and the armed forces, the Division of Medical Sciences has sought to make the medical experience of the military-veteran population an accessible resource for studies in the natural history of disease. The Medical Follow-up Agency carries out this responsibility, with the Committee on Epidemiology and Veterans Follow-up Studies advising on program policy and development. In addition to a general program of epidemiologic and follow-up studies, the Committee and the Follow-up Agency have developed the NRC Twin Registry of 16,000 pairs of veteran twins as a subsidiary resource with which to evaluate environmental and genetic factors in the etiology of chronic diseases.

Three new proposals for use of the Twin Registry were approved by the Committee during the year—a study of genetic influences on the occurrence of cancer; an intensive investigation of twins and family members with some neurologic disorders, especially presenile dementia; and a study of genetic factors in relation to earnings, occupational mobility, health, and family size.

Other research proposals approved by the Committee include: (1) A study of men exposed to microwave radiation; (2) An investigation into possible long-term health effects of organic arsenic compounds, used in the treatment of syphilis during World War II; (3) A 30-year clinical follow-up of men diagnosed as having retrobulbar neuritis or multiple sclerosis during World War II.

Progress was made in a variety of studies, including an epidemiologic and follow-up study of amyotrophic lateral sclerosis; a study of the effects of prisoner-of-war status on later health; clinical trials of adjuvants to surgery in the treatment of cancer of the lung, stomach, and colon-rectum; a study of body build and later patterns of mortality.

COMMITTEE FOR THE STUDY OF INBORN ERRORS OF METABOLISM

See page 45.

AD HOC COMMITTEE ON S-HEMOGLOBINOPATHIES

See page 33.

COMMITTEE ON BIOLOGIC EFFECTS OF ATMOSPHERIC POLLUTANTS

The Committee was established in 1970 in response to a request from the National Air Pollution Control Agency, now a part of the Environmental Protection Agency (EPA), to prepare a series of documents to serve as the basis for publication by EPA of air-quality criteria documents. Detailed reviews were published on fluorides, lead, and particulate polycyclic organic matter. A brief report was prepared on asbestos. Reports are nearing com-

pletion on chromium, manganese, nickel, vanadium, and vapor-phase organic pollutants. Reports on airborne particles (particularly fine particles), chlorine, and hydrogen chloride, copper, selenium, and zinc are being prepared.

The 1970 Amendment to the Clean Air Act increased the number of control strategies available to EPA, and these reviews can now be used by EPA to provide information on which to base a decision as to whether or not a substance should be regulated (at least partly on the basis of the asbestos report, the EPA has declared asbestos a hazardous substance). The reports also enable EPA to decide whether a substance is from a point source or is ubiquitous, thereby determining which regulatory option should be taken, and provide a scientific document for use as backup material in any public hearings connected with control of a substance.

AD HOC COMMITTEE TO EVALUATE THE HAZARD OF LEAD IN PAINT

In the fall of 1972, the Bureau of Product Safety, Food and Drug Administration, asked the Division of Medical Sciences for assistance in determining a safe concentration of lead in paint for household use. The agency is confronted with the problem of deciding the maximal concentration of lead in paint that will permit the prevention of lead poisoning in future generations of children who have pica. The Committee was established to determine whether there is sufficient evidence on which to establish a rational maximal concentration of lead in paint and, if not, what research is needed to provide such evidence.

TOXICOLOGY INFORMATION PROGRAM COMMITTEE

In 1966, the President directed the Secretary of Health, Education, and Welfare to establish a computer-based file of toxicologic information "open to all people with a legitimate need to know its contents." The responsibility for the program was assigned to the National Library of Medicine (NLM). In 1968, at the request of the Director of NLM, the Toxicology Information Program Committee was organized to assist in the development and evaluation of basic concepts and guidelines for long-range planning of the program and to recommend major program elements and the priority that each should be given.

The Committee may be considered as making two major contributions to the Toxicology Information Program, which has now developed a major resource for a large segment of the scientific community. First, it has continued to promote the concept of the program as a coordinating activity, trying to enhance information exchange on the basis of cooperation among information centers, rather than a single in-house effort. Second, it has helped to ensure the utility of the program's products and services by evaluating proposed innovations in the light of user requirements, rather than sheer technologic feasibility.

ADVISORY COMMITTEE ON THE BIOLOGIC EFFECTS OF IONIZING RADIATION

See page 29.

ADVISORY COMMITTEE TO THE RADIATION REGISTRY OF PHYSICIANS

In 1961, the Advisory Committee was established in the Division of Medical Sciences and the Registry was initiated at Johns Hopkins University with support from the Atomic Energy Commission and the National Institutes of Health. The American College of Radiology and the College of American Pathologists agreed to cooperate in providing the populations to be compared in a long-term study of the somatic and genetic effects of occupational exposure on radiologists, compared with physicians in another specialty. The Registry was subsequently transferred to the Bureau of Radiological Health, Food and Drug Administration.

During the past year, an abbreviated questionnaire was developed, with the Committee's assistance, to be used to update information on those who had responded earlier and to present a somewhat easier task to those who had not responded to an earlier detailed questionnaire.

COMMITTEE ON RADIOLOGY

One of the principal activities of this Committee is to evaluate applications for postdoctoral awards in radiology and nuclear medicine for the James Picker Foundation. Over the years, radiologic scientists in 16 different countries have received approximately 450 awards from the Foundation. In January 1973, the Committee reviewed more than 100 applications, interviewed several applicants for academic fellowships, and transmitted its recommendations to the Foundation, which awarded fellowships and grants to young scientists and senior investigators for advanced training and research in the radiologic sciences. The Foundation also awards pilot grants for feasibility studies. From a total of 14 applicants for pilot and feasibility studies, the Committee chairman selected six investigators to receive awards totaling about $20,000.

COMMITTEE ON VIRAL HEPATITIS

It is widely accepted that there are two types of viral hepatitis: type A, which is generally transmitted by ingestion, and type B, or post-transfusion hepatitis. The ability to test for the "Australia antigen" (HB Ag), which is associated with the type B virus, has indicated the highly infectious nature of that disease and shown that a large number of presumably healthy people harbor the antigen in their serum.

In early April 1971, the National Institutes of Health (NIH) established a Task Force on Viral Hepatitis to promote an exchange of information and cooperation among NIH groups that were engaged in research on hepatitis.

NIH soon recognized the need for knowledge about the research activities of other governmental and nongovernmental agencies and, in June 1971, asked the Division of Medical Sciences to establish a group to develop a system for facilitating communication among investigators. The Committee on Viral Hepatitis was organized in response to this request, and liaison was effected with appropriate federal agencies, professional societies, and other organizations. The Committee's recommendations with respect to specific epidemiologic, clinical, or technical problems are published in appropriate journals or directed to concerned agencies.

The Committee has published recommendations for the handling of carriers of HB Ag. Its statement used a system of nomenclature for the two forms of hepatitis and their related antigens and antibodies that had been adopted by the Committee. The Committee has also made recommendations on the infectivity of serum containing antibody to HB Ag and the utility of the highly sensitive radioimmunoassay technique for screening blood donors. It has afforded a forum for discussions of false-positive HB Ag tests related to sensitivity to guinea pig protein and the relative accuracy of commercial kits for HB Ag testing.

ADVISORY COMMITTEE ON MILITARY ENVIRONMENTAL RESEARCH

In January 1972, the Commanding General of the U.S. Army Medical Research and Development Command asked the Division of Medical Sciences for assistance in the field of environmental research. A multidisciplinary Advisory Committee on Military Environmental Research was established and, subsequently, the Committee established *ad hoc* task forces on Toxicology and on Pesticide Disposal.

The Task Force on Toxicology visited the Biomedical Laboratories at Edgewood Arsenal, Maryland, evaluated a toxicology research proposal that had been made to the U.S. Army Medical Research and Development Command, and prepared a report to the Command.

The Task Force on Pesticide Disposal suggested changes in a draft request for research proposals that limited the percentage of effort that could be devoted to biodegradation of DDT, Chlordane, etc., in which the likelihood of payoff would be very small.

COMMITTEE ON NAVAL MEDICAL RESEARCH

The Committee reviewed specific research programs identified by the Navy; *ad hoc* groups, chaired by members of the Committee, were appointed for these specific studies.

In 1971, the Surgeon General of the Navy requested (1) an appraisal of the intrinsic merit of the clinical research program, the newly established clinical investigation program, and the training and education programs in naval hospitals; and (2) advice concerning the future conduct and support

of these programs with respect to their individual merit, their influence on the quality of medical service and medical care provided in the Navy, and their influence on the recruitment and retainment of professional Naval Medical Department personnel. A final report was prepared and issued in 1973.

Another study involved an appraisal of the scientific quality of the Navy's nonionizing radiation research program, and a critical assessment of its scope, direction, and content. The purpose of the Navy program is to determine and characterize the biologic effects of nonionizing radiation in relation to current safety standards within the Department of the Navy. A final report was issued in 1973.

An *ad hoc* committee was formed in August 1972 in response to a request from the Surgeon General of the Navy for (1) an assessment of the scope, balance, and quality of naval dental research and postgraduate educational programs and of how these relate to the Navy's operational requirements; and (2) advice concerning the future planning, emphasis, and needs of these programs with particular relation to maintenance of quality dental care and promotion of recruitment and retention of competent dental officers in an all-volunteer Navy. The committee reviewed documents, received briefings, and visited Naval dental facilities, and a report on its observations, conclusions, and recommendations was transmitted to the Navy in 1973.

COMMITTEE ON PROSTHETICS RESEARCH AND DEVELOPMENT (CPRD)

The CPRD is supported by the Veterans Administration and the Office of Vocational Rehabilitation. Cooperating laboratories include the Army Medical Biochemical Research Laboratory, the Navy Prosthetics Research Laboratory, and the Veterans Administration Prosthetics Center. The Committee has established Subcommittees on Fundamental Studies, Design and Development, Evaluation, Child Prosthetics Problems, and Sensory Aids to assist CPRD in keeping abreast of new developments; to correlate and coordinate research by various governmental agencies; to advise its sponsors on the scope and progress of its program; to recommend needed research; to ensure that promising new devices and techniques are made available promptly to organizations concerned with the education of medical and paramedical personnel in these fields; and to disseminate research results nationally and internationally through publications.

The Subcommittee on Design and Development and its workshop panels encourage and coordinate the design and development of improved prosthetic and orthotic devices, promote the exchange of information between developers, provide leadership in attacking critical problems, provide a forum for the evaluation of new ideas and suggestions, and encourage the endeavors of competent designers. During the year the Tenth Workshop

on Upper-Limb Prosthetics and the Eighth Workshop Panel on Lower-Limb Orthotics were held. The former focused on the immediate and early fitting of upper-limb prostheses; the emphasis in the latter workshop was on above-knee orthoses and orthotic knee joints providing knee stability.

The Subcommittee on Evaluation has considered a wide range of subjects, including the results of the clinical use of the Technical Analysis Forms, Prescription Form, and Disability Classification Forms, and has reviewed clinical evaluations of three ankle-foot orthoses, the Ljubljana functional electric stimulator, and the VA externally powered upper-limb prostheses. The Subcommittee also arranged an orientation course on the application and evaluation of the Medtronic-Rancho implanted peroneal stimulator.

The Subcommittee on Child Prosthetics Problems encourages research in this field and disseminates the resulting information to clinicians and others engaged in the treatment of child amputees. Under its auspices the Cooperative Child Amputee Research Program is carried on through 32 participating treatment centers that have met standards of practice established by the Subcommittee. Information is exchanged through the *Inter-Clinic Information Bulletin.* The Subcommittee arranged a Conference on the Child with an Orthopedic Disability—His Orthotic Needs and How to Meet Them and a symposium for clinic chiefs on the delivery of health services for children with limb deficiencies.

The Subcommittee on Sensory Aids is concerned with the development of sensory aids for the blind and partially sighted and for the deaf and hard of hearing, and encourages research in these areas. For example, the Subcommittee played a major role in the evaluation of the Bionic laser cane developed under the auspices of the Veterans Administration and is trying to develop guidelines for the conduct of future projects for the evaluation of mobility aids. The Subcommittee plans to assist in the development of an orderly system for the evaluation of reading machines for the blind. The Veterans Administration has requested the formation of a panel of consultants to advise on hearing-aid performance criteria to be used in the selection of aids for VA purchase.

During the year, the CPRD arranged or collaborated in workshops on the Comprehensive Management of Musculoskeletal Disorders in Hemophilia, Injuries of Adolescents in Sports and Recreation, the Role of Engineering in Spinal Cord Injury Programs, and the Integrity of Endoskeletal Prostheses.

In addition, 38 proposals (18 for new projects and 20 for continuations) in the fields of prosthetics, orthotics, and sensory aids were reviewed and appraised by the Committee at the request of sponsors.

COMMITTEE ON PROSTHETIC-ORTHOTIC EDUCATION

The prime concern of the Task Force on Standardization of Prosthetic-Orthotic Terminology is with standardization of prosthetic and orthotic nomenclature. It is also concerned with the application of descriptive terms to the prescription of devices for patients; the use of selected terminology and prescription information in the negotiation of fee schedules and contracts of third-party payees, such as the Veterans Administration, the Social and Rehabilitation Service of the Department of Health, Education, and Welfare, Blue Cross-Blue Shield, and the Social Security Administration; and the need for a comprehensive information retrieval system based on a standardized prosthetic and orthotic terminology.

The *ad hoc* Committee on Information Retrieval is concerned with standard nomenclature as it is needed for inclusion in existing retrieval systems, such as the Medical Literature Analysis and Retrieval System (MEDLARS) of the National Library of Medicine, and for development of a complementary system to permit retrieval of literature not analyzed and included in MEDLARS. Through meetings held during the year with representatives of Canadian and United Kingdom information retrieval groups, efforts are being made to develop a system that might be universally accepted by the English-speaking world.

Newsletter . . . Amputee Clinics, CPOE's bi-monthly publication, is an effective vehicle for communication between amputee-clinic chiefs and others involved in the care and management of amputees.

COMMITTEE ON DIMETHYL SULFOXIDE

See page 46.

COMMITTEE ON PROBLEMS OF DRUG DEPENDENCE

The Committee was established in the Division of Medical Sciences to promote educational programs and to stimulate a search for less addictive agents. Although the Committee has retained its main interest—the scientific aspects of drug dependence—it has recently taken into account related problems in the psychologic, sociologic, and public-health aspects of drug abuse. The modest grant program, supported by donations from the pharmaceutical industry, is being continued. Supported projects include the Veterans Administration cooperative study of new analgesics conducted at four hospitals, two other clinical investigations of the efficacy and safety of analgesics, and two basic pharmacologic studies related to drug dependence.

Testing in monkeys is an important part of the Drug Dependence Research (Screening) Program of the Committee, under which it receives

new compounds from domestic and foreign pharmaceutical firms and from academic and government laboratories. After screening in mice at NIH laboratories, they are transmitted to the University of Michigan or the Medical College of Virginia under an NIH code number for blind testing for morphine-like dependence and antagonistic action in monkeys. If the results indicate that the compound may have therapeutic value, the Committee may recommend further testing for drug dependence in man at the Addiction Research Center (National Institute of Mental Health) in Lexington, Kentucky. A notable development was the approval of support of a primate colony for the testing of new compounds for drug dependence at the Medical College of Virginia. The new project will supplement the overtaxed Michigan program, which the Committee continues to supervise.

In February 1973, the Committee sponsored a Conference on Standardization of Self-Administration Techniques in Animals for Determination of Drug Dependence. This method of investigation is considered of some importance in predicting the dependence potential of a new compound. However, no conclusions have been reached on the method by the Committee.

A project begun last year under contract to the Bureau of Narcotics and Dangerous Drugs is assessing the therapeutic adequacy of synthetic substitutes for the opium alkaloids and will predict the impact on medical practice of total substitution. A preliminary report on the first phase of the study has been prepared. In the second phase, the American Medical Association is collaborating with Committee consultants in using a questionnaire to determine the prescribing practices of physicians in this regard and their reaction to the proposed substitution.

On November 9, 1972, the Committee formally objected to a proposed federal regulation that would restrict all preparations of codeine to prescription use. Although there is some evidence of abuse of codeine cough syrups, the Committee did not feel there was justification for penalizing all sufferers of symptoms relieved by codeine for the error of a few. Furthermore, pharmacists could do much to prevent the abuse of these preparations. The regulation is not yet final.

DRUG RESEARCH BOARD

A contract was completed during the year with the Food and Drug Administration (FDA) to consider ethical criteria in drug evaluation and to advise the FDA on these criteria, with special reference to the problem of drug monitoring. A report on these matters was prepared by the Drug Research Board (DRB).

A principal concern of the DRB through the years has been with methodology of development and evaluation of drugs. Activities in this sphere have continued to center about problems of mutagenesis and carcinogenesis. Major conferences on microsomes and drug oxidations, research needs pertain-

ing to contraceptive drugs, dermatopharmacology, and pediatric clinical pharmacology have been offered under DRB sponsorship.

In 1969 a proposal was made to the FDA for the "prospective review of research conducted for an NDA (new drug application) submission with the aid of outside consultants." The aims of the proposal were to improve the scientific quality of drug evaluation, to ensure that NDA's are complete in essential detail, to avoid needless research, and to expedite the decision-making process. At the time, the FDA Commissioner indicated his desire to apply the proposed prospective review in a pilot study with one or two new drugs. For a number of reasons, however, the pilot study was not undertaken. The possible savings in manpower, time, and money, and the increment in quality of studies under this plan could, in DRB's opinion, be so considerable that DRB is continuing its efforts to effect a pilot study. During the past year, this matter was considered at all DRB meetings, and there will be a report from the FDA on its moves to implement the study when DRB meets in October 1973.

The Drug Efficacy Study is essentially complete, and all reports of the 4,000 drugs that were reviewed by DRB in the Study have been published in the Federal Register. Problems of interpretation, however, have required a continuing contractual relationship with the FDA.

The DRB continued to examine legislative proposals that might amend the status and function of the FDA, and it has brought to the attention of the appropriate committees of Congress its view that the FDA should remain with the Department of Health, Education, and Welfare. Placement of the FDA outside the Department would deprive it of the scientific basis for its decisions and thus would not accord with the public interest.

COMMITTEE ON PROBLEMS OF DRUG SAFETY

In May 1973, the Committee conducted a major Conference on Carcinogenesis Testing in the Development of New Drugs. The Conference reviewed evaluative methods, including some of the newer methods that offer promise of considerably shorter-term evaluation. It was recognized that the benefit-risk equation must be taken into consideration in evaluation for carcinogenic activity.

Mutagenesis is an equally difficult and closely related area of the Committee's interest. The Committee and the Drug Research Board have convened a number of conferences; the relevance of the various tests to mammals and specifically to man has not been resolved in these conferences, however, and any decision to require additional procedures must be carefully considered. Further conferences are being planned. Having established the conference pattern, the Committee is acting as a catalyst to encourage such groups as the Environmental Mutagen Society to take direct responsibility for further activities in this area, with the Committee serving as cosponsor.

The Committee planned and served as cosponsor for workshops on problems of dermatopharmacology and on applications of biochemistry to drug evaluation. A report on contraceptive drugs, focusing on problems of thromboembolism and carcinogenesis, based on a July 1972 Conference on Contraceptive Pharmacology, will be available early in fiscal year 1974.

Evaluation of drugs in children continued to occupy the Committee; a report on research needs in pediatric clinical pharmacology has been completed. The report is based on the Conference on Pediatric Clinical Pharmacology, which was sponsored by the American Academy of Pediatrics, the National Institute of Child Health and Human Development, and the National Institute of General Medical Sciences.

Plans are under way for conferences on human experimentation, drug development planning (with the focus on pharmaceutical industry planning procedures in drug studies), and on quality of early clinical trials (to be held with support from the Food and Drug Administration, and sponsored by the American Society for Pharmacology and Experimental Therapeutics, the American Society for Clinical Pharmacology and Therapeutics, the Food and Drug Administration, and the Pharmaceutical Manufacturers Association).

COMMITTEE ON BRAIN SCIENCES

The goal of the Committee is to bring together the core and peripheral disciplines that relate to brain and behavior in an interrelationship that forms the basis for a new scientific concept—neuroscience. Brain processes that come within neuroscience include those with a biologic basis and exclude attributes of the mind. Within this limitation, the Committee's activities have been focused on the education of neuroscientists and the exchange of information among them.

Projects related to information exchange include review and expansion of the medical subject headings in behavioral sciences for the National Library of Medicine and compilation and distribution of the U.S. component of the International Brain Research Organization (IBRO) survey of research facilities and manpower in brain sciences for the National Institute of Mental Health (NIMH). With regard to education, a study was prepared for the Office of Science and Technology that presented a profile of neuroscience in the United States, with emphasis on courses in brain and behavior that were available to medical-school undergraduates.

A measure of the Committee's success in promotion of neuroscience has been the enthusiasm with which a new professional society, the Society for Neuroscience, has been received. Planning and organization for the society was spearheaded by the Committee in 1969. The Society is now approaching a membership of 3,000 and has scheduled its third annual meeting.

The Committee is conducting an evaluation of the impact of research on the application of discoveries in mental health and neurology. The evaluation consists of a series of documented historical analyses of the role of research in the solution of significant societal problems. Four models were selected for study: the use of drugs in mental disease states, exemplified by chlorpromazine in schizophrenia; the diagnosis and treatment of convulsive disorders, exemplified by electoencephalography and Dilantin in epilepsy; behavior modification, exemplified by phobias, obesity, and management of mentally retarded institutionalized populations; and recognition of the importance of early experience in child development. The first case study has been completed and the other three are expected to be by the end of 1973.

EVALUATION OF THE NATIONAL PITUITARY AGENCY

The National Pituitary Agency (NPA), sponsored by the National Institute of Arthritis, Metabolism, and Digestive Diseases (NIAMDD) with the cooperation of the American Association of Pathologists and Bacteriologists, supplies—free of charge to qualified investigators—human pituitary glands, six peptide hormones, alpha and beta chains of three glycoproteins, and purified hormone and antiserum for radioimmunoassay. The NIAMDD has requested an evaluation of the NPA (1) to determine the effect of the availability of endocrine products on the type, volume, and quality of research in endocrinology, (2) to identify future research needs in endocrinology, and the hormonal and cell products related thereto, (3) to ascertain the role of the NPA or an NPA-like agency in support of such research, and (4) to develop a model for such an agency. To undertake this evaluation, a committee was established. Its membership encompasses the disciplines of cell biology, physiology, biochemistry, endocrinology, obstetrics and gynecology, internal medicine, pediatrics, protein chemistry, immunochemistry, human genetics, operations research, and statistics.

HEALTH NEEDS OF CHILDREN

The American Academy of Pediatrics and other agencies expressed a need for an evaluation of the overall health needs of children in the United States and, in October 1972, the Executive Committee of the Division of Medical Sciences recommended the establishment of an *ad hoc* group to determine what role the Division could play in meeting such a requirement. The *ad hoc* Study Group to Define the Role of the Division of Medical Sciences to Serve the Health Needs of Children was established with money made available through the Program Initiation and Development Fund of the National Academy of Sciences. It is expected to formulate its recommendation by December 1973.

COMMITTEE ON PHOTOTHERAPY IN THE NEWBORN

Early in 1972, the Division assembled an *ad hoc* committee to look into the use of light as a form of treatment for hyperbilirubinemia in the newborn. The group concluded that there was a need for a central, national focus for the biomedical and bioengineering research and development required to evaluate the safety and efficacy of the use of light energy in the treatment of human disease, and in May 1972, the Committee on Phototherapy in the Newborn was established. The Committee's members represent the fields of pediatrics, molecular biology, biochemistry, photobiology, and bioengineering. The Committee is to develop guidelines for correct clinical practice, stimulate research to acquire the knowledge found to be lacking, and encourage the development of safe and effective equipment for use in phototherapy.

The Committee has studied clinical and research data on phototherapy and has written the specifications of a meter to measure the spectral irradiance that reaches the newborn baby. In addition, the Committee held a workshop on the metabolism of bilirubin, photosensitizing reactions, the photodynamic aspects of light, the bioengineering aspects of phototherapy, and the clinical use of phototherapy. An interim report will be published in one of the pediatric journals. The Committee expects to complete its study in May 1974.

U.S.A. NATIONAL COMMITTEE FOR IBRO

In December 1971, the Governing Board of the National Academy of Sciences authorized the Academy to adhere to the International Brain Research Organization (IBRO) and to establish the U.S.A. National Committee for IBRO in the Division of Medical Sciences. The purpose of the National Committee is to effect appropriate U.S. participation in IBRO through the Academy and to advise the President of the Academy on international matters relevant to neuroscience. On the national level, the National Committee is expected to seek its own funding and to cooperate in obtaining IBRO fellowships and placements in the United States. On the international level, the National Committee serves as a channel to professional groups whose interests are in brain and behavior and tries to facilitate the use of special foreign currencies for exchange agreements between the NAS and its counterparts in other countries.

U.S.A. NATIONAL COMMITTEE ON THE INTERNATIONAL UNION AGAINST CANCER

Authorization was obtained from the Governing Board to conduct a travel-grant program to benefit American scientists who will need assistance to attend the XI International Cancer Congress to be held in Florence, Italy, in October 1974. The grant program was announced in appropriate journals

and a selection panel of five members of the National Committee will act on applications early in 1974.

Nine cancer research and educational institutes and societies are Full Members of the Union and their representatives make up the membership of the National Committee plus two representatives from the National Cancer Institute.

U.S.A. NATIONAL COMMITTEE FOR THE INTERNATIONAL COUNCIL OF SOCIETIES OF PATHOLOGY

The U.S.A. National Committee was established to coordinate the activities of the five U.S. pathology societies that adhere to the International Council for the International Council of Societies of Pathology (ICSP). ICSP was established at the request of the World Health Organization (WHO) in 1962 to assist the WHO in selecting appropriate locations for International Reference Centers for the Histologic Typing of Tumors and to advise on qualified personnel for the Cooperating Centers in an effort to promote worldwide standardization of tumor nomenclature.

Limitations of funds at WHO have threatened the productivity of the IRC program in recent years. The U.S.A. National Committee, however, was instrumental in obtaining additional support for the program from the National Cancer Institute, as a result of which the IRC program is making remarkable and rapid progress. Five new IRC's—on liver/biliary/pancreas/endocrine tumors began work in 1972-1973.

The National Committee also distributes in the United States the publications of the IRC's, each of which contains the nomenclature and classification agreed upon by the IRC and its Cooperating Center, definitions and explanatory notes, and photomicrographs. Selected histologic sections covering each classification are distributed to national societies adhering to the ICSP to serve as reference sets and for teaching purposes. Seven of these sets are now on sale—on lung tumors, breast tumors, soft tissue tumors, oropharyngeal tumors, odontogenic tumors, bone tumors, and tumors of the salivary glands.

U.S.A. NATIONAL COMMITTEE FOR THE INTERNATIONAL UNION OF PHYSIOLOGICAL SCIENCES

Authorization was obtained from the Governing Board to conduct a travel-grant program to benefit American scientists who will need assistance to attend the XXVI IUPS Congress, to be held in New Delhi, India, in October 1974. The grant program was announced and a selection panel of four members of the National Committee will act on applications early in 1974.

The organization adhering to IUPS in India is the Association of Physiologists and Pharmacologists, which has more than 600 members from the faculties of all the medical schools in India. In addition to the adher-

ing members of IUPS, 45 nonmember countries have been contacted and special invitations have gone to specific persons in the People's Republic of China.

DIVISION OF PHYSICAL SCIENCES

COMMITTEE ON LINE SPECTRA OF THE ELEMENTS

Support of spectroscopic research and manpower requirements in spectroscopy depend strongly on the demand for spectroscopic data and the uses to which they are put. The Committee is conducting a questionnaire survey to determine the support of spectroscopic research, the size of the programs, and who uses spectroscopic data—what kind, in what form, and how often. On the basis of the survey, the Committee will address the questions of support for future research in spectroscopy and the number of young spectroscopists that may be required. This will provide the management of the National Standard Reference Data System with needed information on the relative importance of spectroscopic reference data compilations and their usefulness in science and industry.

COMMITTEE ON NUCLEAR SCIENCE

The Committee, its Subcommittees on Radiobiology, Radiochemistry, and Radioactivity Standards, and its *ad hoc* panels respond to requests from government agencies for information and assistance, conduct survey studies, sponsor conferences, and produce monographs and reports.

Subcommittee on Radiobiology and Ad Hoc Panel on Low-Level Radiation Exposure

During the past year, the Subcommittee planned for an assessment of research needs in the field of low-dose radiation exposure. The Subcommittee is also working on reports on the users of accelerators in radiation therapy and on nuclear medicine. Following the Subcommittee's assessment, an *ad hoc* Panel on Low-Dose Radiation Exposure was formed to evaluate the adequacy of current investigative approaches, to identify approaches that are promising and those that are not, and to assess the extent to which our knowledge about the degree of effects of low-level exposure in human beings is likely to be improved and in what time frame.

Subcommittee on Radiochemistry

The revisions of the monographs in the Radiochemistry of the Elements series is proceeding on schedule. Approximately 18 of the authors of the original monographs are participating in the revision program. Seven revised monographs have been accepted and will appear in a new title in the series as a collection of revised procedures. It is planned to cover 7–10 elements in each annual supplement to the Radiochemistry Series. A monograph entitled "Neutron Activation Technique for the Measurement of

Trace Metals and Marine Environment" has been submitted for publication in the Radiochemical Techniques Series. Monographs are being prepared on low-level counting and soil sampling in the environment. A panel of the Subcommittee, in cooperation with the Division of Nuclear Chemistry, American Chemical Society, is attempting to ascertain the future need for radiochemists by means of a postcard survey directed to 490 approved chemistry departments.

Subcommittee on Radioactivity Standards

In cooperation with the Subcommittee on Radiochemistry, the Subcommittee has prepared a new and significantly expanded "Users Guide" to the use of standards and associated counting problems. This document will be issued in September 1973. The Subcommittee is currently working to expand work at the National Bureau of Standards, to standardize commercial standard preparations, and to provide relatively simple decay schemes for nucleii of interest to, for example, health physicists.

Ad Hoc Panel on Nuclear Data Compilations

This Panel is overseeing and administering a three-year program to bring nuclear data compilations up to date by October 1974.

Ad Hoc Panel on Heavy-Ion Sources

The Panel is reviewing the present state of ion-source research and development in the United States and abroad and will relate its findings to perceived needs for ion-source performance and for the understanding of ion sources and then will seek to identify the areas of research that should receive priority.

Ad Hoc Panel on Heavy-Ion Facilities

This Panel will review heavy-ion research programs considering all relevant existing facilities and will attempt to determine quantitatively the scientific need for improving existing facilities or establishing new heavy-ion accelerator facilities. The Panel will also evaluate accelerator technology applicable for heavy-ion acceleration.

Statistical Panel on Manpower and Education

The Panel will deal with such questions as: How has the population in nuclear science changed since 1969? During the same period what migration has occurred into—and from—the field? What projected manpower needs can be expected in nuclear science in the next five years? Will adequate manpower be available to staff emerging institutions? One of the difficult problems is the extent to which applied nuclear science can be covered, including specifically medicine and isotope utilization and, more generally, technology and power.

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Ad Hoc Panels Resulting From Findings of the Physics Survey

Three statistical panels were formed following the publication of the report, *Physics in Perspective,* and the Survey panel reports (see page 36). The Statistical Panel on Nuclear Facilities was established to expand the data base on nuclear facilities to include the interests of nuclear chemists and others, including foreign installations, and to develop information concerning running costs, with the hope of establishing some kind of canonical fraction of the total operating support available to each installation.

The Statistical Panel on Publications was established because the Physics Survey found that relatively little in the way of hard fact is available regarding the distribution of research papers over subfields of physics, nations, and institutions.

The Statistical Panel on Funding and Level of Effort will maintain statistical information on funding and level of effort, in terms of scientific man-years in the nuclear sciences, building upon information collected during the Physics Survey.

COMMITTEE ON RADIO FREQUENCIES

This Committee serves as a means of coordinating the knowledge and views of the U.S. scientific and engineering communities regarding the radio frequencies needed for research. The Committee works actively with the U.S. Government in securing these frequencies, and works with the ICSU Inter-Union Commission of Frequency Allocations for Radio Astronomy and Space Science and other interested international organizations. A current list is maintained of U.S. Radio Astronomy Observatories, and the Committee staff assists the radio-astronomy observatories in registering their radio frequencies with the Federal Communication Commission. *A 1973 List of Radio and Radar Astronomy Observatories* was compiled and distributed to radio astronomers and radio-astronomy observatories.

Subcommittee on Radio Astronomy

The Subcommittee is concerned about the possible interference by broadcasting satellites in the 2500–2690 MHz band to radio-astronomy observations in the 2690–2700 MHz band. Tests with transmissions in these bands from ATS satellites are being arranged to determine what measures can be taken to protect radio-astronomy observations.

Subcommittee on Earth and Life Sciences

Plans for the utilization of the HF radio-frequency bands for the collection of ocean data are proceeding satisfactorily. A proposal was prepared and submitted to the FCC requesting changes in their rules and regulations to permit transmissions in the region of 150 MHz for tracking and telemetry of scientific data.

SOLID STATE SCIENCES COMMITTEE

At an October 1972 meeting of the Committee and its Advisory Panel, presentations were made on some of the basic scientific problems of certain important fields of energy conversion research, e.g., superconducting electric generators, liquid fast breeder reactors, and new batteries. The objective was to improve communications between energy researchers and solid-state researchers. The Committee is planning a study that will explore how recent advances in surface science can be brought to bear most effectively on catalytic problems of technological and societal urgency and will examine by what methods liaison between research in catalysis and research on "simple" systems can be improved.

PHYSICS SURVEY COMMITTEE

The report of the Committee's two-year study, *Physics in Perspective,* was published in the early fall of 1972 (see page 36).

COMMITTEE ON ATMOSPHERIC SCIENCES

The Committee's Panel on Weather and Climate Modification completed its report, *Weather and Climate Modification* (see page 5), which was issued in December 1972.

A study on atmospheric chemistry is nearing completion. The Panel on Atmospheric Chemistry is examining the natural and artificial gaseous and particulate constituents in the stratosphere and troposphere and the means to a better understanding of the role of the dynamics and chemistry of the atmosphere in the source, transport, transformation, and sinks of such constituents. In addition, the Panel is reviewing the status of training and manpower, measurements, and facilities and the role that the field of atmospheric chemistry has in prescribing programs that will contribute to our knowledge of how man's activities may be having a significant impact on the weather and climate. The Panel has identified four areas that require immediate and continuing research: urban air quality, climatic variation, stratospheric composition, and migration and fate of atmospheric trace constituents. As the study progresses, the relative priority of the several topics may change. The Panel expectes to complete its report by December 1973.

The Committee has also assumed the task of the former Science and Engineering Committee Advisory to NOAA in advising NOAA on its long-range predictions and research plans.

U.S. COMMITTEE FOR THE GLOBAL ATMOSPHERIC RESEARCH PROGRAM

The Global Atmospheric Research Program (GARP) is an international scientific and technical program to increase understanding of the general

circulation of the atmosphere, to develop a physical and mathematical basis for extended prediction, and to elucidate the basis for climate and climatic variations. A major scientific program identified early in the deliberations of the U.S. National Committee was the requirement to study the interaction of convection and synoptic scales of motion. Basic plans for a GARP Atlantic Tropical Experiment (GATE) were developed internationally, and the Committee established a GATE Advisory Panel to deal with the specific problems in the component scientific and technical areas.

The GATE Advisory Panel recently reviewed the activities of the GATE Project Office of NOAA and is assisting the Project Office in developing final plans for U.S. participation in GATE during 1974.

During the past year, a study of the requirements for clear-air turbulence research as part of the national GARP program was completed by the Clear Air Turbulence Panel. The review urged full government cooperation in providing suitable aircraft to assist in a winter-time program to determine the dynamics and mechanics of the wave momentum flux over the Rocky Mountains. The Panel also sought assistance from NASA and the Department of Defense in providing informatoin that could be used for statistical studies of atmospheric turbulence. A report transmitted to the government in September 1972, *Plan for U.S. Clear-Air Turbulence Research in the Global Atmospheric Research Program,* describes the problem and research needs.

Other Committee and panel activities during the year included a review of the data analysis, processing, cataloging, and archiving efforts of the BOMEX Analysis Program; an examination of the scientific problems and data requirements for the study of climatic change and the theory of modeling climate; a review of international plans outlining the scientific objectives and requirements for global data to be collected during the First GARP Global Experiment in 1977; and discussions of the nature of physical processes in oceanic and polar regions with the Ocean Science Committee (Division of Earth Sciences) and the Committee on Polar Research. These Committees have undertaken activities that will lead to substantial contributions to the GARP.

The U.S. National Committee for GARP sponsors a special GARP Topics series in the Bulletin of the *American Meteorological Society* to keep the scientific community informed of national and international activities and scientific problems being dealt with by GARP.

GEOPHYSICS RESEARCH BOARD

See page 59.

COMMITTEE ON POLAR RESEARCH

The Committee advises the Office of Polar Programs, National Science Foundation, on U.S. research programs in polar regions and represents the Academy in the Scientific Committee on Antarctic Research (SCAR) of the International Council of Scientific Unions (ICSU).

The XII SCAR Plenary Session and associated meetings were held in Canberra, Australia, in August 1972. The delegates prepared statements on man's impact on the Antarctic environment; use of radio isotopes in the Antarctic; data handling; and the conservation of flora and fauna. The statements will be considered at the VII Antarctic Treaty Consultative Meeting in New Zealand in the fall. SCAR accepted an invitation to hold its XIII meeting in the United States in 1974, along with its Third Symposium on Antarctic Biology. SCAR has also been invited to hold its Third Symposium on Antarctic Geology and Solid Earth Geophysics at the University of Wisconsin in 1976.

Reports were completed by the Committee's Panels on Glaciology, Upper Amosphere Physics, Geology and Solid Earth Geophysics, and Unmanned Geophysical Observatory. The Ross Ice Shelf Project Steering Group completed its task and was disbanded. The Polar Cores Study was completed and transmitted to the NSF Office of Polar Programs.

Other panel activities included a review by the Panel on Biological and Medical Sciences of biological and medical research and international collaboration, which was discussed at the XII SCAR meetings; and preliminary plans for the Third SCAR Symposium on Antarctic Biology. The Panel on Glaciology reviewed the status of glaciology programs—Greenland Ice Sheet Project, Arctic Ice Dynamics Joint Experiment, International Antarctic Glaciology Program, Polar Experiment, Dry Valley Drilling Project Program, and Glaciology of the Antarctic Peninsula. The Panel on Glaciology also reviewed plans for the International Conference on Permafrost, Yakutsk, USSR, and reviewed the report of the Interagency Arctic Research Coordinating Committee.

SPACE SCIENCE BOARD

The Board met several times during the year to consider major thrusts in space science in the 1980's, flight programs in astronomy, planning for a special study on Scientific uses of the Space Shuttle, cooperative experiments for the joint U.S.-USSR manned space mission in 1975, biological effects of high-energy heavy ions, and maintenance of a viable and balanced program of space science in an era of budgetary constraints.

U.S. participation in the international magnetospheric study being planned by the International Council of Scientific Unions for 1976–1978 was the topic of a joint Space Science Board-Committee on Solar-Terrestrial Research study held in January 1973. The study's report, *International Magnetospheric Study: Guidelines for United States Participation,* was published by the Academy in the spring.

The Committee on Space Astronomy, established early in 1973, has begun a review of the NASA astronomy program, placing emphasis on plans for the restructured High-Energy Astronomy Observatories, the forthcoming Orbiting Solar Observatory, and the proposed Large Space Telescope.

The Committee on International Relations assists and advises the Board in its international activities, concentrated largely in U.S. participation in the international Committee on Space Research (COSPAR). Following the 1972 COSPAR Annual Plenary, a preliminary report of the meeting was completed and distributed. In preparation for the 1973 meeting the call for U.S. papers and meeting circulars was distributed, and an *ad hoc* panel of the Committee served as jury for U.S. papers and made recommendations to the COSPAR Program Committee for the May 1973 annual meeting in the Federal Republic of Germany.

The report of the Committee on Space Biology and Medicine's Radiobiological Advisory Panel, *HZE-Particle Effects in Manned Spacecraft,* was published in the spring of 1973. The Panel also conducted a review of NASA's radiobiology program and facilities. A review of NASA's programs in microbiology was carried out by the Committee on Space Biology and Medicine's Panel on Microbiological Problems of Manned Spacecraft. Both ground-based research programs and operational plans for Skylab were evaluated. A Panel on Renal and Metabolic Effects of Spaceflight was established in February 1973 to look into mechanisms responsible for physiological changes observed in previous spaceflight crews.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL ASTRONOMICAL UNION (USNC–IAU)

The 15th General Assembly of IAU will be held in August 1973 in Sydney, Australia, and an "Extraordinary" General Assembly is scheduled to be held in three cities in Poland in September. The USNC–IAU screened about 300 applications for membership in the IAU from U.S. astronomers or scientists in related fields, and submitted 200 nominations to the IAU. The Subcommittee on Nominations also reviewed proposed invitations to nonmembers to participate in either or both of the General Assemblies. Another *ad hoc* subcommittee reviewed some 150 applications for travel grants to participate in the General Assemblies, and made about 60 individual grants. Members and invitees were equally eligible for travel grants. The U.S. National Committee considered General Assembly agenda items, including IAU policies and proposed revisions thereof. The USNC–IAU and the Council of the American Astronomical Society have submitted a revised constitution for the USNC–IAU for approval by the National Academy of Sciences-National Research Council.

The Subcommittee on Inter-American Astronomy sponsors astronomical programs in South America, and provides guidance for a program of positive observations of Southern Hemisphere Reference Stars. The program is scheduled for completion by the end of 1973. Funds have been furnished by the National Science Foundation and the National Aeronautics and Space Administration in equal amounts and are administered by the

Academy to support the work of two Argentine observatories, La Plata and Felix Aguilar (University of Cuyo, San Juan), and to provide funds to the Yale-Columbia Southern Observatory for the logistic support of the U.S. Naval Observatory's field party on their site.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS (USNC–IUPAP)

The USNC–IUPAP assists in the preparations for the triennial IUPAP General Assemblies, helping to ensure appropriate U.S. participation in these and in the intervening specialized meetings of the IUPAP Executive Committee and IUPAP Commission. The Committee was responsible for organizing the XIV General Assembly of IUPAP, which was held at the National Academy of Sciences in Washington in September 1972. During that General Assembly, the USNC–IUPAP made recommendations for membership on the IUPAP Executive Committee and all IUPAP Commissions, with the result that there now is a U.S. member on the Executive Committee and each IUPAP Commission.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL COMMISSION FOR OPTICS (USNC–ICO)

During the year, the USNC–ICO was involved mainly with the Ninth General Assembly and Congress of the ICO, which was held in Santa Monica, California, in October 1972. The proceedings of the General Assembly are being published by the Academy and will be issued in February 1974.

U.S. NATIONAL COMMITTEE OF THE INTERNATIONAL UNION ON THEORETICAL AND APPLIED MECHANICS (IUTAM)

At the request of the U.S. National Committee, the Academy obtained limited funds for support of travel of qualified scientists to take part in the 13th General Assembly and International Congress of IUTAM, held in Moscow in August 1972. More than 40 scientists received grants under this program. The U.S. National Committee is preparing for the 7th U.S. National Congress of Applied Mechanics, to be held in June 1974 in Boulder, Colorado.

U.S. NATIONAL COMMITTEE FOR THE INTERNATIONAL UNION OF RADIO SCIENCE (USNC-URSI)

The USNC-URSI participated in the XVII General Assembly of URSI, held in Warsaw, Poland, in August 1972. The U.S. delegation numbered 150 out of a total of about 740 delegates from 30 countries.

ADVISORY COMMITTEE TO THE AIR FORCE SYSTEMS COMMAND

The Committee provides advice and guidance on scientific and technical questions of concern to the Command. Five reports were issued during the year. In August 1972, a summer study on the "Air Force and Space" was sponsored for the Scientific Advisory Board of the U.S. Air Force. A study has begun on advanced axial-flow compressor technology.

ARMY COUNTERMINE ADVISORY COMMITTEE

A series of technical essays on the basic phenomena contributing to the detection of concealed explosives has been written by several recognized authorities to define, where possible, the potential and the technical limitations researchers could expect to find. Reports are being prepared.

COMMITTEE ON BASIC RESEARCH ADVISORY TO THE U.S. ARMY RESEARCH OFFICE (ARO)

This is a joint Committee with the NRC Divisions of Chemistry and Chemical Technology, Earth Sciences, Engineering, Biology and Agriculture, Medical Sciences, Mathematical Sciences, and Physical Sciences.

The Committee evaluates the scientific merits of unclassified basic research proposals submitted to ARO in the fields of chemistry, engineering, environmental sciences, life sciences, metallurgy and ceramics, mathematics, and physics. From the inception of the ARO program on July 1, 1961, to June 30, 1973, the NRC Committee has received a total of 5,698 research proposals. During the 12-month period, July 1, 1972, to June 30, 1973, 309 proposals were received and evaluated, with the advice and assistance of approximately 1,200 referees.

COMMITTEE ON UNDERSEA WARFARE

Early in 1972, the Director of Antisubmarine Warfare and Tactical Electromagnetic Programs asked the Committee for advice on the research necessary to enhance the Navy's capability to defend the surface fleet. The Committee established a Panel on Countermeasures in Fleet Defense in May 1972. The Panel subsequently recommended a concentrated study, which was held from July 9 to August 17, 1973, at the Academy's summer study facility in Woods Hole, Massachusetts. The study was divided into eight working groups, covering acoustics, optics/air, electronics, mines and mine countermeasures, ships, defense, communications, and purposes.

MINE ADVISORY COMMITTEE

In March 1972, the Committee was requested by the Navy to conduct a detailed evaluation of the research and development effort—current and projected—in support of the Airborne Mine Countermeasures Program. The

study was conducted in two phases—programs being considered for support in the FY 1973 and FY 1974 budgets, and an evaluation of long-range requirements in the light of current and developing technology. The study report was transmitted to the Navy in August 1972.

CLIMATIC IMPACT COMMITTEE

See page 40.

EVALUATION PANELS FOR THE NATIONAL BUREAU OF STANDARDS

The scope of scientific disciplines covered by programs of the National Bureau of Standards is diverse and encompasses almost all fields of the physical sciences. Guided by an Executive Committee, 26 panels, with interests corresponding to the NBS scientific programs, identify major problem areas in the technical programs and draw attention to issues that are common to several organizational units that they believe are of sufficient importance to warrant being discussed with the Director of the Bureau.

OFFICE OF SCIENTIFIC PERSONNEL

POSTDOCTORAL ASSOCIATESHIP PROGRAMS

These programs provide to scientists and engineers opportunities for postdoctoral research in laboratories of participating organizations. Although the Associates largely choose their own research topics, their choice must be germane to the general objectives of the host laboratories. Through these programs, the Associates not only contribute to achieving the research goals of the laboratories, but also provide stimulation to the professional staffs of the laboratories. The Office of Scientific Personnel announces research opportunities available through the Associateship programs, receives applications, and arranges for their evaluation by panels of scientists and engineers appointed by the President of the Academy.

There are two types of programs, which differ primarily in the method of appointment of awardees. In the Postdoctoral Research Associateship Programs, awardees receive temporary Civil Service appointments; in the Resident Research Associateship Programs, the NRC makes appointments on behalf of participating federal organizations, and is administratively responsible for the Associates during their tenure. In both programs, awards are based on quality-ordered lists of applicants approved by the NRC panelists.

The participating federal agencies in the Postdoctoral Research Associateship Programs include the Agricultural Research Service, Bureau of Mines, National Bureau of Standards, Naval Bureau of Medicine and Surgery, Naval Ordnance Laboratory, Naval Undersea Center, Naval Weapons Center, and the U.S. Geological Survey. In fiscal year 1973, 172 of 312 applicants were recommended; 42 were appointed by these agencies.

Fiscal year 1973 appointments under the Resident Research Associateship Program were made on behalf of the Air Force Systems Command, Army Materials and Mechanics Research Center, Feltman Research Laboratory of the U.S. Army Munitions Command, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, Naval Research Laboratory, Ballistic Research Laboratories at Aberdeen Proving Ground, Smithsonian Astrophysical Observatory, and U.S. Army Natick Laboratories. Of 867 applications, 178 new appointments were made and 196 renewals.

FELLOWSHIP PROGRAMS

Fellowship Program of the National Science Foundation

In the Graduate Fellowship Program of the National Science Foundation (NSF), the Fellowship Office announces the competition, distributes application materials, processes applications, arranges for them to be evaluated by panels of scientists and engineers appointed by the President of the Academy, and reports the results of the evaluation to the NSF. NSF establishes the conditions for eligibility, makes the final awards upon the basis of recommendations of the NRC panels, and has cognizance of the activities of the Fellows during their tenures.

In the 1973 competition, 5,717 applications were submitted and were evaluated by 103 panelists. New awards based on the nominations by the panels were offered by NSF to 457 applicants in this competition, and all awards to previous awardees numbered 1,032, making a total of 1,489 possible awards.

Churchill Scholarships

Since 1964, the United States Churchill Foundation has offered graduate scholarships in science and engineering at the University of Cambridge, Churchill College, to candidates selected by an OSP panel from the nominees of a group of American universities and colleges. In recent years, the program has been funded at approximately 10 appointments a year, including a few renewals recommended by the College.

In FY 1973, the Churchill Foundation transmitted 38 applications to the NRC for evaluation. Twenty applications were approved and Churchill College appointed 8 applicants as Churchill Scholars.

National Aeronautics and Space Administration (NASA) International University Fellowships in Space Sciences

See page 52.

International Atomic Energy Agency Fellowships (IAEA) in Peaceful Uses of Nuclear Energy

See page 52.

Senior Fulbright-Hays Program

See page 52.

NATIONAL BOARD ON GRADUATE EDUCATION

The National Board on Graduate Education (NBGE) was established in 1971 by the Conference Board of Associated Research Councils to provide a means for an analysis of graduate education today and of its relation to American society in the future. The Office of Scientific Personnel provides an administrative home for the NBGE. Financial support during FY 1973 was provided by the Andrew W. Mellon Foundation, the Carnegie Corporation, the National Science Foundation, and the National Institute of General Medical Sciences. Support for research projects has been received from the Ford Foundation and the National Science Foundation (NSF).

At the request of the NSF, the Board has undertaken an evaluation of the NSF Science Development Program. During the period 1964 to 1972, this program granted $231 million to universities to improve their graduate science education and research. Among the questions the study will explore are: the impact of this institutional support program upon the quality of graduate departments, the effect of the emphasis upon geographic dispersion of the funds, impacts of this program upon non-recipient departments in funded institutions, and the long-range effects upon an institution when such major support programs are withdrawn.

The Ford Foundation has provided support to the Board for a study of the adjustments of the system of graduate schools to recent changes in its environment, such as decreased federal fellowships and traineeship support, rising financial pressures, changes in student enrollment patterns, and labor market difficulties. Statistical analysis of data pertaining to enrollments, faculty, and financial support of students is under way and will be complemented by a number of site visits. This study will be completed by early 1974.

The Board completed *An Annotated Bibliography on Graduate Education, 1971–1972,* which was distributed in October 1972.

BOARD ON HUMAN RESOURCES

The Board is concerned with educational issues at all levels—preschool, elementary, and secondary schooling—but emphasizes college and other forms of postsecondary education, including graduate and adult education. The Board is also concerned with the related issue of career development, and has been investigating how these questions pertain to particular subsectors of our population, such as women and racial and ethnic groups. Recurrent education is another issue of interest to the Board. Panels on the Benefits of Higher Education and on Factors in Career Development have been established to deal with these questions. A conference report, *Does College Matter?—Some Evidence on the Impacts of Higher Education,* was published by Academic Press in 1973.

The Board is planning to establish a third panel—on recurrent education, or lifelong learning—a concept that has gained acceptance in a number of European countries. The Board will study its relevance to the United States, where mass education is more of a reality.

The Board's staff has also begun a study of opportunities for male and female graduate students. The issue is one of defining sexual discrimination and developing data that will enable us to see whether or not it exists and, if so, in what form.

MANPOWER STUDIES

Doctorate Records File

The Doctorate Records File (DRF), one of the major sources of data for OSP manpower studies, is a computerized file of information resulting from the annual Survey of Earned Doctorates questionnaire. The Survey is conducted with the cooperation of the graduate deans, and forms are filled out by graduates as they complete all requirements for their research doctorates. The DRF operation is supported jointly by the National Science Foundation, the U.S. Office of Education, the National Endowment for the Humanities, and the National Institutes of Health.

In FY 1972, 33,001 persons received the earned doctorate in the United States, an annual increase of 3.6% over FY 1971. The increase contrasts with the 8% increase in FY 1971 and 14.6% in FY 1970. Preliminary estimates for FY 1973 indicate that the increase may about equal the increase from 1971 to 1972. For the first time, racial and ethnic identification was asked for on the Doctorate Survey form. Data from this survey should be available early in 1974. In the meantime, an informal data booklet on women Ph.D.s was prepared and distributed, upon request, to a large number of universities and other groups concerned with equal opportunities in employment.

The sixth annual *Summary Report,* presenting data on the 1972 doctorate recipients, was distributed to the graduate deans of doctorate-granting universities, federal agencies, and other organizations and individuals. A more comprehensive book, covering a century of doctoral education in the United States, is being planned.

Study of NIGMS Postdoctorals

This three-year study was completed and the final report was sent to the National Institute of General Medical Sciences near the end of FY 1973. The project consisted of a follow-up of about 4,300 post-Ph.D.s and an almost equal number of post-M.D.s who had been supported by the NIGMS via fellowships and traineeships in the period 1958–1970. The career patterns and career achievements of awardee groups were compared with those of groups from the same graduation cohorts who had not had postdoctoral training.

Study of the Effect of NIH Training Programs on the Career Patterns of Bioscientists

A detailed research plan was developed during the year that divides the study into three basic tasks: (1) To identify those who were trained under these programs and to describe this population of individuals at the time of training; (2) To compile career information, including employer, work activity, achievements, productivity, and fields of specialization; and (3) To collect information about how the training programs have affected the career patterns and consequently how effective they have been in accomplishing their goals.

Comprehensive Roster of Doctoral Scientists and Engineers

At the request of the National Science Foundation, a comprehensive roster of some 275,000 doctoral scientists (including social scientists) and engineers was assembled from the Doctorate Records File, the National Register of Scientific and Technical Personnel, *American Men and Women of Science,* college catalogues, and other sources. Individuals who have earned doctorates either from foreign institutions or in non-science-related fields but were employed in science in the United States were included on this roster along with all U.S. science doctorate-holders. A preliminary report is planned for late 1973; a more extensive report will be forthcoming later, based on analyses to be made during 1974.

MINORITY-GROUP PROJECTS

The Office of Scientific Personnel completed a project to develop a roster of minority-group (Black Americans, Spanish-speaking Americans, and American Indians) scientists and engineers. This project was supported by the NAS Program Initiatives Fund. Its purpose was to obtain nominations of minority-group members who might be considered for appointment to panels, committees, and boards of the NRC. The information, which was obtained in a questionnaire survey, has been computerized and is available for consideration by NRC offices when new committee appointments are made.

APPENDIX I

THE NATIONAL ACADEMY OF SCIENCES

AUTUMN MEETING 1972

The 106th Autumn Meeting of the National Academy of Sciences was held in Washington, D.C. on October 16, 17, and 18, 1972. One hundred and five members, one member emeritus, and one foreign associate registered during the meeting as follows:

Alberty, Robert A.
Alvarez, Luis W.
Ames, Bruce N.
Anfinsen, C. B.
Astin, Allen V.
Axelrod, Julius
Bacher, Robert F.
Baker, W. O.
Baldeschwieler, John D.
Beams, J. W.
Bearn, Alexander G.
Bigeleisen, Jacob
Bisplinghoff, Raymond L.
Bloch, Konrad E.
Branscomb, Lewis M.
Brinkhous, Kenneth M.
Bronk, Detlev W.
Brown, Harrison
Burris, R. H.
Carmichael, Leonard
Clemence, G. M.
Cloud, Preston
Cohen, Philip P.
Cole, Kenneth S.
Collins, Samuel C.
Condon, E. U.
Crewe, Albert V.
David, E. E., Jr.
Dicke, Robert H.
Doell, Richard R.
Eagle, Harry
Eggan, Fred
Eilenberg, Samuel
Emery, K. O.
Festinger, Leon
Forbush, Scott E.
Fraenkel, Gottfried S.
Friedman, Herbert
Friedmann, Herbert
Garwin, Richard L.
Gibbon, John H., Jr.
Gilman, Henry
Goldberg, Leo
Goldhaber, Gertrude S.
Goldhaber, Maurice
Handler, Philip
Hardy, James D.
Haskins, Caryl P.
Haworth, Leland J.
Herzfeld, Karl F.
Hollaender, Alexander
Horsfall, James G.
Hubbert, M. King
Hunsaker, J. C.
Hutchinson, G. Evelyn
King, C. G.
Kistiakowsky, G. B.
Koelle, George B.
Kompfner, Rudolf
Kramer, Paul J.
Leaf, Alexander
Licklider, J. C. R.
Lindsley, Donald B.
Luce, R. Duncan
Lush, Jay L.
Luyten, Willem J.
Markert, Clement L.
Merrifield, Bruce
Miller, C. Phillip
Mulliken, Robert S.
Neel, James V.
Nolan, Thomas B.
Olson, Harry F.
Onsager, Lars
Panofsky, W. K. H.
Pierce, J. R.
Piore, E. R.
Ratliff, Floyd
Reichelderfer, F. W.
Richter, Curt P.
Riggs, Lorrin A.
Ripley, S. Dillon II
Schmitt, Francis O.
Shannon, James A.
Shockley, William
Shull, Harrison
Sinsheimer, Robert L.
Skoog, Folke
Stewart, T. D.
Szentágothai, János (Foreign Associate)
Teuber, H. L.
Thomas, Lewis
Turkevich, Anthony L.
Udenfriend, Sidney
Watson, Cecil James
Weber, Ernst
Wedel, Waldo R.
Went, F. W.
Wetmore, Alexander
Williams, Carroll M.
Willier, Benjamin H.
Wilson, Robert R.
Witkop, Bernhard
Woodring, Wendell P. (Member Emeritus)
Yoder, Hatten S., Jr.
Zwanzig, Robert
Zworykin, V. K.

BUSINESS SESSION

The Academy met in business session on Tuesday, October 17, 1972, President Handler presiding.

Committee on Election Procedures

Mr. Astin reminded the membership that when amendments to the Bylaws, which would have removed the requirement to vote on the preference lists of all classes, were defeated at the 1972 Annual Meeting, the membership had voted in favor of the appointment of a committee to study election procedures and to bring recommendations to the 1973 Annual Meeting. Such a committee, composed of the five class chairmen, John Rodgers, and Harrison Shull, with the Home Secretary serving ex officio, had been appointed and had met in July. The Committee had agreed unanimously that the present voting procedures should be retained. However, the Committee had proposed the circulation of a brief questionnaire with the next preference ballot to ascertain the extent of the opposition to voting outside the classes in which members are competent to judge the qualifications of nominees for membership. The Council had approved this procedure; therefore, questionnaires would be circulated with ballots and the results reported at the 1973 Annual Meeting.

The Committee had also proposed two Bylaw changes relating to Voluntary Nominating Groups: first, a change from January 31 to July 1 in the date for filing voluntary nominations; second, the addition of a phrase stipulating that at least six of the signators of any VNG petition must be from the class to which the nominee will be referred. These proposed changes had been referred to the Bylaws Committee.

The Committee thought it desirable to broaden the opportunities for suggestions for membership in the Academy. The Bylaws do not stipulate that nominations must be made by members. The suggestion was brought to the attention of the Council. The Council noted that nominations have been received from outside the Academy from time to time, that present procedures are consistent with the Bylaws, and that publicizing the fact that nominations from persons other than Academy members were acceptable was not advisable. The Council had no objection, however, to clarification of the relevant Bylaws, and the matter was referred to the Bylaws Committee.

TNG on Lunar and Planetary Sciences

The Home Secretary reported that a proposal for the establishment of a Temporary Nominating Group in Lunar and Planetary Sciences had been received and the Council had approved its creation for the 1974 elections, provided that the relevant Class and Sections responded favorably. Although three endorsements had been received, the Section of Geology had not felt that such a Group was necessary. Consequently, the proposal would be brought back to the C ouncil for further consideration.

Resignations and Refusals

The Home Secretary announced that one of the individuals elected to membership at the 1972 Annual Meeting, George Brooks Field, had declined to accept election for personal reasons.

He then reminded the membership that action on the resignation of Bruce Wallace had been deferred at the Annual Meeting. Since that time Mr. Wallace had reaffirmed his resignation; therefore, Mr. Astin moved that it be accepted with regret, and the membership so voted.

Shortly after the Annual Meeting Thomas Eisner had submitted his resignation. After discussion with Mr. Eisner during the past summer, Mr. Handler had again invited him to reconsider his action. Since no response had been received as yet, Mr. Astin suggested that action on this resignation be deferred.

Report of the Home Secretary

Committee on Bylaws

The Home Secretary announced that he had been requested to reactivate the Bylaws Committee. Paul Kramer (of Class II) is continuing as chairman, with the following members, one from each Class: Jacob Bigeleisen (Class I), Lewis M. Branscomb (Class III), Alexander Bearn (Class IV), and Fred Eggan (Class V). Several proposed changes had been referred to the Committee by the Council, and one pertaining to redefinition of emeritus status had been received from the membership. Prior to the 1973 Annual Meeting all proposed amendments would be circulated to the membership.

Age Structure of Membership

Mr. Astin reported that Rudolf Kompfner had revised the proposal, which he had presented at the Annual Meeting, for modification of the age structure of the Academy. The revised version had been submitted to the Council. Other members had also made known their concern about getting younger people elected to membership. At its August 1971 meeting, the Council had adopted a resolution urging Sections to give particular attention to the nomination of younger individuals; however, there had been no apparent impact on 1972 elections. The Council had agreed at its October 1972 meeting that a Committee should be established to study and recommend procedures, such as those suggested by Mr. Kompfner, for effecting a modification of the age structure of the Academy. Mr. Bernhard Witkop inquired about the membership of this Council Subcommittee, indicating that members might wish to present suggestions to them. Mr. Handler stated that he would provide this information in the next Letter to Members.

1973 Annual Meeting Plans

The Home Secretary announced that the Academy was cooperating with the Smithsonian Institution in the planning of a celebration of the 500th anniversary of the birth of Copernicus at the time of the 1973 Annual Meet-

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ing. Several symposia were being planned by the joint NAS-Smithsonian Committee on the Copernican Celebration. These symposia would be held on Monday, Tuesday, and Wednesday afternoons of the Annual Meeting and on Thursday, with Business Sessions taking place on Monday, Tuesday, and Wednesday mornings. A commemorative volume was also being prepared.

Mr. Handler further announced that a musical composition had been commissioned by the Academy and would be performed on the Sunday evening prior to the Annual Meeting as part of a larger musical program. In addition, he described the role played by the Academy in securing the allocation of PL 480 funds for construction of an Astronomical Center in Poland.

Mr. Goldhaber remarked on a conflict of the Annual Meeting with the meeting of the American Physical Society, and Mr. Handler noted a potential conflict with that of the American Philosophical Society, if the Annual Meeting dates were moved forward.

Report of the Foreign Secretary

The Foreign Secretary indicated that the most important single development he would report was the signing of the charter of the International Institute for Applied Systems Analysis. Mr. Howard Raiffa had been appointed Director and a site in Vienna had been agreed on. The NAS Foreign Secretary is to serve as Academy representative on the Council of the Institute and would also chair the Finance Committee.

Mr. Brown next discussed briefly the ICSU General Assembly, which he had attended in Helsinki in September, and the recommendations made to ICSU by the ICSU Committee on the Free Circulation of Scientists in regard to the plight of Soviet scientists.

Other topics briefly described by the Foreign Secretary included the IUPAP General Assembly held for the first time in the United States at the Academy, the visit of a delegation of Chinese medical scientists to the United States, and a planned meeting of representatives of major Western Academies to discuss cooperative projects and common problems, including those related to the free circulation of scientists. The meeting would take place in Italy in early spring.

In response to a question from Philip P. Cohen, Mr. Brown mentioned some of the bilateral programs in which his office was participating in Latin America, specifically projects in Colombia, Brazil, Peru, Argentina, and Central America. He suggested that anyone desiring more detailed information on programs in which the NAS Office of the Foreign Secretary was engaged should write to him.

Mr. Kompfner raised a question about the origin of the International Institute for Applied Systems Analysis, and Mr. Handler summarized the

five and one half years of planning and negotiation that had been necessary to bring this project to fruition.

Report of the Treasurer

Mr. Piore stated that the report on Fiscal Year 1972 would be mailed to the membership in late December. The annual budget for NAS–NRC amounted to $36.6 million, a ten percent increase over the previous fiscal year. Endowment investments had increased in value by about 20 percent during the past fiscal year.

He further indicated that the NAS was custodian of $4.7 million provided by the Atomic Energy Commission to cover termination pay obligations to Japanese employees of the Atomic Bomb Casualty Commission.

Mr. James G. Horsfall inquired whether the ABCC was being terminated, and Mr. Handler explained that it was not. There being no pension plan in Japan, the aforementioned funds were needed to meet the obligations of the severance pay plan followed by ABCC.

Mr. J. C. Hunsaker inquired about the funding of certain NAE projects and Mr. Piore indicated that the NAE received funds from the government agencies for which it conducted studies and had also small private funds.

Mr. Bigeleisen suggested that capital gains received on the investment of endowment income might be applied to the initiation of NAS studies. Mr. Piore indicated that the current ten to twelve percent return on investments, which Morgan Guaranty Trust Company had been instructed to seek, had been sufficient to meet Academy obligations without drawing on the endowment. He and Mr. Handler agreed that Mr. Bigeleisen's suggestion was a potential option.

Report of the President

Mr. Handler began his informal report with a brief discussion of the NRC reorganization. He reviewed the Assembly and Commission concepts, indicating that it had appeared advisable to reduce the number of Commissions from twelve to four, which would be concerned with Natural Resources, Human Resources, Social Technologies, and Peace and National Security. There would also be an Office or Commission on International Relations. The Council had endorsed the concept of a Commission on Natural Resources. It had hoped that two Commissions could be organized by the end of the fiscal year, with two more the following year. The Assemblies would then be established.

The President commented next on the increasing involvement of the federal government in regulatory activities and the implication of this concern for Academy activities and their management. He called particular attention to legislation of interest to the Academy, including the

Water Quality Control Act of 1972, the Act to Establish an Office of Technology Assessment, the National Science Policy and Priorities Act, and the Federal Advisory Committee Act, which superseded Executive Order 11671. Discussion of the latter bill on the floor of the House indicated that its provisions did not apply to Academy Committees.

Mr. Handler then described the Resident Staff Fellowship Program that the Academy had established under a grant from the Sloan Foundation and indicated that applications were being received and that the initial appointments probably would be made early in 1973.

The concern of the Council with a more constructive response to the issues raised at recent Annual and Autumn Meetings by Mr. Shockley had led to a small *ad hoc* planning effort, under the auspices of the Division of Behavioral Sciences, to organize a series of seminars on Human Behavioral Genetics. The objective would be to explore the state of the art in this field and make recommendations on any appropriate and constructive action the Academy might take.

In conclusion, the President described the interaction of the Council with M. V. Keldysh and the Russian delegation at a special meeting on the previous day. At this time, in the context of a discussion of areas of inter-Academy cooperation, the NAS Council had made known the acute and widespread concern of U.S. scientists in regard to Soviet restrictions on the freedom of scientists seeking to emigrate. It was Mr. Handler's impression that their views had been clearly and adequately communicated and "that the message would indeed go home."

Cloud Resolution

Mr. Preston Cloud, having informed the President that he wished to present a resolution to the membership, was recognized and read his resolution concerning a requirement, under consideration by the California State Board of Education, that all public-school science textbooks give parallel treatment to the theory of evolution and to special creation.

Mr. Cloud moved the approval of the resolution and the motion was seconded. Mr. Horsfall stated that in his opinion the Academy was overstepping itself, that the matter was the concern of the people of California. Mr. Philip P. Cohen then suggested that the resolution might be reframed so that it was not addressed specifically to the California State Board of Education and that it would probably be acceptable if thus modified.

A vote having being called for, the President asked for a show of hands. The President then asked whether any of those who had voted against the resolution would have approved it had it been reframed in more general terms and had it not been addressed specifically to the California State Board of Education. An informal show of hands indicated that most of those opposed would indeed have found the resolution acceptable had this been the case. Mr. Cloud indicated his willingness to make such changes if this

procedure would not delay transmission of the resolution. The membership voted in favor of the following wording of the resolution:

> Whereas we understand that the California State Board of Education is considering a requirement that textbooks for use in the public schools give parallel treatment to the theory of evolution and to belief in special creation; and
>
> Whereas the essential procedural foundations of science exclude appeal to supernatural causes as a concept not susceptible to validation by objective criteria; and
>
> Whereas religion and science are, therefore, separate and mutually exclusive realms of human thought whose presentation in the same context leads to misunderstanding of both scientific theory and religious belief; and
>
> Whereas, further, the proposed action would almost certainly impair the proper segregation of the teaching and understanding of science and religion nationwide, therefore
>
> We, the members of the National Academy of Sciences, assembled at the Autumn 1972 meeting, urge that textbooks of the sciences, utilized in the public schools of the nation, be limited to the exposition of scientific matter.

Shockley Resolution

The President then recognized Mr. Shockley who stated that he had a resolution to present and read the following:

PROPOSED RESOLUTION REGARDING THE EIGHTY PERCENT GENETICITY ESTIMATE FOR CAUCASIAN IQ

Since 1966, Dr. Shockley has maintained that the National Academy of Sciences has responsibility inherent in the charter granted to it by Abraham Lincoln to evaluate and express quantitative facts on the behavioral traits of the human species. This proposed resolution concerns a cornerstone statement relevant to these biological facts. A version of this statement was proposed by Dr. Shockley in a paper read before the National Academy of Sciences in October 1966. It was subsequently transmitted in inquiries made to the Academy by two representatives in Congress in 1969. The responses did not give a definitive evaluation. It was an item discussed obliquely in the Davis Committee Report approved at the Annual Meeting of the Academy in 1971. At that meeting, in an evaluation of the Davis Report, Dr. Shockley requested permission to show a lantern slide on which he based his estimate of significance level at 1 part in 2000 as discussed in the resolution below. The permission was not granted. At the Fall Meeting of the Academy in 1971, Dr. Shockley presented the reasoning in a contributed paper. At the business meeting he proposed a similar resolution that was tabled. Dr. Shockley's position in regard to the Academy's position on these matters has been published in the Congressional Record of 20 Dec 69 as follows: "I regard the Academy's position as being the most serious and obvious dereliction of intellectual responsibility in the history of science."

Dr. Shockley plans to introduce a reworded version of the resolution at the business session of the National Academy of Sciences at the Spring Meeting of the National Academy of Sciences, 23–26 Apr 72. This resolution, that *does not bear on the emotionally-loaded racial issues involved in such questions as "busing"*, is as follows:

> Whereas, estimates of the level of significance by Academy member Shockley (See Proc., N.A.S., *68*, 2889a (1971), Phi Delta KAPPAN, Jan 72, pp. 297–312; and Phi Delta KAPPAN, Mar. 72, pp. 415–419.) lead to the conclusion that,

if environmental influences on IQ variance were as large as 30%, then there is only one chance in 2000 that the tabulation by A. R. Jensen of the IQs for 244 separately reared white identical twins, compiled from four independent studies from England, Denmark and the United States, would have been deceptive by pure chance effects so as to mislead erroneously to an observed value of geneticity of more than 80% leaving less than 15% for environmental effects and

Whereas, the report of the Ad Hoc Committee on Genetic Factors in Human Performance (Proc., N.A.S. *69,* (1972)) states that *all that can be said* is that with respect to some human quality problems genetic factors are highly important while with respect to others, they are unimportant and thus does not suggest that the important behavioral trait of IQ is ever dominated by genes; therefore, it is

Resolved, That the Council (of the National Academy of Sciences) be requested to arrange for a review of the significance level calculations and to issue an appropirate statement to resolve the related environment-heredity uncertainty.

Mr. Shockley asserted that he believed it appropriate for the NAS to undertake the indicated study, that the topic was relevant to national problems, that the conclusion to which the resolution points was not agreed on by the psychological community, and that the present resolution was directed toward a definable problem in mathematical statistics that could be readily addressed. He therefore moved the adoption of the resolution.

Mr. Shull indicated that he had a substitute resolution that he would like to present but that he did not wish to prevent discussion of Mr. Shockley's resolution.

Mr. Bigeleisen then referred to the seminars in Human Behavioral Genetics that were being organized in response to a request from Council and which the President had described in his report. In view of this current effort, Mr. Bigeleisen moved that the resolution be tabled pending the outcome of the seminar project. The membership voted in favor of the motion.

The President inquired whether Mr. Shull still wished to present his resolution, and Mr. Shull stated that he did not think it necessary at this time.

Plight of Soviet Scientists

Mr. C. B. Anfinsen expressed his disappointment at not being allowed to address a series of questions concerning the plight of Soviet scientists to Mr. Keldysh following the latter's presentation. He asked for suggestions as to appropriate action one might take to exert continuing pressure on the Russians. Mr. Bigeleisen stated that his Section was considering preparation of a statement addressed to Keldysh protesting the situation. Mr. E. U. Condon said that he would have liked to see the NAS take a firm position but recognized the obligation of the President to spare his guests embarrassment. Messrs. Piore and Handler recapitulated events of the meeting of the Council with the Russian delegation and assured the membership that pressure had been exerted. Mr. Anfinsen indicated that he had given Mr. Keldysh a copy of the questions he had hoped to ask.

Report Review Committee

The Vice President explained the advisory role of the Report Review Committee and its efforts to function effectively and constructively and at the same time to avoid becoming a censor. He also referred to an increasing trend among the public and its representatives in government toward protection of the individual. The conflict between individual rights and interests and large corporate rights and interests was receiving growing attention.

He concluded his remarks by stating that the Report Review Committee had prepared a set of recommendations for consideration by the Council that would relieve the President from the entire responsibility for the final decision on those very few reports on which authors and reviewers could not reach agreement.

ACADEMY RECEPTION

On the evening of October 16, a reception for Academy members and guests was held in the Great Hall of the Academy, hosted by President and Mrs. Handler.

SCIENTIFIC PROGRAM

The scientific sessions, all of which were open to the public, were held in the Academy's Auditorium and Lecture Room beginning on October 16 and continuing through October 18 as follows:

Monday, October 16

(Auditorium)

PLANT GROWTH REGULATION

R. H. BURRIS, *Chairman*, University of Wisconsin, Madison, Wisconsin

ISRAEL ZELITCH, Connecticut Agricultural Experiment Station, New Haven, Connecticut: *Plant Productivity and the Control of Photorespiration.*

FRITS W. WENT, Desert Research Institute, University of Nevada, Reno, Nevada: *Competition Among Plants.*

STANLEY P. BURG, University of Miami, Miami, Florida: *Ethylene in Plant Growth.*

PETER CARLSON, Brookhaven National Laboratory, Upton, New York: *Culturing of Protoplasts and Somatic Hybridization.*

LEON DURE III, University of Georgia, Athens, Georgia: *Abscissic Acid—Germination and Dormancy.*

(Lecture Room)

INSTRUMENTATION AND MEASUREMENTS IN THE PROGRESS OF SCIENCE

LEWIS M. BRANSCOMB, *Chairman,* International Business Machines Corporation, Armonk, New York: *Introduction.*

IRWIN I. SHAPIRO, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Difference Techniques in Radio and Radar Astronomy.*

ALBERT V. CREWE, Fermi Institute for Nuclear Studies, University of Chicago, Chicago, Illinois: *The Future of Single Atom Microscopy.*

PETER L. BENDER, Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado: *Applications of Lasers in Geophysics.*

CONTRIBUTED PAPERS

(Room 150)

W. SHOCKLEY, Stanford University, Stanford, California: *Mathematical Models for Assortative Mating in American Negro Populations Resulting in Correlation Between Fractions of Caucasian Ancestry.*

MAN-LI S. YEW, Clayton Foundation Biochemical Institute, University of Texas, Austin, Texas (Introduced by Roger J. Williams): *"Recommended Daily Allowances" for Vitamin C (Ascorbic Acid).*

(Auditorium)

THE DEVELOPMENT OF BRAIN AND BEHAVIOR: CRITICAL PROCESSES

FRANCIS O. SCHMITT, *Chairman,* Neurosciences Research Program, Massachusetts Institute of Technology, Brookline, Massachusetts: *Introductory Remarks.*

RICHARD L. SIDMAN, Harvard Medical School, Boston, Massachusetts: *Cell Interaction in Brain Development*

FLOYD L. BLOOM, Laboratory of Neuropharmacology, NIMH, St. Elizabeth's Hospital, Washington, D.C.: *Chemical Communication Between Brain Cells.*

WILLIAM F. GANONG, University of California School of Medicine, San Francisco, California: *The Brain and the Internal Environment.*

HANS-LUKAS TEUBER, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Influence of Early Exposure on Brain Development.*

(Lecture Room)

THE NEW ACCELERATORS

MAURICE GOLDHABER, *Chariman,* Brookhaven National Laboratory, Upton, New York.

LOUIS ROSEN, Los Alamos Scientific Laboratory, Los Alamos, New Mexico: *The Los Alamos Meson Physics Facility (LAMPF).*

W. K. H. PANOFSKY, Stanford Linear Accelerator Center, Stanford, California: *Colliding Beams vs. Beams on Stationary Targets: Competing Tools for Elementary Particle Physics.*

KJELL JOHNSEN, European Organization for Nuclear Research, Geneva, Switzerland: *The CERN Intersecting Storage Rings (ISR).*

ROBERT RATHBUN WILSON, National Accelerator Laboratory, Batavia, Illinois: *The Batavia Accelerator.*

Wednesday, October 18

(Auditorium)

INSTITUTE OF MEDICINE NATIONAL HEALTH POLICY ISSUES

JOHN R. HOGNESS, *Chairman,* Institute of Medicine, Washington, D.C.: *The Institute of Medicine: Programs and Plans.*

LEWIS THOMAS, Yale University School of Medicine, New Haven, Connecticut: *The Place of Science and Technology in Medicine.*

AVEDIS DONABEDIAN, University of Michigan School of Public Health, Ann Arbor, Michigan: *Criteria for Evaluating Different Kinds of Health Service Organizations.*

JULIUS RICHMOND, Judge Baker Guidance Center, Boston, Massachusetts: *Policy Issues Related to the Financing of Education.*

(*Lecture Room*)

MODELING WITH THE AID OF DIGITAL COMPUTERS

LAWRENCE R. KLEIN, University of Pennsylvania, Philadelphia, Pennsylvania: *Computer-Based Models of the National Economy.*

ROBERT LANGRIDGE, Princeton University, Princeton, New Jersey: *Interactive Three-Dimensional Computer Graphics in Molecular Biology.*

EDWARD A. FEIGENBAUM, Stanford University, Stanford, California: *Computer Models of Cognitive Processes in Chemistry and Psychology.*

J. C. R. LICKLIDER, *Chairman,* Massachusetts Institute of Technology, Cambridge, Massachusetts: *Advances in Modelling Methods and Facilities.*

ANNUAL MEETING, 1973

The 110th Annual Meeting of the National Academy of Sciences was held in Washington, D.C., April 23–25, 1973. Three hundred and thirty-three members, one member emeritus, and four foreign associates registered during the meeting as follows:

Abbot, C. G.
Abelson, Philip H.
Adams, Robert McCormick
Alberty, Robert A.
Alder, Berni J.
Anderson, Herbert L.
Anderson, Philip W.
Anderson, Thomas F.
Anfinsen, C. B.
Astin, Allen V.
Axelrod, Julius
Babcock, Horace W.
Baker, James G.
Baker, W. O.
Baldeschwieler, John D.

Barghoorn, Elso S.
Barrett, C. S.
Barschall, Henry H.
Beams, J. W.
Bearn, Alexander G.
Bender, Myron L.
Berliner, Robert W.
Bigeleisen, Jacob
Billings, Marland P.
Bing, R. H.
Bloch, Konrad E.
Blout, Elkan R.
Bode, H. W.
Bodian, David
Boekelheide, V.
Bok, Bart J.
Bonner, James F.
Boyer, P. D.
Braidwood, Robert J.
Branscomb, Lewis M.
Brattain, Walter H.
Breit, Gregory
Breslow, Ronald
Brink, Frank, Jr.
Brink, R. Alexander
Brinkhous, Kenneth M.
Brode, Robert B.
Brode, Wallace R.
Bronk, Detlev W.
Brooks, Harvey
Brown, Harrison
Bueche, Arthur M.
Burke, Bernard F.
Cairns, T. L.
Carrier, George F.
Carter, H. E.
Chamberlain, Joseph W.
Chargaff, Erwin
Christy, Robert F.
Clemence, G. M.
Cloos, Ernst
Cloud, Preston
Cohen, Morris
Cohen, Philip P.
Cole, Kenneth S.
Coleman, James S.
Collins, Samuel C.
Colowick, Sidney P.
Condon, E. U.
Cool, Rodney L.
Cotton, F. Albert
Crane, H. R.
Crawford, Bryce, Jr.
Crewe, Albert V.
Cristol, S. J.
Crow, James F.
Curtin, David Y.
Darby, William J.
Dauben, William G.
Davis, Bernard D.
Davis, Kingsley
Dennison, David M.
Dicke, Robert H.
Djerassi, Carl
Doell, Richard R.
Dole, Vincent P.
Doty, Paul
Drickamer, Harry G.
DuBridge, L. A.
Duffin, R. J.
Duwez, Pol
Eagle, Harry
Ebert, James D.
Edelman, Gerald M.
Edsall, John T.
Eggan, Fred
Eilenberg, Samuel
Eliel, Ernest L.
Elsasser, Walter M.
Engel, Albert E. J.
Estes, William K.
Evans, Harold J.
Fairbank, William M.
Finland, Maxwell
Folkers, Karl
Forbush, Scott E.
Fowler, William A.
Fried, Josef
Friedman, Herbert
Friedmann, Herbert
Fuson, R. C.
Galambos, Robert
Gall, Joseph G.
Garner, Wendell R.
Garwin, Richard L.
Gates, Marshall
Gerard, R. W.
Giacconi, Riccardo
Gibson, Eleanor Jack
Gibson, James J.
Giles, Norman H.
Gilman, Henry
Ginzton, E. L.
Glass, H. Bentley
Gleason, Andrew M.
Goddard, David R.
Gold, Thomas
Goldberg, Leo
Goldberger, M. L.
Goldhaber, Gertrude S.
Goldhaber, Maurice
Gomory, R. E.
Goody, Richard M.
Gordy, Walter
Goudsmit, Samuel A.
Grad, Harold
Griffin, Donald R.
Griffin, James B.
Grobstein, Clifford
Gunsalus, Irwin C.
Gutowsky, H. S.
Hackerman, Norman
Hahn, Erwin L.
Handler, Philip
Hardy, James D.
Harlan, Jack R.
Harrison, J. M.
(Foreign Associate)
Haskins, Caryl P.
Hasler, Arthur D.
Hedberg, Hollis D.
Heisenberg, Werner
(Foreign Associate)
Hendricks, Sterling B.
Herring, W. Conyers
Hertz, Roy
Herzfeld, Karl F.
Hill, Terrell L.
Hille, Einar
Hirsch, James G.
Hirschfelder, Joseph O.
Hoard, J. L.
Hoffman, Roald
Hofmann, Klaus
Hollaender, Alexander
Homans, George C.
Horowitz, Norman H.
Horsfall, James G.
Hoyle, Sir Fred
(Foreign Associate)
Hughes, Vernon W.
Hunsaker, J. C.
Hutchinson, G. Evelyn

Jacobson, Leon O.
Jacobson, Nathan
John, Fritz
Kabat, Elvin A.
Kac, Mark
Kaiser, A. Dale
Kamen, Martin D.
Kaplan, Henry S.
Karlin, Samuel
Kennedy, Donald
Kety, Seymour S.
King, C. G.
Kistiakowsky, G. B.
Kleene, Stephen C.
Klotz, Irving M.
Kolthoff, I. M.
Kompfner, Rudolf
Koopmans, Tjalling C.
Kramer, Paul J.
Lang, Anton
Lardy, Henry
Larrabee, Martin G.
Lawrence, H. Sherwood
Lax, Benjamin
Leaf, Alexander
Leonard, Nelson J.
Leopold, Luna B.
Levine, Philip
Levinthal, Cyrus
Lewis, Edward B.
Licklider, J. C. R.
Liepmann, Hans W.
Lindsley, Donald B.
Lovering, Thomas S.
Luce, R. Duncan
Lush, Jay L.
Mac Lane, Saunders
Malkus, Willem V. R.
Malone, Thomas F.
Markert, Clement L.
Mayall, N. U.
Mayer, Joseph E.
McCarty, Maclyn
McDermott, Walsh
McElroy, W. D.
Meinwald, Jerrold
Meister, Alton
Melton, Arthur W.
Menard, H. W.
Menzel, Donald H.
Merrifield, Bruce
Mislow, Kurt
Moore, Stanford
Mountcastle, Vernon B.
Mulliken, Robert S.
Murdock, George P.
Neel, James V.
Neff, William D.
Nelson, Oliver E., Jr.
Ney, Edward P.
Neyman, Jerzy
Nier, Alfred O. T.
Nirenberg, Marshall W.
Nolan, Thomas B.
Noyes, W. Albert, Jr.
Oncley, J. L.
Orowan, Egon
Osterbrock, Donald E.
Page, Irvine H.
Pappenheimer, John R.
Patrick, Ruth
Pettijohn, F. J.
Pfaffmann, Carl
Pierce, J. R.
Piore, E. R.
Pitzer, K. S.
Rahn, Hermann
Raper, John R.
Raper, Kenneth B.
Revelle, Roger
Rice, Oscar K.
Rich, Alexander
Riggs, Lorrin A.
Ripley, S. Dillon II
Robert, John D.
Roberts, Richard B.
Rodgers, John
Roeder, Kenneth D.
Rollins, Reed C.
Rose, Jerzy E.
Roseman, Saul
Rossini, Frederick D.
Russell, Elizabeth S.
Sabin, Albert Bruce
Sachs, Robert G.
Salpeter, E. E.
Schachman, Howard K.
Scharrer, Berta
Schawlow, Arthur L.
Scheraga, H. A.
Schmidt, Carl F.
Schmitt, Francis O.
Scholander, P. F.
Seitz, Frederick
Shane, C. D.
Shannon, James A.
Shedlovsky, Theodore
Sheehan, John C.
Shemin, David
Shockley, William
Shull, Harrison
Simon, Herbert A.
Simpson, John A.
Sinsheimer, Robert Louis
Skoog, Folke
Slichter, Charles P.
Smith, Emil L.
Snell, George D.
Sperry, Roger W.
Spiegelman, Sol
Spoehr, Alexander
Sporn, Philip
Sprague, G. F.
Stadtman, E. R.
Stebbins, G. Ledyard
Stellar, Eliot
Stewart, T. D.
Stockmayer, W. H.
Szentágothai, János
(Foreign Associate)
Szent-Györgyi, Albert
Tanford, Charles
Tarbell, D. Stanley
Teuber, H.-L.
Thimann, Kenneth V.
Thomas, L. H.
Tukey, John W.
Turkevich, Anthony L.
Ulam, S. M.
Underwood, Benton J.
Vagelos, P. Roy
Van Vleck, J. H.
Vickery, H. B.
Wall, Frederick T.
Warren, Shields
Watson, Cecil James
Weber, Ernst
Wedel, Waldo R.
Weinberg, Alvin M.
Weiss, Paul

Weller, Thomas
Wells, John W.
Westheimer, Frank H.
Wetmore, Alexander
Wheeler, John A.
Whinnery, John R.
Whipple, Fred L.
White, Abraham
Wick, Gian-Carlo
Williams, Carroll M.
Williams, Roger J.
Wilson, Edward O.
Witkop, Bernhard
Wood, Harland G.
Woodring, Wendell P. (Member Emeritus)
Woolsey, Clinton N.
Wright, Sewall
Wu, C. S.
Yoder, Hatten S., Jr.
Zener, Clarence
Zinder, Norton D.
Zwanzig, Robert
Zworykin, V. K.
Zygmund, Antoni

BUSINESS SESSION

In opening the meeting, President Handler welcomed the membership to the Annual Meeting, and the celebration of the five hundredth anniversary of the birth of Copernicus. The President expressed the gratitude of the Academy to those who had served on the Program Committee for the Annual Meeting and the Copernican celebration: Messrs. John W. Wheeler, Chairman; Bernard D. Davis, Owen Gingerich, Stephen E. Toulmin, Gerald Holton, Robert P. Multauf, Walter Shropshire, Jr., and Fred L. Whipple. He also thanked Alexander Hollaender for his loan of paintings from his collection and the Smithsonian Institution for the loan of early scientific instruments on display during this meeting.

President's Announcements

Tellers for the Preference Ballot

The President announced the names of those who served as Tellers for the Preference Ballot: Sterling B. Hendricks, Chairman; T. Dale Stewart, and Ernst Weber.

Newly Elected Section Chairmen

Mr. Handler announced that the following members had been elected to serve as Section Chairmen for three-year terms beginning July 1, 1973:

Mathematics—Nathan Jacobson to succeed R. H. Bing.

Geology—Hatten S. Yoder, Jr. to succeed John Rodgers.

Zoology—Theodore H. Bullock to succeed Carroll Williams.

Applied Physical and Mathematical Sciences—George F. Carrier to succeed H. W. Bode.

Social, Economic, and Political Sciences—Paul A. Samuelson to succeed Kingsley Davis.

Members Deceased Since the 1972 Annual Meeting

At the request of the President, the members assembled and stood in silence as the Home Secretary read the names of those who had died since the last Annual Meeting as follows:

Abraham Adrian Albert, born November 9, 1905; elected to the Academy in 1943; died June 6, 1972.

William Bloom, born September 15, 1899; elected to the Academy in 1954; died May 11, 1972.

Ira Sprague Bowen, born December 21, 1898; elected to the Academy in 1936; died February 6, 1973.

Paul Rufus Burkholder, born February 1, 1903; elected to the Academy in 1949; died August 11, 1972.

Hans Thacher Clarke, born December 27, 1887; elected to the Academy in 1942; died October 21, 1972.

Farrington Daniels, born March 9, 1889; elected to the Academy in 1947; died June 23, 1972.

John Heysham Gibbon, Jr., born September 29, 1903; elected to the Academy in 1972; died February 5, 1973.

Edward Richard Gilliland, born July 10, 1909; elected to the Academy in 1948; died March 10, 1973.

Frederick Lee Hisaw, born August 23, 1891; elected to the Academy in 1947; died December 3, 1972.

Aharon Katzir-Katchalsky, foreign associate, born September 1914; elected to the Academy in 1971; died May 30, 1972.

Edward Calvin Kendall, born March 8, 1886; elected to the Academy in 1950; died May 4, 1972.

Solomon Lefschetz, born September 3, 1884; elected to the Academy in 1925; died October 5, 1972.

Daniel Sanford Lehrman, born June 1, 1919, elected to the Academy in 1970; died August 29, 1972.

Robert Helmer Mac Arthur, born April 7, 1930; elected to the Academy in 1969; died November 1, 1972.

Leonard Amby Maynard, born November 8, 1887; elected to the Academy in 1944; died June 22, 1972.

Philip Duryeé McMaster, born September 14, 1891; elected to the Academy in 1952; died March 20, 1973.

Carl Vernon Moore, born August 21, 1908; elected to the Academy in 1970; died August 13, 1972.

William Thomas Pecora, born February 1, 1913; elected to the Academy in 1965; died July 19, 1972.

Dickinson W. Richards, born October 30, 1895; elected to the Academy in 1958; died February 23, 1973.

Harlow Shapley, born November 2, 1885; elected to the Academy in 1924; died October 20, 1972.

Stanley Smith Stevens, born November 4, 1906; elected to the Academy in 1946; died January 18, 1973.

Cecil Edgar Tilley, foreign associate, born May 14, 1894; elected to the Academy in 1967; died January 24, 1973.

Stephen Prokop Timoshenko, born December 23, 1878; elected to the Academy in 1940; died May 29, 1972.

Harry Shultz Vandiver, member emeritus, born October 21, 1882; elected to the Academy in 1934; died January 4, 1973.

Georg von Békésy, born June 30, 1899; elected to the Academy in 1956; died June 13, 1972.

Benjamin Harrison Willier, born November 2, 1890; elected to the Academy in 1945; died December 3, 1972.

Biographical Memoirs Assigned Since the 1972 Annual Meeting

Roger Adams, to Nelson J. Leonard

Edgar Collins Bain, to James B. Austin

Solomon Aaron Berson, to Irving M. London
William Bloom, to Don W. Fawcett
Paul Rufus Burkholder, to James G. Horsfall
Hans Thacher Clarke, to H. B. Vickery
Farrington Daniels, to Robert A. Alberty
Paul Darwin Foote, to Allen V. Astin
Walter Abraham Jacobs, to Lyman C. Craig
Edward Calvin Kendall, to Dwight J. Ingle
Daniel Sanford Lehrman, to Frank A. Beach
Robert Helmer Mac Arthur, to G. Evelyn Hutchinson
Colin Munro MacLeod, to Walsh McDermott
Leonard Amby Maynard, to William J. Darby
Carl Vernon Moore, to Oliver Lowry
Eugene Lindsay Opie, to Esmond R. Long
John Rodman Paul, to Paul B. Beeson
William Thomas Pecora, to Charles A. Anderson
Jack Schultz, to Thomas F. Anderson
Harlow Shapley, to Bart J. Bok
Joseph Slepian, to John A. Hutcheson and Clarence Zener
Joseph Edwin Smadel, reassigned to Lewis Thomas
Julian Haynes Steward, to Fred Eggan and Gordon Willey
Stephen Prokop Timoshenko, to C. Richard Soderberg
Georg von Békésy, to Floyd Ratliff
Wiliam Barry Wood, Jr., to James G. Hirsch

Biographical Memoirs Received Since the 1972 Annual Meeting

Harold Delos Babcock, by I. S. Bowen
Edward Wilber Berry, by Ernst Cloos
Hans Thacher Clarke, by H. B. Vickery
Peter Debye, by J. W. Williams
Clarence Henry Graham, by Lorrin A. Riggs
William King Gregory, by Edwin H. Colbert
Donald Forsha Jones, by Paul C. Mangelsdorf
Arthur Remington Kellogg, by Frank C. Whitmore, Jr.
Mervin J. Kelly, by John R. Pierce
Victor Kuhn La Mer, by Louis P. Hammett
Charles Christian Lauritsen, by William A. Fowler
Clarence Cook Little, by George D. Snell
Cyril Norman Hugh Long, by James D. Hardy and Ora K. Smith
Joseph Hoover Mackin, by Harold L. James
Walter Curran Mendenhall, by Thomas B. Nolan
James Flack Norris, by John D. Roberts

Actions on Invitations to the Academy to be Represented on Special Occasions

Occasion of the Seventy-sixth Annual Meeting of The American Academy of Political and Social Science on the topic, "China in the World Today," Philadelphia, Pennsylvania, on April 14–15, 1972. Henry David and Anne G. Keatley.

Occasion of the Centenary Celebration of Paul Langevin, at the Institute of France, Paris, France, on September 26, 1972. Allen V. Astin.

Inauguration of Richard M. Cyert as President of Carnegie-Mellon University, Pittsburgh, Pennsylvania, on March 9, 1972. Herbert A. Simon.

Occasion of the Twentieth Anniversary of the Establishment of the Czechoslovak Academy of Sciences, November 21, 1972. Greetings.

Elections

The elections at the annual meeting resulted as follows: Vice President, Saunders Mac Lane, for a four-year term beginning July 1, 1973.

Four members of the Council of the Academy for a three-year term beginning July 1, 1973, as follows: Horace Babcock, Maclyn McCarty, Kenneth S. Pitzer, and Carroll M. Williams.

Foreign Associates: Sune Bergström, Karolinska Institute, Stockholm, Sweden; Albert Eschenmoser, Eidgenössische Technische Hochschule, Zurich, Switzerland; W. A. Engelhardt, U.S.S.R. Academy of Sciences Institute of Molecular Biology, Moscow, U.S.S.R.; Dennis Gabor, Columbia Broadcasting System Laboratories, Stamford, Connecticut; Jean Goguel, Ecole nationale supérieure des Mines, Paris, France; Motoo Kimura, National Institute of Genetics, Mishima, Japan; George Klein, Karolinska Institute, Stockholm, Sweden; Ben Roy Mottelson, Nordisk Institut for Teoretisk Atomfysik, Copenhagen, Denmark; V. Ramalingaswami, All India Institute of Medical Sciences, New Delhi, India; Andrei Sakharov, U.S.S.R. Academy of Sciences P.N. Lebedev Institute of Physics, Moscow, U.S.S.R.; I. S. Shklovsky, U.S.S.R. Academy of Sciences Institute of Space Research, Moscow, U.S.S.R.

Members: Edward Hamblin Ahrens, Jr., Robert Wayne Allard, Andrew Alm Benson, Howard Alan Bern, James Daniel Bjorken, Harold Charles Bold, John Tyler Bonner, Frederick Herbert Bormann, Gordon Howard Bower, Felix Earl Browder, Donald David Brown, Arthur Earl Bryson, Jr., Bernard Budiansky, John Werner Cahn, Donald Thomas Campbell, Robert Merritt Chanock, Albert McCavour Clogston, Ansley Johnson Coale, Philip Ernest Converse, George Constantin Cotzias, Ellis Brevier Cowling, James Edwin Darnell, Jr., Albert Dorfman, Otis Dudley Duncan, Isidore Samuel Edelman, Walles Thomas Edmondson, Edmond Henri Fischer, Marshall Fixman, Robert William Fogel, Robert Elder Forster, Donald Sharp Frederickson, Gerhart Friedlander, Milton Friedman, Theodore Henry Geballe, Clifford James Geertz, James Freeman Gilbert, Harry Goldblatt, Ludwik Gross, Gordon G. Hammes, Zellig Sabbatai Harris, Marion Frederick Hawthorne, David Mark Hegsted, Robert Fleming Heizer, Richard Marx Held, John Joseph Hopfield, Kurt Julius Isselbacher, Percy Lavon Julian, Joseph Jacob Katz, Joseph Bishop Keller, Lawrence Robert Klein, William Lester Kraushaar, Edwin Gerhard Krebs, Aaron Bunsen Lerner, Choh Hao Li, Seymour Martin Lipset, James Ross Macdonald, James Gardner March, Paul A. Marks, Jacob Marschak, Victor Almon McKusick, William Burdette McLean, Stanley Lloyd Miller, Raymond David Mindlin, Marvin Lee Minsky, Beatrice Mintz, Franco Modigliani, Yoichiro Nambu, Gerry Neugebauer, Bernard More Oliver, Alwin Max Pappenheimer, Jr., Robert Ghormley Parr, Rowland Pettit, David Pines, John Michael Prausnitz, Charles Henry Rammelkamp, Simon Ramo, Helen M. Ranney, Lester James Reed, William Lawson Russell, Jarvis Edwin Seegmiller, Irving Ezra Segal, Richard Burton Setlow, Robert Phillip Sharp, Horton Guyford Stever, Julian Munson

Sturtevant, Helen Brooke Taussig, Kip Stephen Thorne, William Trager, Merton Franklin Utter, Cecil Herbert Wadleigh, Robert Mowbray Walker, Anthony Francis Clarke Wallace, Donald Edward White, Gilbert Fowler White, Maxwell Myer Wintrobe.

Report of the Home Secretary

The membership of the National Academy of Sciences, as of April 16, 1973, was 918. In addition, there were 118 foreign associates, and 16 members emeriti. Since the last Annual Meeting 23 members, two foreign associates, and one member emeritus have died. Five members transferred to emeritus status. In addition, the membership was reduced by two through one resignation accepted at the 1972 Annual Meeting and one accepted at the Autumn Meeting. One individual elected at the 1972 meeting declined to accept membership.

The membership of the Academy is distributed by Class as follows:

Class I	Physical and Mathematical Sciences	412
Class II	Biological Sciences	281
Class III	Engineering and Applied Sciences	110
Class IV	Medical Sciences	44
Class V	Behavioral and Social Sciences	71

A new Section, No. 19, Social, Economic, and Political Sciences, became operational last year. Six members transferred to the new Section and seven newly elected members joined.

In response to the action of the membership at the 1972 Annual Meeting, the Council established an ad hoc committee under the chairmanship of the Home Secretary to review our election procedures. The committee made several recommendations. One led to two proposed Bylaw changes to be considered at this meeting. Another led to a special meeting of Class Chairmen (or their representatives) in early January to review and propose changes in the biographies submitted for the nominees for membership. A related one will require the Home Secretary to submit more explicit guidelines to the Section Chairmen for the preparation of hopefully better biographies for future nominees for membership. Still another recommendation led to the special ballot (that accompanied the Preference Ballot) concerning the attitudes of members towards the present voting rules for the Preference Ballot. The results of this ballot will be reported separately at this meeting.

This is the second year that we have elected Officers and Councilors by mail ballot. A total of 668 valid ballots were cast in the 1973 election. The results of this election are separately reported.

The Bylaws require that accompanying the ballot there shall be "a brief biography listing the professional accomplishments of each nominee." Last year we used, for this purpose, the biographies in American Men of Science or Who's Who in America, supplemented by a listing of known Academy-NRC activities. This year we sought the assistance of the Nominating Committee and the special nominating groups with a final editing in the Home Secretary's office and the addition of some data concerning Council-NRC activities. This year's biographies drew more criticism than those of last year so suggestions from the membership on this matter would be appreciated.

The 1972 Autumn Meeting was the second consecutive one scheduled in Washington in the hope of improving attendance. One hundred five members participated, down 16 from the year before, but still well above the average attendance of recent autumn meetings held in other localities. Recent Autumn Meeting attendance figures are as follows: 1967, University of Michigan—47; 1968, California Institute of Technology—87; 1969, Dartmouth College—63; 1970, Rice University—36; 1971, NAS, Washington, D.C.—121; 1972, Washington, D.C.—105. The attendance at the scientific sessions, however, was very disappointing, particularly in view of the fact that the respective program chairmen had arranged for excellent groups of papers. Because of this, it is tentatively planned that parallel sessions will not be scheduled at future fall meetings, except perhaps for contributed papers or some other special circumstance.

The status of Memoirs for deceased members is separately reported; however, the Home Secretary would like to remind members that they are urged to submit, for our files, biographical and bibliographical material and periodically to update it. In the process of assisting individuals assigned to prepare Memoirs, it is embarrassing to have to advise them, more often than not, that there is little or nothing concerning their subject in our file. The task of your future biographers will be considerably lightened if you will keep our files reasonably up-to-date concerning your respective careers.

The Office of the Home Secretary suffered a major loss last December when Miss Edna Gilbertson decided to retire prematurely on the advice of her physician. Miss Gilbertson had been the mainstay of the past four Home Secretaries and she had given the Academy and its members unusually competent and dedicated service. Mrs. Victoria Crawford has taken over the responsibilities as chief of staff of the Office of the Home Secretary. I am sure that you will find Vicki Crawford and her associates happy to assist you on any matter related to Academy membership activities.

Only one question, in regard to who had declined election in 1972, was directed to Mr. Astin. He summarized his interaction with George B. Field, who had declined membership for personal reasons.

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Report of the Foreign Secretary

The Foreign Secretary stated that his report had been mailed to the membership. He then briefly summarized some of the highlights of the past year, mentioning, in particular, the visits of Chinese delegations of medical doctors, natural scientists, high energy physicists, hydrologists, chemists, and entomologists, and plans for a U.S. scientific delegation to visit China in May 1973. Arrangements for these visits are handled by the Committee on Scholarly Communication with the People's Republic of China. He referred also to the conduct of a workshop on science policy in which representatives of the Bulgarian Academy of Sciences and the NAS had participated. Mr. Brown then spoke briefly about the creation of the International Institute for Applied Systems Analysis, ICSU's new headquarters in Paris, an invitation to ICSU to hold the 1976 General Assembly in the United States, and a meeting of representatives of nongovernmental Academies of Science in Bellagio in March 1973, at which time the issues and problems related to migration of scientists were discussed. Mr. Brown further announced that the Council had recently approved a plan for the reorganization of the Office of the Foreign Secretary consistent with the overall restructuring of the NRC.

Report of the Treasurer

Mr. Piore stated that financial status reports covering the intervals July 1, 1971—June 30, 1972 and July 1, 1972—December 31, 1972 had been mailed to the membership.

The Academy's annual expenditures for the year ending July 30, 1972, totaled approximately $38 million. Less than 1½ percent of the funds spent by the Academy in this period were devoted to activities designated as classified under Government Security Regulations.

The Academy's investments continue to be managed by Morgan Guaranty Trust Company of New York. As of December 31, 1972, Academy investments had a value of more than $28 million.

The only outstanding debt at present results from the purchase of a new computer, charges for the use of which should fully reimburse the expenses incurred.

In the coming year some financial impact will be felt as the NRC reorganization proceeds and a shift to a different mode of operation takes place.

In concluding, the Treasurer encouraged members to consider making gifts, bequests, or contributions to the Academy, possibly through such a mechanism as a Membership Fund to be used for special purposes. He also urged any members who had questions to write him for more detailed information on his report.

The President requested a motion to receive the Report of the Treasurer, the Home Secretary so moved, and the membership voted acceptance.

Report of the Vice President

As Mr. Kistiakowsky came to the podium, he received a rising vote of thanks from the membership for his work on behalf of the Academy as Vice President, Chairman of the Report Review Committee, member of the Council, "father" of COSPUP, and active member of many other NAS Boards and Committees throughout his years of NAS membership.

The Vice President announced the names of those serving on the Report Review Committee and expressed gratitude to them and the 121 Academy members who at the request of RRC, had participated in the review of reports during the past year. Of 370 reports last year, 44 unclassified and 7 classified were reviewed by RRC or its panels. (The Vice President reminded the membership that many Academy activities do not result in formal reports, for example, fellowship selection panels and international organizational activities.) He commented on the increasingly close coupling of the NAS membership to the output of NRC that has developed in recent years. In nearly all instances the revisions recommended by RRC reviewers have been wholly or largely accepted.

In regard to classified reports, Mr. Kistiakowsky indicated that they had dealt with technical and applied scientific problems related to military technology. None were related to the war effort in Vietnam or to politically sensitive issues.

Report of the President

Mr. Handler began his report with the statement that science had never been more exciting, mentioning illustrative examples in a variety of fields. He then described in detail the changing climate in which science is conducted. He spoke of the level, or declining (in constant dollars), support for science in recent years, the low priority currently accorded fundamental research, the downgrading of science in the executive branch of the federal government, and the implications of withdrawal of support for graduate and postgraduate training. He called attention to the need for careful analysis of:

1. The seriousness of the overall shortage of funds for science;
2. The distribution of such funds as are available between basic and applied science and among fields within each of these general categories;
3. The role of peer review in decision making and of how and where to defend this system if it merits preservation;
4. The implications of present policies in regard to student support—not only for the student but for our academic institutions.

Mr. Handler next listed briefly many of the requests directed to the Academy in recent months by the Congress and emphasized the urgent need to assure the provision of objective, impartial advice and to reduce response time. The NRC reorganization he viewed as a means of placing

the Academy in a better position to anticipate as well as respond to both Congressional and federal agency requests for assistance.

In concluding the President described some recent Academy efforts to improve communication with the general public and its representatives. He mentioned as examples the Academy Forum, the first program of which will take place in May, a series of luncheons for the general press at which knowledgeable scientists discuss informally such topics as energy or delivery of health care, and an informal meeting of members of the Environmental Studies Board with the Senate Committee on Environment, chaired by Mr. Muskie.

Amendments to the Constitution and Bylaws

At the request of the President, the Home Secretary introduced proposed amendments to the NAS Constitution and Bylaws for consideration by the membership. He introduced Paul J. Kramer, Chairman of the Committee on Bylaws and Jacob Bigeleisen, who served on this Committee, and indicated that Messrs. Kramer and Bigeleisen would assist in clarifying any questions the membership might have in regard to the proposed amendments.

The Home Secretary explained that two proposed amendments to the Constitution would be presented for approval at this meeting. If approved, they would be submitted to the membership at the 1973 Autumn Meeting for ratification.

The Home Secretary briefly summarized the proposed amendment to Article III, Section 1, page 4, which would eliminate the mandatory requirement for a fall meeting. On motion from Mr. Kramer, the membership voted approval.

The membership then approved the amendment deleting Sections 1 and 2 of Article V, renumbering the remaining Sections under this Article, and changing the title of Article V to "Of Reports."

Presented next for consideration by the membership were 28 amendments to the Bylaws, each of which was read by the Home Secretary, with additional information being supplied at times by Messrs. Kramer and Bigeleisen. The membership voted in favor of amendments to Bylaw I(5) and Bylaw I(6).

The amendment to Bylaw I(7), which states that "A member who has not paid his dues for four years shall automatically be transferred to the rolls of members emeriti unless specific exception is made by the Council," occasioned some discussion. Mr. Bok thought it inappropriate to group the elder statesmen with the delinquents, and Mr. Kabat proposed a substitute amendment as follows: "A member who has not paid his dues in four years automatically loses his vote until his status in good standing is reestablished." The Home Secretary commented that this modification was essentially the same as the statement in the Bylaws, and Mr. Bigeleisen spoke in favor of

retaining the clause permitting special exception to be granted by the Council. Bernard Davis suggested that as nonpayment of dues was not a significant problem, and as the amendment proposed by the Bylaws Committee appeared adequate to cover any such problem that might arise, protracted discussion seemed unnecessary. Kingsley Davis agreed that the matter was not urgent; therefore, he moved that this amendment be tabled to allow the Bylaws Committee to give it further consideration. The membership voted in favor.

Amendments to Bylaws II(1), II (2), II(5), II(6), II(7), II(8), a new II(6), II(9), II(10), and III(3) elicited little discussion and each was approved by the membership.

Subsequently, it was realized that the wording of the amendment to Bylaw II(1) was ambiguous:

> The Council shall designate from among its members and officers the individuals who, in addition to the President and the Vice President, shall participate in the governance of the National Research Council.

Such a statement could be interpreted as excluding any other group from serving on the Governing Board of the NRC. Therefore, Mr. Pitzer moved that the previous action approving this amendment be reconsidered, and the membership so voted. The Home Secretary then presented a substitute amendment and accepted a slight modification in wording proposed by Mr. Tukey to clarify further the intent of the amendment. The members then voted in favor of the following amendment to Bylaw II(1):

> The Council shall designate which of its members and officers, in addition to the President and Vice President, shall represent the Council in the government of the National Research Council.

The Home Secretary and Committee on Bylaws withdrew a proposed amendment to Bylaw III(4), as this was directly related to Bylaw I(7), which had been tabled; therefore action at this time was not appropriate.

Because of the withdrawal of the amendment which would have deleted Bylaw III(4), the numbering of other subsequent amendments to this Bylaw would have to be revised. Mr. Piore moved that the Bylaws Committee be authorized to deal with the necessary renumbering apart from and subsequent to approval of the content of these amendments as presently numbered, and the membership so voted.

Amendments to Bylaws III(5), III(6), and IV(7) were approved.

In regard to Bylaw IV(8), Mr. Tukey inquired about the reasons that the Committee on Bylaws had not accepted the recommendation of the Committee on Election Procedures, which by specifying a deadline of July 1 rather than December 15, as in the amendment, for submission to the Home Secretary of background material on nominees proposed by VNG's, would have allowed more time for consideration by the Secretary and Class concerned. Mr. Bigeleisen explained that the purpose of VNG's was to generate additional names and that the procedure advocated by the Committee on Election Procedures appeared likely to result in vetoes of these

names by Sections, which would defeat the purpose of the VNG. The Bylaws Committee had agreed that a two-week revision of the existing deadline, rather than a six-month one, was sufficient for submission of VNG nominations to Classes. Mr. Tukey stated that the intent had not been to have Sections veto VNG nominees but to allow time for a collective view from Sections, on all nominees, to be presented to the Class Membership Committee. Knowledge of the feelings of the Sections could be of great assistance to the Class Membership Committee. However, Mr. Tukey would not oppose the proposed amendment, which the membership then approved.

Approval of an amendment to Bylaw 4(11), (1) was voted; however, the following proposed amendment to Bylaw IV(11), (2), paragraph 3 occasioned discussion:

> Each Chairman shall keep a record of the names listed on the informal ballot and retain those receiving ten percent of the members voting on the informal ballot in the prior year except that those names shall be struck from the list who receive a progressively smaller fraction of the vote in the two sequential years after the first year.

Messrs. Fowler and Rodgers suggested that it would be difficult to eliminate names under this procedure and expressed their preference for the existing system. Mr. Piore then moved that the amendment be tabled to allow the Committee on Bylaws to study its implications more thoroughly and present a new version at the Autumn Meeting. The membership voted in favor.

The amendment providing for the addition of a paragraph to Bylaw 4(11), (2) was accepted, but the following amendment to Bylaw IV(16), paragraph 4, required some clarification:

> In no case shall a nominee be declared elected if he receives fewer than one hundred votes in all.

Questions arose on whether this amendment would affect the 1973 election, and, although the Home Secretary stated that it would not, some suggested that the amendment should so stipulate. The rationale for the increase from 50 to 100 was questioned, with Mr. Astin explaining that 100 would represent approximately one tenth of the Academy membership after the 1973 election. It was also suggested that in the event that an optional system of voting—i.e., the option to vote in less than five classes—were adopted, the Bylaw would require further amendment. The Home Secretary concurred. A motion to table failed, and the membership then voted in favor of the amendment as presented.

An amendment to Bylaw IV(16) was accepted by the membership with inclusion of the words "present and voting," the approved version reading as follows:

> Should a nominee listed on the preference ballot die after the meeting of the class membership committee, he may be elected posthumously by a majority of the members present and voting without reference to quotas. There shall be no other posthumous election.

The amendment to Bylaw IV(19) was approved.

The Committee on Bylaws withdrew from the agenda an amendment to Bylaw V(1), as the necessity for this change was contingent upon acceptance of the amendments to the Constitution, the final vote on which would not take place until the Autumn Meeting.

Amendments to Bylaws V(3), V(4), and VI(1) were approved.

Mr. Piore expressed concern about the language used in proposed amendments to Bylaw VI(2). To speak of committees on trust funds implied responsibility for such funds rather than merely selection of recipients of awards from trust funds. After suggestions for modification in wording received from several members, which were accepted by the Bylaws Committee, the following amendments were approved by the membership:

> Standing committees of the Academy on awards shall consist of at least three or not more than five members. In order to secure continuity and rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the members of the committee shall be appointed for staggered terms, each term of appointment to cover at least one award.
>
> The committees on awards from trust funds shall be empowered to evaluate recommendations and to determine the recipients of the award provided by the trust funds, consistent with the allocation of funds as determined by the Council.

TNG in Planetary Sciences

The Home Secretary announced that the Council had approved the creation of a TNG in Planetary Sciences for the 1974 elections and that the membership of this TNG would be appointed at the June meeting of the Council.

He also announced that the Council had voted to continue the TNG's in Environmental and Field Biology, for Class IV, and for Class V.

Mr. John D. Roberts then moved a departure from the agenda to discuss the NAS-NAE relationship next, while most of the members registered for the meeting were still present. A two thirds vote was necessary and the motion carried easily.

NAS–NAE Relationship

Mr. Handler briefly summarized the information in the April 1973 *Letter to Members*. He then read the following resolution unanimously adopted by the Council at its meeting on April 22, 1973:

> The National Academy of Sciences extends to the NAE an invitation to work together to develop effective means for the two Academies to cooperate in the national interest on activities of mutual and overlapping concern. Should the NAE decide to remain as an organization under the NAS charter, the invitation to do so remains open.

The Council had agreed that the President should present this resolution to the membership at the Annual Meeting for their endorsement. It would then be transmitted to the NAE.

Mr. Astin moved acceptance of the resolution by the membership. Mr. Kistiakowsky asked whether this action would supersede a previous action of Council by which it was agreed that the terms of any agreement reached by NAS and NAE in regard to governance of NRC would be submitted by mail ballot to the membership. The President indicated that it did not; should further negotiations result from this action, any agreement reached by the Councils would be submitted to the membership for ratification.

Mr. Brooks asked whether cooperation between separate Academies could take place on projects of mutual interest without a vote of the entire membership; he was assured that it could and that this was the intent of the resolution.

Mr. Fowler inquired whether the final sentence of the resolution implied a threat to NAE. The President asserted that just the opposite was meant. To prevent the appearance of the two sentences being interdependent, Mr. Westheimer proposed that the resolution be amended by insertion of "Furthermore" as the initial word of the second sentence. Mr. Astin accepted this change and the membership then voted to endorse this resolution as amended for transmission to the NAE.

Mr. Thimann spoke in favor of a weighted voting system, and Mr. Garwin advocated a system of voting by lot under which all members would not have to vote every year. Mr. Glass asserted that the chief problem related to election procedures was insufficient time to review the biographical data and insure its adequacy. He urged a thorough overhaul of the entire election process.

Autumn Meeting

The Home Secretary announced that the 1973 Autumn Meeting would take place on Monday and Tuesday, October 22–23, 1973. No program was yet planned, though the possibility of working sessions to discuss the organization and plans of the various Assemblies had been proposed.

Report on the Sectional Structure of Class II

In the absence of Mr. Grobstein, Chairman of the Committee on the Sectional Structure of Class II, Mr. Kenneth Thimann stated that this Committee's preliminary report had been the subject of discussion at the meeting of Class II. In general the Class was sympathetic with the intent of the plan but not in accord on all its details. Further study, including a questionnaire survey of the membership, was planned and by 1974 a move toward reorganization might occur. Mr. Markert added that a straw vote taken at the Class meeting had revealed approval of the reorganization plan developed by the Committee.

Committee on Election of Younger Members

Mr. Astin reported that this Committee had met, that it was still gathering data, and that no report was yet available.

Special Election Ballot Questionnaire

The Home Secretary informed the membership that the Committee on Election Procedures had recommended circulation of a questionnaire with the preference ballot to determine the extent of dissatisfaction at voting outside the Classes in which one was competent. Since 70 percent of those who returned questionnaires had misinterpreted one of the two key questions, the results were not entirely clear; however, further study of election procedures appeared advisable. Of the 577 responses, 278 were in favor of retention of the present system, 252 were in favor of an optional system, and 47 were undecided. Among those who sent in comments, these comments were two to one (107 to 55) in favor of an optional system. In spite of misinterpretation of the question*, the data on voting patterns—the Classes in which members would or would *not* vote under an optional system (according to how the question was interpreted)—showed some closely similar trends characteristic of various Classes.

Report of Ad Hoc Committee on Classified Research

Mr. Riccardo Giacconi reported that eight of his Committee members had met in January 1973 and a draft of their recommendations had been developed. He planned to circulate this to all members of the Committee for their suggestions and approval. The final report would then be sent to President Handler. He emphasized that what he reported at the meeting was only for information. He stated that the Resolution adopted by the membership at the 1972 Annual Meeting, adherence to its provisions, and the very small percentage of studies that were actually classified—some were classified only because they involved access to classified material—had apparently largely eliminated the problem the Committee originally addressed. The President commented that he foresaw no problem in implementing these suggestions when formally transmitted to the Council, and that, in large part, they were already in place.

Seminars in Human Behavioral Genetics

The President announced the names of members of the *ad hoc* Committee on Genetic and Environmental Factors in Human Performance, which

*Members were supposed to indicate the Classes in which they would not vote; those misinterpreting the question marked the Classes in which they would vote.

had met during the past few months to plan the format for a series of seminars on this subject. A plan had been submitted to the Council, but the Council had not approved all details of this plan. It was expected, however, that these seminars would get under way during the summer.

Reorganization of the NRC

The President announced that one Assembly and one Commission had been established and the Terms of Reference for two other Assemblies approved by the Council. Plans currently were being developed for two other Commissions. It was hoped that by September 1973 all major components of the restructured NRC would be in place.

Migration of Scientists

The Foreign Secretary presented for consideration a copy of a letter to academies of science drafted by a group of representatives of major nongovernmental academies who met at Bellagio in March 1973. The letter discussed migration of scientists and requested each academy to make its position on this subject known to the President of the International Council of Scientific Unions, which is making a study of the problem and developing guidelines and recommendations. Mr. Brown stated that it was not the intention of this letter to endorse the so-called "brain drain" but to reassert and endorse the principle of free circulation of scientists.

Mr. Bigeleisen moved that the membership endorse this statement, and the membership voted in favor.

Resolution on Biomedical Sciences

Mr. Philip P. Cohen introduced, on behalf of Mr. Alexander Rich, a resolution directed to the President and Council and endorsed by the Section on Biochemistry. The resolution called attention to the implications for fundamental research and education in biomedical sciences of recent federal government support policies and urged the President and Council to consider these problems and present appropriate recommendations to the Executive and Legislative Branches of government and the public. Mr. Cohen moved that the membership approve this resolution for transmission to the Council.

In the discussion that ensued, it was evident that the membership was in sympathy with the intent of the resolution; however, many feared that to endorse this statement pertaining to one field of scientific endeavor would imply that all was well in other fields or that the equally serious plight of other fields was not of concern to the Academy. Some also thought that the subject was adequately covered in the President's Report, which in their opinion should be made public, and that the Academy was already addressing the serious problems facing all science. In response to a request that he

withdraw the resolution, since its purpose of drawing the Council's attention to the critical situation in biomedical sciences had, in effect, been accomplished by its introduction and discussion, Mr. Cohen refused and asked that the membership vote on the resolution. Mr. Brown stated that he would be embarrassed to vote either for or against this resolution and moved that it be tabled. The membership so voted.

Suggestions to the Council

Mr. Bart J. Bok was recognized by the Chair to call to the attention of the Council some topics of serious concern, especially to younger scientists, and to urge that the Council devote more attention in its future deliberations to these problems. He prefaced his remarks by commending the President on his report and the Council on its awareness and leadership, indicating that his intention was not to criticize or denigrate but to stimulate greater attention and action. He then listed three problems of growing concern in the scientific community:

1. Unemployment, underemployment, new types of employment of young doctorates.
2. Public education in science.
3. General support of science, especially of young scientists just beginning their careers.

Mr. Handler indicated that the Council would try to be responsive to these concerns. He pointed out the difficulties of constructive action in areas fraught with political overtones and pointed in particular to a number of carefully prepared COSPUP studies, commended by the scientific community but labeled as self-serving by those outside it. He assured Mr. Bok and the membership that he and the Council would give the problems mentioned careful attention. Mr. Thimann described briefly the plans of the AAAS Committee on Public Understanding of Science and reminded NAS members of the importance of participation in efforts of this kind and of the contributions to science education of the public that they could make as individuals.

Resolution Presented by Mr. Shockley

Mr. Shockley introduced for consideration by the membership the same resolution he had offered three times previously (see Minutes of Business Sessions of April 25–26, 1972. He stated that action on this resolution would be consistent with Academy action in regard to other issues, for example, adoption in October 1972 of a resolution dealing with parallel treatment of evolution and creationism in public school text books. He further stated that the group engaged in planning an Academy activity in Human Behavioral Genetics had not addressed the specific problem dealt with in his resolution, namely review of a significance level calculation in a study of

Caucasian twins. He therefore moved acceptance of his resolution, when he then read.

Mr. Shull then introduced the following substitute resolution approved by the Council for presentation to the membership:

PREAMBLE

The Council of the National Academy of Sciences has carefully considered the issues and problems involved in the kinds of resolutions that its member, Dr. William Shockley, has been bringing before its meeting for several years. In each case the membership has been asked to vote yes or no on sponsoring research in a particular field, or on setting up a commission to come to a definitive conclusion in that field. Since only a small minority of the membership has any expertise in the field, and since many of those with expertise doubt that the field has progressed to the point at which a definitive conclusion is warranted, the membership has responded by tabling the issue, a procedure that has been subjected to considerable misinterpretation in the public press. The Council feels strongly that all objectively posed scientific questions deserve an airing through the established multiple mechanisms of research, review, publication, and criticism available to all scientists. Many fields of research in diverse sciences impinge strongly on important social and economic issues of our time, and choice among these for maximum benefit to the health and welfare of America is difficult and uncertain. The Council doubts the wisdom of attempting to select one field from among the many that might prove valuable. The Council therefore proposes the following substitute motion for that currently on the floor.

RESOLUTION

The National Academy of Sciences acknowledges Mr. Shockley's having brought to its attention the inquiry in which he is currently engaged, and encourages him and others engaged in such efforts to follow the normal scientific procedures of publication so that their resullts may be subjected to the usual peer review and accorded the scientific impact afforded by such publication.

Mr. Shockley questioned the accuracy of certain statements in the Shull resolution and again reminded the membership that it had taken stands in the past on specific issues such as battery additives and creationism. The action he requested was consistent with such past actions. Mr. Crow asserted that he had no quarrel with Mr. Shockley's data and that in the seminar series planned on Environmental and Genetic Factors in Human Performance an inquiry would be made into the issues raised. The membership then voted on the substitute resolution moved by Mr. Shull and this resolution was accepted.

Reports of Committees on Trust and Endowment Funds

Henryk Arctowski Award Fund

The Committee for this Fund considered by correspondence the terms of the bequest, and concluded that, since an award of the Arctowski Medal and Prize was made in 1972, they would not make a recommendation for an award in 1973.

The financial status of the Arctowski Fund as of February 28, 1973, was as follows: Capital contribution, $95,736; Addition from earned income, $52,403; Realized capital gain, $41,751; Short term investments, $4,500; Cash, $5,768; *Total equity,* $200,158.

N. U. MAYALL, Chairman.

Cyrus B. Comstock Fund

The Comstock Prize is awarded every five years for the most important discovery or investigation in electricity, magnetism, or radiant energy. This year the Council of the Academy approved the recommendation of the Committee that Robert H. Dicke receive the Prize. It will be presented on the evening of April 23.

The financial status of the Cyrus B. Comstock Fund as of February 28, 1973, was as follows: Capital contribution, $10,400; Addition from earned income, $29,847; Realized capital gain, $9,141; Short term investments, non; Cash, $1,992; *Total equity,* $51,380.

E. R. PIORE, *Chairman.*

Arthur L. Day Bequest

The Arthur L. Day Fund ". . . for advancing the studies of the physics of the earth", is the largest single endowment item in the Academy's holdings. To meet the opportunities created by this special-purpose fund, two groups were created:

A Trustee's Committee with broad responsibilities for the use of the income, and a Selection Committee having the duties of making recommendations for specific projects to be supported. Two broad activities for support were approved by the NAS Council; namely, the Arthur L. Day Prize and Lectureship to be awarded, at intervals, for distinguished work in earth physics, and a broad program of project support of international collaboration on the physics of the earth, the latter to be carried out by making grants to American research men for the specific support of their joint work with collaborators in other countries, and especially to provide field expenses and equipment for the joint work abroad. Both of these activities have been initiated, perhaps a bit slowly. A wider range of proposals for the support of foreign collaboration would be welcomed. Appropriate subject matter includes work with foreign colleagues in geophysics, geochemistry, tectonics, petrology, seismology, aeronomy, meteorology, physical oceanography, and special topics in astronomy, paleoclimatology, and paleobiology related to earth history.

The report of the Selection Committee is appended herewith. The financial statement of the Day Fund, as of February 28, 1973, was as follows: Capital contribution, $1,398,474; Addition from earned income, $108,000; Realized capital gain, $87,468; Short term investments, none; Cash, $29,428; *Total equity,* $1,623,370.

MERLE A. TUVE, *Chairman.*

Since the last annual report to the Academy, the Committee on Selection for the Arthur L. Day Fund has approved the following actions and grants:

No. 19. Dr. James N. Brune, Institute of Geophysics and Planetary Physics, University of California, San Diego, in support of travel expenses and field studies in connection with a cooperative geophysics program with Dr. Cinna Lomnitz of the Institute of Geophysics of the National University of Mexico ---------- $7,500

No. 20. Dr. Francis T. Wu, Department of Geology, State University of New York at Binghamton, in support of collaborative research with Iaakov Karcz of the Israeli Geological Survey, on recent crustal movements and microearthquakes in the region between the Mediterranean and the Dead Sea Rift (Israel) ---------- $1,950

For the Selection Committee:

HERBERT FRIEDMAN, *Chairman.*

Henry Draper Fund

No recommendation has been made by the Committee for the award of the Henry Draper Medal and Award for 1973. According to the normal frequency pattern, the next award of the Draper Medal is scheduled for 1974. The financial status of the Henry Draper Fund as of February 28, 1973, was as follows: Capital contribution, $6,000; Addition from earned income, $11,000; Realized capital gain, $9,333; Stort-term investments, $2,300; Cash, $1,912; *Total equity,* $30,545.

LEO GOLDBERG, *Chairman.*

Daniel Giraud Elliot Fund

The financial status of the Daniel Giraud Elliot Fund as of February 28, 1973, was as follows: Capital contribution, $8,000; Addition from earned income, none; Realized capital gain, $7,088; Short-term investments, $1,900; Cash, $1,137; *Total equity,* $18,125.

No award of the Elliot Medal is scheduled for 1973.

S. DILLON RIPLEY, *Chairman.*

Gibbs Brothers Fund

The Committee on the Gibbs Brothers Fund again reports its disappointment in receiving no nominations. Thus it does not find it possible to present a candidate to the Council of the Academy for an award in 1973. The Committee hopes, however, and will exert special efforts to the realization of these hopes, to find a candidate adequately qualified for an award in 1974.

The financial status of the fund as of February 28, 1973, was as follows: Capital contribution, $24,000; Addition from earned income, $4,000; Realized capital gain, $4,096; Short term investments, none; Cash, $676; *Total equity,* $32,772.

PHILIP SPORN, *Chairman.*

Wolcott Gibbs Fund

During the period March 1, 1972 to February 28, 1973, no new grants were made; the number and amount of grants made during the preceding period ending February 29, 1972 were at such level that current income into

the Fund during this period had been exceeded by grant commitments. Of a total of $6,450 committed from the Wolcott Gibbs Fund to designated Indian chemists, there remains $2,250 committed but not yet expended.

A further payment was made under Grant No. 38 (total commitment $700, of which $516.39 has been paid, as reported in 1972), as follows:

Dr. J. D. Cherayil and Dr. T. M. Jacob, Indian Institute of Science, Bangalore: "Synthetic Investigations in Nucleic Acids". For Spectrographic Cells, February 1973, $149.90.

The financial status of the Wolcott Gibbs Fund as of February 28, 1973, was as follows: Capital contribution, $5,173; Addition from earned income, $8,453; Realized capital gain, $9,334; Short term investments, $1,720; Cash, $232; *Total equity,* $24,912.

JAMES S. COLES, *Acting Chairman.*

Benjamin Apthorp Gould Fund

The principal action to report is that the Board of Directors of the Gould Fund agreed to nominate Dr. Kenneth I. Kellermann, a Staff Astronomer of the National Radio Astronomy Observatory in Charlottesville, Virginia, as the second recipient of the Benjamin Apthorp Gould Prize. This suggestion was approved by the Council of the National Academy of Sciences and Dr. Kellermann has been informed that he will be given the Gould Award, which includes an honorarium of $5000, at the Annual Meeting of the Academy to be held in Washington late in April of this year.

Among the younger astronomers of the United States, Kenneth Kellermann is one of the most outstanding and prolific workers. He represents a fine blend between a competent radioastronomical observer and a sound interpreter and theoretical analyst of assembled observational data. His researches have ranged already all the way from planetary studies to interpretive analyses of cosmological significance for radio source surveys and statistics. He has been one of the prime movers in the development of long base line interferometry, in which spectacular area of research he is considered one of the pioneers. The planning and execution of a scheme involving cooperative efforts between United States and Soviet radioastronomers in the area of long base line interferometry owe much to the efforts of Dr. Kellerman. His initiative helped to achieve the detection of very small distant radio sources, several with angular dimensions of only a few thousandths of a second of arc. Kenneth Kellermann is indeed one of the brightest young giant stars on the radioastronomical horizon.

The financial status of the Fund, as of February 28, 1973, was as follows: Capital contribution, $40,000; Addition from earned income, $28,578; Realized capital gain, $23,780; Short term investments, $3,690; Cash, $7,107, *Total equity,* $103,155.

B. J. BOK, *Chairman.*

Marcellus Hartley Fund

No award of the Public Welfare Medal is contemplated for 1973. For the year 1972 the Medal was awarded to Dr. Leonard Carmichael.

The financial status of the Fund as of February 28, 1973, is as follows: Capital contribution, $1,168; Addition from earned income, $32; Realized capital gain, $1,013; Short term investments, none; Cash, $3,479; *Total equity,* $1,266.

HARVEY BROOKS, Charmain.

Joseph Henry Fund

No grants have been made since the last annual report.

The financial status of this fund as of February 28, 1973, was: Capital contribution, $39,740; Addition from earned income, $33,024; Realized capital gain, $43,280; Short term investments, none; Cash, $4,226; *Total equity,* $120,270.

MURRAY GELL-MANN, *Chairman.*

Jessie Stevenson Kovalenko Fund

The financial status of the Fund as of February 28, 1973, was as follows: Capital contribution, $43,741; Additional from earned income, $7,000; Realized capital gain, $26,782; Short term innvestments, none; Cash, $3,009; *Total equity,* $80,532.

The Committee unanimously nominated Dr. Seymour S. Kety to receive the Award this year, and this was approved by the Council of the Academy. The presentation is planned for Monday evening, April 23.

R. W. GERARD, *Chairman.*

Marsh Fund

The Marsh Fund of the National Academy of Sciences was established in the Will of the late O. C. Marsh to promote original research in the natural sciences.

The income from this Fund allows the Academy to make small grants of up to about $1,000 in support of worthy original research projects.

Review of applications has been placed on a more formal basis. Applications received by March 1 or September 1 will be reviewed in April or October and awards announced on May 1 or November 1.

Since the last report to the Academy, the Committee on the Marsh Fund has approved the following grants:

No. 149. To Mr. Armand Campagna, Jr., Biological Science Center, Boston University, 2 Cummington Street, Boston, Mass. 02215, for illustrations of the sonic mechanisms in several brotulid ophidioid fishes for use in dissertation and subsequent publications_ $720.00

No. 150. To Dr. Albert E. Wood, 20 Hereford Avenue, Cape May Court House, New Jersey 08210, for continuation of his research on fossil rodents_____ $250.00

No. 151. To Dr. John R. Boreske, Jr., Museum of Comparative Zoology, Harvard University, for illustrations of research on the phylogenetic and taxonomic relationships of North American Fossil Amiid fishes and European taxa_____ $265.00

The financial status of the Marsh Fund, as of February 28, 1973, was: Capital contribution, $10,000; Addition from earned income, $12,100; Realized capital gain, $17,690; Short term investments, none; Cash, $1,291; *Total equity,* $41,081.

JOHN D. BALDESCHWIELER, *Chairman.*

Murray Fund

The Committee recommends that the Agassiz Medal be granted in 1973 in connection with the centennial celebration of the Agassiz-Anderson School of Natural History sponsored by the Marine Biology Laboratory and the Woods Hole Oceanographic Institution during August 13–17, 1973. The request is made to the Council for supplemental funding which will enable the award to be made this year.

The financial status of the Murray Fund as of February 28, 1973 was: Capital contribution, $6,000; Addition from earned income, $6,000; Realized capital gain, $8,935; Short term investments, $900; Cash, $391; *Total equity,* $22,226.

FRANK PRESS, *Chairman.*

NAS Award in Microbiology

This award is given at intervals greater than one year, and an award was made in 1972 to Charles Yanofsky. Accordingly, the Committee did not take action this year. One nomination was received from a member of the Academy. Short term investments, $10,000; Cash, $459; *Total equity,* $10,459.

BERNARD D. DAVIS, *Chairman.*

J. Lawrence Smith Fund

The Committee has recommended the award of the J. Lawrence Smith Medal for 1973 to Dr. Clair Patterson of California Institute of Technology.

The financial status of the J. Lawrence Smith Fund as of February 28, 1973, before the award recommended, was as follows: Capital contribution, $8,000; Addition from earned income, $41,000; Realized capital gains, $11,336; Short term investments, none; Cash, $2,598; *Total equity,* $62,934.

PRESTON CLOUD, *Chairman.*

Mary Clark Thompson Fund

In the past the Mary Clark Thompson award, a gold medal, has been made to paleontologists. However, the original terms of the gift stated that the award should be "for the most important services to geology and paleontology." In the latter part of 1971 the members of the Section of Geology voted to recommend that the basis of the award be expanded to include all fields of geology. On February 4, 1972 the Council of the Academy accepted the recommendation that the Mary Clark Thompson Medal be awarded for most important services to geology and/or paleontology.

The Committee began serious deliberations during the summer of 1972 concerning the most suitable candidate for the medal. It soon became very

obvious that the Committee was unanimous in choosing Hollis Dow Hedberg, Professor Emeritus of Geology at Princeton University and retired Vice-President for Exploration of the Gulf Oil Corporation. Hollis Hedberg has been pre-eminently successful in combining industrial research and basic research in geology and in bringing the results to bear on public policy. As a prelude to the study of the origin of sedimentary rocks it is necessary to have an international stratigraphic classification of sedimentary rocks. Hedberg's contribution to this subject is indicated by the titles of a few of his papers: "Time-Stratigraphic Classification of Sedimentary Rocks" (1948) and "Towards Harmony in Stratigraphic Classification" (1959). His most recent contribution to this subject is "An International Guide to Stratigraphic Classification, Terminology, and Usage," prepared in 1972 for the 24th International Geological Congress by Hedberg as President of the International Subcommittee on Stratigraphic Classification.

His research on compaction of clay reported in 1936 in the American Journal of Science applied keen insight and skillful analysis of data to a significant problem. This research—after 37 years—still maintains a lively rate of citation in current research. His vast knowledge of stratigraphy culminated in a paper entitled, "The Stratigraphic Panorama," his presidential address to the Geological Society of America in 1960. In the mid-1960's the Mohole Committee, of which he was chairman, was a necessary prelude to the more recent extensive deep-sea drilling program that has so revolutionized geologic thinking.

As Vice-President of Exploration for the Gulf Oil Company he had a rare opportunity to visit many parts of the world. His international reputation is clearly indicated by the honors he has received. In 1970 he delivered the prestigious William Smith Lecture to the Geological Society of London. He has also contributed to public policy issues of mineral exploration, as indicated by such papers as: "The Role of National Governments in Exploration for Mineral Resources," "Some Matters of Concern to the Petroleum Industry with Respect to Public Policy on Mineral Resources of the World Ocean," "Who Should have Jurisdiction Over Offshore Mineral Resources?," "Sea bed: the big questions" (in War/Peace Report, Vol. 9, pp. 3–9).

The financial status of the Thompson Fund as of March 1973 is: Capital contribution, $10,000; Addition from earned income, $700; Realized capital gain, $8,831; Short term investments, none; Cash, $1,960; *Total equity,* $21,491.

MARLAND P. BILLINGS, *Chairman.*

U.S. Steel Foundation Award in Molecular Biology

Members of the selection committee, appointed by President Handler, recommended that the 1973 U.S. Steel Foundation Award in Molecular Biology,

administered by the Academy, be made to Donald D. Brown of the Carnegie Institution of Washington. The recommendation was approved by the Council of the Academy.

An honorarium of $5,000 comprises the award which will be presented to Professor Brown on April 23.

A. DALE KAISER, *Chairman.*

Charles Doolittle Walcott Fund

The financial status of the Walcott Fund, as of March 15, 1973, is as follows: Capital contribution, $5,000; Addition from earned income, none; Realized capital gain, $4,388; Short term investments, $1,800; Cash, $248; *Total equity,* $11,436.

The next award of the Charles Doolittle Walcott Medal is due in 1977.

ERNST MAYR, *Chairman.*

G. K. Warren Prize

Understanding of the geology of rivers has benefited greatly by recent research that has been central to the work and interests of G. K. Warren, which properly merits recognition among the recipients of the prize. The Committee on the G. K. Warren Prize was therefore pleased to nominate Luna B. Leopold to be so honored as the second medalist for his leading research in fluviatile geology.

The present Committee is in accord with earlier recommendations that "fluviatile geology" be liberally interpreted, inasmuch as understanding of fluviatile geology can be advanced through research on other kinds of streams such as glaciers, and those in the oceans and the atmosphere.

It is understood that the next award of the G. K. Warren Prize will be made in 1977.

The current status of the trust fund as furnished by the Home Secretary is as follows: Capital contribution, $15,000; Addition from earned income, $1,500; Realized capital gain, $2,161; Short term investment, none; Cash, $900; *Total equity,* $19,561.

The Committee is composed of Hollis D. Hedberg, William W. Rubey, and W. B. Langbein.

W. B. LANGBEIN, *Chairman.*

James Craig Watson Fund

In the period March 1, 1972 to March 1, 1973, the James Craig Watson gold medal and an honorarium of $2,000 was awarded to Andrê Deprit on Monday, April 24, 1972.

The financial status of the Fund, as of February 28, 1973 was: Capital contribution, $25,000; Addition from earned income, $19,400; Realized capital gain, $23,490; Short term investments, $4,600; Cash, $1,674; *Total equity,* $74,164.

PAUL HERGET, *Chairman.*

Report on the Proceedings

The recent steady growth in the size of the Proceedings continued unabated, and indeed at an accelerated pace, in 1972. During that year we published 856 papers, as compared with 721 in 1970. The size of the first five issues of 1973 shows a further increase by comparison with the corresponding issues last year. Moreover, the average length per paper appears also to have increased. There is, at present, no indication that the number of papers published, assuming no change in editorial policy, will level off in the foreseeable future. Moreover, the Proceedings contains a built-in growth factor that is not present in most journals. The membership of the Academy is increasing from year to year, and will be increasing even more rapidly in the next five years; hence the number of individuals eligible to communicate papers to the Proceedings automatically increases also. We must consider whether we wish to let this growth follow its course, or whether we should impose controls. If the latter, what should the controls be?

The Proceedings remains predominantly a journal of the biological sciences; about 86 per cent of the papers published in 1972 were so classified. Indeed, many of the papers labeled "chemistry" were of particular interest to biochemists. I record these facts, without comments, for your consideration.

We have begun to publish invited papers dealing with important problems concerning the broader aspects of science and its social relations, as well as selected invited review articles. Examples from the first category include short papers by Goeller, Meadows, Solow, Brubaker, and S. J. Singer based on presentations they have made before COSPUP on Resources and the Future; an example from the second category is a comprehensive review of the Russian literature of Neuropsychology written by Dr. Luria. We hope to continue, or even to expand, these features.

I hope the Proceedings will become a medium for the publication of papers from the newer Sections of the Academy, particularly in Medicine, Applied Biology, and the Social and Behavioral Sciences. Suggestions to facilitate such publication will be welcomed.

ROBERT L. SINSHEIMER,
Chairman, Editorial Board.

SUNDAY EVENING CONCERT

On Sunday evening, April 22, a concert of Polish madrigals and a new work, "Copernicus", commissioned by the Academy through the generosity of the Copernicus Society of America was presented to the members and guests. Written in commemoration of the Copernicus Quincentary with music by Leo Smit and narration by Sir Fred Hoyle, the work was drawn from the highly developed music of Medieval and Renaissance Poland. This was the premiere performance of "Copernicus."

AWARD CEREMONY

On Monday evening, April 23, 1974, the National Academy of Sciences honored ten scientists and two staff members for outstanding achievements in their respective fields during a ceremony which was held in the Academy auditorium. The ceremony was to have been preceded by an address by Jacob Bronowski, Director of the Council for Biology in Human Affairs of The Salk Institute. However, he was unable to attend because of an illness. His film "The Ascent of Man" was shown in his absence. In addition, those members who had been elected in 1972 were presented to the membership by President Handler to the applause of their fellow members. They signed the Members' Book and were greeted by President Handler.

The J. Lawrence Smith Medal for investigations of meteoric bodies was presented to Clair Cameron Patterson of the California Institute of Technology, in "recognition of his groundbreaking isotopic studies of meteorites, particularly on lead isotopics and the age of the solar system."

Robert H. Dicke, of Princeton University, was presented the Comstock Prize for most important discovery or investigation in electricity, magnetis or radiant energy in recognition of his "pioneering development and use of instruments of high precision in the investigation of the nature of gravitation and the universe."

The Mary Clark Thompson Medal for most important services to geology and paleontology was presented to Hollis Dow Hedberg of Princeton University in recognition of "his outstanding contributions to theoretical geology."

The Jessie Stevenson Kovalenko Medal was awarded to Seymour Solomon Kety in "recognition of his furthering of the essential understanding of balance between hereditary and other biological factors, on the one hand, and psychosocial experiential ones, on the other, in the pathogenesis and manifestations of schizophrenia."

The United States Steel Foundation Award in Molecular Biology was presented to Donald David Brown of the Carnegie Institution of Washington, in recognition of "his studies of the structure, regulation, and evolution of genes in animals, particularly the genes specifying ribsomal RNA in Xenopus and silk fibroin in Bombyx."

Luna Bergere Leopold was the recipient of the second G. K. Warren Prize for noteworthy and distinguished accomplishment in fluviatile geology. Dr. Leopold was cited for his "contributions to the field of hydraulic geometry of rivers, and his studies of the riverine environment."

The second National Academy of Sciences Award in Aeronautical Engineering was presented in absentia to Donald Wills Douglas, Sr., in recognition of his "vast contribution to the aviation world."

Samuel Karlin of Stanford University was the second recipient of the National Academy of Sciences Award in Applied Mathematics and Numerical

Analysis. This award established by the International Business Machines Corporation is presented for distinguished achievements in fundamental research relevant to other fields of science. Dr. Karlin was cited for his "brilliant and productive mathematical work encompassing genetics, economics, approximation theory, probability and statistics, and game theory."

The Benjamin Apthorp Gould Prize for distinguished work in astronomical research was presented to Kenneth I. Kellermann of the National Radio Astronomy Observatory. Dr. Kellermann was cited for his "pioneering contributions in the areas of planetary radio astronomy, source flux densities and spectra, short wavelength source surveys and statistics, variable sources, and long baseline interferometry."

W. Thomas Edmondson of the University of Washington was presented the National Academy of Sciences Award for Environmental Quality in honor of Frederick Gardner Cottrell. This award made for outstanding contributions to improve the quality of environment, or the control of pollution by man, was presented to Dr. Edmondson in recognition of his "scientific contributions to limnology."

The first two National Academy of Sciences Awards for Distinguished Service were presented to Hugh Odishaw and William N. Carey, Jr. The 1972 award was presented to Dr. Odishaw and the 1973 award to Dr. Carey for their records of "continuous leadership in the programs and commitments of the National Research Council."

Following the ceremony, an informal reception in honor of the award recipients, guests, and members of the Academy was held in the Great Hall of the Academy by President and Mrs. Handler.

ACADEMY DINNER

The annual Academy dinner, held in cooperation with the Smithsonian Institution, was held on Tuesday, April 24 at the Regency Ballroom of the Shoreham Hotel. Janusz Groszkowski, President Emeritus of the Polish Academy of Sciences, and Honorary Chairman of the Symposium, was the principal speaker.

WEDNESDAY EVENING CONCERT

On Wednesday, April 25, a Concert was presented with Leon Kirchner conducting players of the Boston Symphony Orchestra with soloists Peter Serkin and Diane Hoagland. The program included the work of four land-mark 20th Century composers: Anton Webern, Oliver Messiaen, Leon Kirchner, and Arnold Schoenberg.

SPECIAL PUBLIC INTEREST ACTIVITIES

On Tuesday, April 24, the Smithsonian Institution and the Copernican Committee presented "Innovation in Technology, A Case History Approach" at the History and Technology Auditorium with Robert P. Mult-

hauf as convenor. In addition, "Space Age Children: The Discovery and Nurture of Scientific Talent" Part I, was presented with Shana Alexander as moderator. Part II was presented on Wednesday. Also on Wednesday "Innovation in Technology, Incentives for Productivity" was concluded.

There were also special exhibitions open to the public. These included: scientific instruments and art objects from the Renaissance, a collection of art and artifacts reflecting Polish culture from the Renaissance onward, representative groups of Polish posters commissioned in honor of the Copernican quincentennial, a display of Copernican stamps, an experimental planetarium, various items relating to the early effort to develop a professional scientific community in the United States, rare books of the Renaissance, and rare art from the Renaissance. In addition to the display of Copernican stamps, a commemorative stamp was sold during the symposium.

COPERNICAN SYMPOSIUM

The Nature of Scientific Discovery

The 1973 Annual Meeting of the National Academy of Sciences celebrated the five hundredth anniversary of the birth of Nicolaus Copernicus. The program for the Copernican Symposium was developed jointly by a special committee of the Academy and Smithsonian Institution under the chairmanship of John Archibald Wheeler and in cooperation with The Copernicus Society of America and the U.S. National Commission for UNESCO.

Monday, April 23

OPENING OF THE COPERNICAN SYMPOSIUM

(Academy Auditorium)

A. RUPERT HALL, Imperial College, London, England: *Introductory Remarks.*

OWSEI TEMKIN, Institute of History of Medicine, Johns Hopkins University, Baltimore, Maryland: *Science and Society in the Age of Copernicus.*

CHARLES EAMES, Designer: *The Age of Copernicus.*

HEIKO OBERMAN, The Institute of Reformation Studies, University of Tübingen, Germany: *Reformation and Revolution.*

Tuesday, April 24

(Baird Auditorium, Museum of Natural History)

STEPHEN TOULMIN, University of California, Santa Cruz, California: *Introductory Remarks.*

GERALD HOLTON, Harvard University, Cambridge, Massachusetts: *Conditions for the Rise and Fall of Science.*

WERNER HEISENBERG, Max-Planck Institute for Physics and Astrophysics, Munich, Germany: *Tradition in Science.*

Wednesday, April 25

(Academy Auditorium)

OWEN GINGERICH, Harvard University, Cambridge, Massachusetts: *Introductory Remarks.*

MAARTEN SCHMIDT, California Institute of Technology, Pasadena, California: *Quasars and The Universe.*

JOHN ARCHIBALD WHEELER, Princeton University, Princeton, New Jersey: *The Universe as Home for Man.*

Tuesday, April 24

(Lecture Room)

CONTRIBUTED PAPERS

JEROME KRISTIAN, Hale Observatories, Pasadena, California (Introduced by Horace W. Babcock): *Quasars as Events in Galaxy Nuclei.* 15 minutes.

E. OROWAN, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Origin of the Surface Features of the Moon.* 15 minutes.

PAUL E. DAMON, University of Arizona, Tucson, Arizona (Introduced by Thomas S. Lovering): *Heliomagnetic-Geomagnetic Modulation of Radiocarbon Production in the Earth's Atmosphere.* 15 minutes.

L. KNOPOFF and M. BUKOWINSKI, University of California, Los Angeles, California: *Is the Inner Core Liquid After All?* 15 minutes.

G. BREIT, M. TISCHLER, S. MUKHERJEE, and G. PAPPAS, State University of New York at Buffalo, Buffalo, New York: *Magnetic Moment Effects on Tests of Charge Independence in Nucleon-Nucleon Scattering.* 15 minutes.

H. T. HAMMEL and P. F. SCHOLANDER, Scripps Institution of Oceonography, University of California, San Diego, La Jolla, California: *Negative Hydrostatic Pressure in the Solvent is the Basis for all Colligative Properties of the Solution.* 15 minutes.

ALBERT SZENT-GYÖRGYI, Marine Biological Laboratory, Woods Hole, Massachusetts: *Electronic Biology.* 15 minutes.

ALBERT B. SABIN and GIULIO TARRO, NCI Frederick Cancer Research Center, Fort Detrick, Frederick, Maryland: *Herpes Simplex and Genitalis Virus Nonviron Antigens: Their Use for Determining Role of these Viruses in Etiology of Some Human Cancers.* 15 minutes.

W. SHOCKLEY, Stanford University, Stanford, California: *Variance of Caucasian Admixture in Negro Populations, Pigmentation Variability and IQ.* 15 minutes.

AUTUMN MEETING, 1973

The 107th Autumn Meeting of the National Academy of Sciences was held in Washington, D.C., on October 22 and 23. Seventy-seven members and one member emeritus registered during the meeting as follows:

Abelson, Philip H.
Adelberg, Edward A.
Alberty, Robert A.
Babcock, Horace W.
Backus, George E.
Benson, Andrew A.
Berliner, Robert W.
Bigeleisen, Jacob
Bold, Harold C.
Branscomb, Lewis M.
Brode, Wallace R.
Bronk, Detlev W.
Brooks, Harvey
Bryson, Arthur E., Jr.
Burris, R. H.
Cahn, John W.
Calvin, Melvin
Chanock, Robert M.
Clogston, Albert M.
Cloud, Preston
Cohen, Morris
Cohen, Philip P.
Crane, Horace R.
Crow, James F.
Dorfman, Albert
Eagle, Harry
Ebert, James D.
Edsall, John T.
Forbush, Scott E.
Forster, Robert E.
Friedman, Herbert
Garwin, Richard L.
Geertz, Clifford
Gilman, Henry
Goldhaber, Gertrude S.
Griffin, James B.
Gross, Ludwik
Hegsted, D. M.
Hendricks, Sterling B.
Hill, Terrell L.
Hollaender, Alexander
Hutchinson, G. Evelyn
Julian, Percy L.
Kistiakowsky, G. B.
Kompfner, Rudolf
Kramer, Paul J.
Lax, Benjamin
Lerner, Aaron B.
Livingston, M. Stanley
Luria, S. E.
Lush, Jay L.
Luyten, Willem J.
MacDonald, Gordon J. F.
Macdonald, J. Ross
Mac Lane, Saunders
McLean, William B.
Meselson, M. S.
Neyman, Jerzy
Nolan, Thomas B.
Purcell, E. M.
Ranney, Helen M.
Roberts, Richard B.
Roman, Herschel L.
Sabin, Albert B.
Seegmiller, J. Edwin
Shannon, James A.
Shockley, William
Shull, Harrison
Stever, H. Guyford
Taussig, Helen B.
Wasserburg, G. J.
Weber, Ernst
Wetmore, Alexander
Williams, Carroll M.
Witkop, Bernhard
Woodring, Wendell P. (Member Emeritus)
Yoder, Hatten S., Jr.
Zworykin, V. K.

BUSINESS SESSION

The Academy met in business session on Tuesday, October 23, 1973, President Handler presiding.

Amendments to Constitution

The Home Secretary reported that, at the Annual Meeting in April of 1973, the membership acting as a committee of the whole accepted two proposed amendments to the Constitution of the NAS. Article VII of the Constitution directs that each amendment ". . . shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be

adopted." Article VII further states that "absent members may send their votes on pending changes in the Constitution to the Home Secretary in writing, and such votes shall be counted as if the members were present." In accordance with the latter provision, the Home Secretary reported that the proposed Constitutional amendments had been sent to all members with a mail ballot. The Home Secretary then presented the proposed constitutional amendments as follows:

1. ARTICLE III, SECTION 1, PAGE 4

The Home Secretary read the proposed new language which would eliminate the mandatory requirement for an Autumn Meeting of the Academy:

SECTION 1. The Academy shall hold one stated meeting called the annual meeting, in April of each year in the city of Washington and such other meetings as may be scheduled by the Council. The Council shall have the power to determine the location for such other meetings, and to fix the date of each meeting. The members shall be notified of other scheduled meetings at least sixty (60) days in advance of the fixed date for such meeting.

The Council shall define the objectives and general content of all meetings and shall establish, under the direction of the Home Secretary, committees on arrangements for the meetings as it deems appropriate.

The Home Secretary then moved the adoption of the above amendment. After the motion was seconded, Mr. Garwin moved that the language be amended for clarification by inserting the word "such" in front of "other scheduled meetings" in the last sentence of the first paragraph of the proposed new Section 1. The President ruled that the proposed amendment, being a clarification, was acceptable without prejudice to the mail ballot previously conducted. There being no objection to this motion, it passed unanimously. The membership then voted to approve the proposed amendment, as clarified, of Section 1, Article III.

2. ARTICLE V, SECTIONS 1 AND 2

The Home Secretary explained that the Bylaws Committee had recommended deleting the constitutional requirement for mandatory sessions of contributed papers at each meeting of the Academy and inserting in the Bylaws a requirement that the Council from time to time schedule contributed papers. The Home Secretary read the two sections proposed for deletion from the Constitution as follows:

SECTION 1. Communications on scientific subjects shall be read at scientific sessions of the Academy, and papers by any members may be read by the author or by any other member, notice of the same having been previously given to the secretary.

Section 2. Any member of the Academy may read a paper from a person who is not a member and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

On a motion by the Home Secretary, the membership voted to delete Sections 1 and 2 of Article V; to renumber Sections 3, 4 and 5 as 1, 2 and 3, respectively; and to modify the title of Article V to read: "Of Reports."

Amendments to Bylaws

At the Annual Meeting in April of 1973, an amendment to the Bylaws had been proposed which would authorize the Council to schedule sessions for contributed papers, in lieu of the previous requirement in the Constitution. At the request of the Bylaws Committee, action on this amendment was held in abeyance until formal action could be taken on the related amendments to the Constitution at the Autumn Meeting.

Noting that the Constitution had now been appropriately amended, the Home Secretary read the following proposed amendment to Bylaw V:

> 1. The Council shall from time to time schedule sessions for contributed papers at scientific meetings of the Academy at which any member shall have the right to read a paper with notice of the same having been previously given to the Home Secretary.

The Home Secretary moved adoption of the above language as a new paragraph 1 of Bylaw V and the renumbering of paragraphs 1 and 2 as paragraphs 2 and 3.

In response to a question from Mr. Shockley, the Home Secretary explained that without the proposed amendment, there would be no obligation for the Council to schedule sessions on contributed papers.

The membership then voted to approve the proposed amendment to Bylaw V, as read by the Home Secretary.

Report Review Committee

The President called on the Vice President, Mr. Saunders Mac Lane, to report in his capacity as Chairman of the Report Review Committee. Mr. Mac Lane began by noting that the Report Review Committee conducts its work through panels which are composed of members of the Academy. While the committee does not review all reports of the Academy and its National Research Council, it is the responsibility of that committee to determine which reports might deserve special attention. In reviewing such reports, the panel attempts to determine whether the report speaks appropriately under the imprimatur of the Academy and, indeed, adequately addresses the purpose of the study. Mr. Mac Lane cited several examples of the types of reports reviewed by the Report Review Committee in the past and others which may be anticipated in the future. He concluded his comments by encouraging Academy members who would like to assist with the work of the Report Review Committee by serving on panels to contact either him or Mr. Robert Green in the Report Review Committee office at the Academy. In particular, he suggested that serving on a panel of the Report Review Committee would be a meaningful initiation for new Academy members

and asked the members present to assist in identifying younger colleagues who should be invited to participate in this important activity of the Academy.

Mr. Garwin suggested that a special letter be written to new members of the Academy inviting them to indicate their willingness to serve on a report review panel and advising them of the facilities available within the Academy offices to assist in this work.

Report of the President

Relationship with NAE

President Handler summarized the progress which had been made in clarifying the relationships with the National Academy of Engineering, beginning with the resolution which was adopted by the National Academy of Sciences at its Annual Meeting in April, 1973. Subsequently, at the Annual Meeting of the NAE, their members requested that two options be developed for consideration at the NAE Autumn Meeting. President Handler reported that Robert Seamans, newly elected President of the NAE, had met with the NAS Council in August, at which time he had proposed a basis for NAE continuance within the NAS corporate structure. His proposal was favorably received and referred to a joint negotiating team consisting of three representatives from each Council. President Handler commented that these recent series of negotiations had been conducted in an atmosphere which reflected the apparent desire of both the NAE and the NAS to identify a relationship of the two bodies which would enable their full cooperation in the implementation of the restructured NRC. He stated that a statement of principles had been agreed upon by the joint negotiating team and submitted to the respective Councils for approval. This document reflects the proposal which was advanced by President Seamans when he met with the NAS Council in August as follows: There would be established an Assembly of Engineering which would operate within the National Research Council; all of the study projects of the NAE would immediately be transferred to that Assembly; the initial chairman of the Assembly of Engineering would be the President of the NAE without setting precedent for this position being so filled in the future; as the organization of the NRC progresses, programs of the Assembly of Engineering would be examined with the intention of transferring those which more properly belong elsewhere; appropriate projects would remain within the Assembly of Engineering. At the same time, NAE would participate in the governance of NRC in a manner generally similar to that discussed by the Academy at the Spring Meeting of 1973.

If approved by both Councils, President Handler explained that the final document will be brought back before the NAS members for approval in the Spring.

Mr. Cloud suggested that consideration be given to changing the name of the Assembly of Engineering to the "Assembly of Engineering and Applied Sciences."

Reorganization of NRC

In connection with the reorganization of the NRC, President Handler reported that two Assemblies and one Commission were now in place and operating. These are the Assemblies of Behavioral and Social Sciences, under the Chairmanship of Robert McC. Adams; the Assembly of Life Sciences, under the Chairmanship of James Ebert; and the Commission on Natural Resources, under the Chairmanship of Gordon MacDonald. He stated that plans were progressing for the establishment of the Assembly of Physical and Mathematical Sciences, the Commission on Societal Technologies and the Commission on Human Resources.

Relationships with Congress

President Handler commented briefly on the increasing awareness in the United States Congress of the National Academy of Sciences, citing as an example the fact that there were nine major bills currently pending which, if enacted, would involve the Academy in tasks of considerable magnitude. While personally welcoming the interest, President Handler expressed his concern about the increasing volume of commitments and the capacity of the Academy to respond in a responsible way, particularly since many of such requests are of an urgent nature and require immediate action. He pointed out that the formation of the new Assemblies and Commissions should enable more timely and effective response than had been possible in the past.

International Activities

In the absence of the Foreign Secretary, President Handler reported briefly on visits by representatives of the NAS to the Royal Society in London and the Soviet Academy. President Handler summarized the series of events surrounding the public condemnation of Academician Andrei Sakharov in the Soviet Union. President Handler observed that the cables seemed to have served their purpose for the time being in that Sakharov still appeared to be at liberty to work as a physicist and to speak out on public issues. Under date of October 15, 1973, President Keldysh had responded to President Handler's cable.

Shockley Resolution

Mr. Shockley proposed the following resolution for adoption by the membership:

> **It is resolved that the Council appoint a committee to take two actions:**
>
> (1) To evaluate [in the light of other related studies] the research on dysgenics by Osborne and Suddick and by Shockley reported at the 1973 Autumn Meeting; and
>
> (2) to prepare a statement for publication after review by the Academy regarding dysgenic issues related to the Osborne-Suddick and the Shockley research.

Mr. Garwin made a motion that the meeting adjourn, which was seconded. Since a motion to adjourn carries precedence over all other motions on the floor, the President called for a vote on Mr. Garwin's motion and it was unanimously passed.

RECEPTION AND BUFFET

On the evening of October 22, a reception and buffet for Academy members and guests was held in the Great Hall of the Academy Building. The reception was hosted by President and Mrs. Handler.

SCIENTIFIC PROGRAM

The scientific sessions, all of which were open to the public, were held in the Academy's Auditorium and Lecture Room, beginning on October 22 and continuing through October 23 as follows:

Monday, October 22

(Auditorium)

FROM KNOWLEDGE TO ACTION: SCIENCE AND ITS USES

This three-session symposium has been prepared for presentation at the Autumn Meeting under the aegis of the Committee on Science and Public Policy, chaired by Melvin Calvin.

I. Science and the Public Sector

Harvey Brooks, *chairman,* Harvard University, Cambridge, Massachusetts: *Introductory Remarks.*

M. Frank Hersman, National Science Foundation, Washington, D.C.: *A National Policy Overview.*

Robert Nathans, State University of New York at Stony Brook, New York: *Practical Applications from Within the University to the Problems of Municipalities.*

William Donaldson, City Manager, Tacoma, Washington: *Science for the Public Sector: The User's Viewpoint.*

II. Science and Industry: The Private Sector

Rudolf Kompfner, *Chairman,* Stanford University, Stanford, California. *Introductions.*

Richard W. Roberts, *Chairman,* National Bureau of Standards, Gaithersburg, Maryland: *Opening Remarks.*

Walter C. Marshall, Atomic Engineering Research Establishment, Harwell, Berkshire, Didcot, England: *Science Policy and Industrial Research.*

Pierre Aigrain, Visiting Professor, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Government Help to Industrial Research: Why and How.*

N. Bruce Hannay, Bell Telephone Laboratories, Murray Hill, New Jersey: *Using Science.*

Monday, October 22

(Lecture Room)

CONTRIBUTED PAPERS

Papers contributed by members of the National Academy of Sciences or by individuals sponsored by members of the Academy.

ANDREW A. BENSON and L. MUSCATINE, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California, and Department of Biology, University of California, Los Angeles, California: *Wax in Coral Mucus Feeds Tropical Reef Fishes,* 15 minutes.

W. SHOCKLEY, Stanford University, Stanford, California: *Confirmation of Negro Economic Gains on Whites and Identification of Dysgenic Subpopulations by "Offset Analysis".* 15 minutes.

R. T. OSBORNE and DAVID SUDDICK, University of Georgia, Athens, Georgia (Introduced by W. SHOCKLEY): *Fertility, IQ and School Achievement.* 15 minutes.

ARTHUR R. JENSEN, University of California, Berkeley, California (Introduced by HARRY F. HARLOW): *How Biased are Culture-Loaded Tests?* 15 minutes.

Tuesday, October 23

(Auditorium)

III. FEDERAL AND ACADEMIC RELATIONSHIPS: BIOMEDICAL SCIENCES AS AN EXAMPLE

JAMES A. SHANNON, *Chairman,* Rockefeller University, New York, New York: *Introductory Remarks.*

IVAN L. BENNETT, JR., New York University Medical School, New York, New York: *The Statistical Base and Some Observable Trends.*

WALTER A. ROSENBLITH, Massachusetts Institute of Technology, Cambridge, Massachusetts: *The University in Prospect.*

CARLETON CHAPMAN, Commonwealth Fund, New York, New York: *The University Medical Center in Prospect.*

(Lecture Room)

REVIEW OF RECENT SCIENTIFIC FINDINGS ON THE NATURE OF THE MOON

M. NAFI TOKSOZ, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Selenophysics—Structure and Physical Properties of the Moon.*

IAN RIDLEY, Lamont Doherty Geological Observatory of Columbia University, Palisades, New York: *Lunar Petrology—The Nature and Origin of Lunar Rocks and Soils.*

LARRY A. HASKIN, Lyndon B. Johnson Space Center, Houston, Texas: *Lunar Chemistry—The Chemical Composition of the Moon and a Comparison With Some Other Planets.*

GERALD J. WASSERBURG, *Chairman,* California Institute of Technology, Pasadena, California: *Lunar Chronology—The Time Scale of Lunar Evolution and Identification of Major Lunar Events.*

DAVID W. STRANGWAY, University of Toronto, Toronto, Canada: *The Magnetic Moon—Evidence for the Ancient Lunar Magnetic Field and Its Origin.*

EPILOGUE. *Some Afterthoughts on Science Management as Learned from Apollo.*

ANNUAL MEETING, 1974

The 111th Annual Meeting of the National Academy of Sciences was held in Washington, D.C., on April 22, 23, and 24. Three hundred and twenty-three members, two members emeriti, and one foreign associate registered during the meeting as follows:

Abelson, Philip H.
Adams, Robert McCormick
Ahrens, Edward H., Jr.
Alberty, Robert A.
Allard, R. W.
Alvarez, Luis W.
Anderson, Philip W.
Anfinsen, C. B.
Arnold, James R.
Astin, Allen V.
Babcock, Horace W.
Bacher, Robert F.
Barghoorn, Elso S.
Barschall, Henry H.
Bartlett, Paul D.
Beach, Frank A.
Beams, J. W.
Bearn, Alexander G.
Bender, Myron L.
Benson, Andrew A.
Berliner, Robert W.
Bernstein, Richard B.
Bigeleisen, Jacob
Bing, R. H.
Bisplinghoff, Raymond L.
Bloch, Felix
Bloch, Konrad E.
Bloembergen, Nicholaas
Blout, Elkan R.
Bodian, David
Boekelheide, V.
Bold, Harold C.
Bonner, J. T.
Braidwood, Robert J.
Branscomb, Lewis M.
Brattain, Walter H.
Breslow, Ronald
Brinkhous, Kenneth M.
Brode, Robert B.
Brode, Wallace R.
Bronk, Detlev W.
Brooks, Harvey
Brown, Donald D.
Brown, Harrison
Buchanan, John M.
Bullock, Theodore H.
Burke, Bernard, F.
Burns, Robert K.
Burris, R. H.
Cairns, T. L.
Campbell, Donald T.
Carrier, George F.
Carter, H. E.
Chamberlain, Joseph W.
Chamberlain, Owen
Chance, Britton
Chanock, Robert M.
Charney, Jule G.
Chern, Shiing-shen
Chodorow, Marvin
Clogston, Albert M.
Cloud, Preston
Cohen, Morris
Cohen, Philip P.
Cohn, Mildred
Cole, Kenneth S.
Colowick, Sidney P.
Cool, Rodney L.
Cotton, F. Albert
Cotzias, George C.
Cowling, Ellis B.
Crane, Horace R.
Crawford, Bryce, Jr.
Cristol, Stanley J.
Crow, James F.
Darnell, James E., Jr.
Dauben, William G.
Dicke, Robert H.
Djerassi, Carl
Doell, Richard R.
Dorfman, Albert
Dragstedt, Lester R.
Drake, F. D.
DuBridge, L. A.
Duncan, Otis Dudley
Dunning, J. R.
Eagle, Harry
Ebert, James D.
Edelman, Isidore S.
Edmondson, W. T.
Eggan, Fred
Eisen, Herman
Eliel, Ernest L.
Estes, William K.
Eugster, Hans P.
Fairbank, William M.
Ferry, John D.
Feshbach, Herman
Fischer, Edmond H.
Flory, Paul J.
Forbush, Scott E.
Fowler, William A.
Fraenkel, Gottfried S.
Fredrickson, Donald S.
French, C. Stacy
Fried, Josef
Friedlander, Gerhart
Friedman, Herbert

Friedmann, Herbert
Friedrichs, K. O.
Galambos, Robert
Garwin, Richard L.
Geballe, T. H.
Giacconi, Riccardo
Giles, Norman H.
Gilman, Henry
Ginzton, E. L.
Glass, H. Bentley
Goddard, David R.
Gold, T.
Goldberg, Leo
Goldberger, M. L.
Goldhaber, Gertrude S.
Goldhaber, Maurice
Gomory, R. E.
Goodenough, Ward H.
Gordon, W. E.
Gordy, Walter
Grad, Harold
Griffin, James B.
Griggs, David T.
Grobstein, Clifford
Gross, Ludwik
Gunsalus, Irwin C.
Gutowsky, H. S.
Haagen-Smit, Arie J.
Haensel, Vladimir
Hahn, E. L.
Hammes, Gordon G.
Hammond, George S.
Handler, Philip
Hardy, James D.
Harlan, Jack R.
Haskins, Caryl P.
Hasler, Arthur D.
Haworth, Leland J.
Hedberg, Hollis D.
Hegsted, D. M.
Held, Richard M.
Hendricks, Sterling B.
Herring, W. Conyers
Hertz, Roy
Herzberg, Gerhard
(Foreign Associate)
Herzfeld, Karl F.
Hirschfelder, Joseph O.
Hirst, George K.
Hollaender, Alexander
Homans, George C.
Hopfield, John J.
Horsfall, James G.
Hubbert, M. King
Hughes, Vernon W.
Hunsaker, J. C.
Hutchinson, G. Evelyn
Hutchison, Clyde A., Jr.
Inghram, Mark G.
Ingle, Dwight J.
Isselbacher, Kurt J.
Jacobson, Leon O.
Jacobson, Nathan
John, Fritz
Julian, Percy L.
Kaplan, Henry S.
Katz, Joseph J.
Keller, Joseph B.
Kety, Seymour S.
King, C. G.
Kistiakowsky, G. B.
Kleene, Stephen C.
Klotz, Irving M.
Knopoff, Leon
Kompfner, Rudolf
Koshland, Daniel E., Jr.
Kramer, Paul J.
Kraushaar, William L.
Krebs, Edwin G.
Larrabee, Martin G.
Lax, Benjamin
Lehninger, A. L.
Lerner, Aaron B.
Levine, Philip
Lewis, Edward B.
Li, Choh Hao
London, Irving M.
Long, Esmond R.
(Member Emeritus)
Lounsbury, Floyd G.
Luce, R. Duncan
Lush, Jay L.
Macdonald, J. Ross
Mackey, George W.
Mac Lane, Saunders
Malkus, Willem V. R.
Mangelsdorf, P. C.
Marcus, R. A.
Mark, H. F.
Marks, Paul A.
Marschak, Jacob
Mayer, Joseph E.
McCarty, Maclyn
McElroy, W. D.
McKusick, Victor A.
McLean, William B.
Meister, Alton
Meselson, M. S.
Miller, Neal E.
Miller, Stanley L.
Minsky, Marvin
Modigliani, Franco
Moore, Stanford
Moser, Jürgen
Mountcastle, Vernon B.
Mulliken, Robert S.
Nambu, Yoichiro
Neff, William D.
Neurath, Hans
Ney, Edward P.
Neyman, Jerzy
Nier, Alfred O. C.
Nolan, Thomas B.
Oliver, B. M.
Oncley, J. L.
Osterbrock, Donald E.
Owen, Ray D.
Pappenheimer, A. M., Jr.
Pappenheimer, John R.
Parr, Robert G.
Pearson, Gerald L.
Pettit, R.
Pfaffmann, Carl
Pines, David
Piore, E. R.
Pitzer, K. S.
Porter, Keith R.
Rahn, Hermann
Rammelkamp, Charles H.
Ranney, Helen M.
Raper, John R.
Raper, Kenneth B.
Reed, Lester J.
Revelle, Roger
Reynolds, John H.
Rice, Oscar K.
Ripley, S. Dillon
Robbins, Frederick C.
Roberts, John D.
Roberts, Richard B.
Rollins, Reed C.
Roman, Herschel L.
Rossini, Frederick D.

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Russell, Elizabeth S.
Russell, William L.
Sabin, Albert B.
Sachs, Robert G.
Scharrer, Berta
Schawlow, Arthur L.
Schmidt, Carl F.
Schmitt, Francis O.
Scrimshaw, Nevin S.
Seaborg, Glenn T.
Seegmiller, J. Edwin
Segal, Irving E.
Setlow, Richard B.
Shane, C. D.
Shedlovsky, Theodore
Shemin, David
Shull, Harrison
Simpson, John A.
Sinsheimer, Robert Louis
Slichter, Charles P.
Smith, Cyril Stanley
Smith, Emil L.
Smyth, Charles P.
Spedding, F. H.
Spiegelman, Sol
Spitzer, Lyman, Jr.
Stadtman, E. R.
Stellar, Eliot
Stever, H. Guyford
Stewart, T. D.
Stockmayer, W. H.
Streitwieser, Andrew, Jr.
Sturtevant, Julian M.
Swift, Hewson
Tarski, Alfred
Taussig, Helen B.
Terman, Frederick E.
Thimann, Kenneth V.
Thomas, Lewis
Thomas, L. H.
Tukey, John W.
Turkevich, Anthony L.
Udenfried, Sidney
Underwood, Benton J.
Utter, Merton F.
Van Vleck, J. H.
Wall, Frederick T.
Wallace, Anthony F. C.
Walling, Cheves
Wangensteen, Owen H.
Weber, Ernst
Weinberg, Alvin M.
Weinberg, Steven
Wells, John W.
Westheimer, Frank H.
Whinnery, John R.
White, Donald E.
White, Gilbert F.
Whitehead, George W.
Williams, Carroll M.
Wintrobe, M. M.
Witkop, Bernhard
Wood, Harland G.
Woodring, Wendell P. (Member Emeritus)
Yoder, Hatten S., Jr.
Zamecnik, Paul C.
Zwanzig, Robert

BUSINESS SESSION

In opening the meeting, President Handler expressed appreciation to the 1974 Program Committee. The members of the committee were: Allen V. Astin, Chairman; Philip Abelson, C. B. Anfinsen, James D. Ebert, Herbert Friedman, and Sterling B. Hendricks. He also encouraged members to make suggestions or recommendations to the home secretary regarding the 1975 Annual Meeting.

President's Announcements

Tellers for Preference Ballot

The President announced the names of those who served as Tellers for the Preference Ballot: Waldo R. Wedel, *Chairman;* Ernst Weber and Thomas B. Nolan, and thanked them for their service in this regard.

Election of Section Chairmen

Mr. Handler announced the names of newly elected Section Chairmen for the three year term ending June 30, 1977, as follows:

Astronomy—Lyman Spitzer, Jr. to succeed Donald E. Osterbrock.
Physics—Charles P. Slichter to succeed William A. Fowler.
Chemistry—Ronald Breslow to succeed Jacob Bigeleisen.
Botany—Lawrence Bogorad to succeed R. H. Burris.
Physiology—Herman Rahn to succeed Vernon B. Mountcastle.
Psychology—Benton J. Underwood to succeed William D. Neff.
Medical Sciences—Leon O. Jacobson to succeed Maclyn McCarty.

Members Deceased Since the 1973 Annual Meeting

The members stood for the reading of the names of twenty-eight members and four foreign associates who had died since the 1973 Annual Meeting:

Charles Greeley Abbot, born May 31, 1872; elected to the Academy in 1915; died December 17, 1973.

Joseph Charles Aub, born May 30, 1890; elected to the Academy in 1957; died December 30, 1973.

Percival Bailey, born May 9, 1892; elected to the Academy in 1953; died August 10, 1973.

George Holman Bishop, born June 27, 1889; elected to the Academy in 1967; died October 11, 1973.

Leonard Carmichael, born November 9, 1898; elected to the Academy in 1943; died September 16, 1973.

*Alfonso Caso, foreign associate, born February 1, 1896; elected to the Academy in 1943; died November 30, 1970.

Edward Uhler Condon, born March 2, 1902; elected to the Academy in 1944; died March 25, 1974.

John Holmes Dingle, born November 24, 1908; elected to the Academy in 1958; died August 15, 1973.

Leslie Clarence Dunn, born November 2, 1893; elected to the Academy in 1943; died March 19, 1974.

Carl Henry Eckert, born May 4, 1902; elected to the Academy in 1953; died October 23, 1973.

Griffith Conrad Evans, born May 11, 1887; elected to the Academy in 1933; died December 8, 1973.

Ralph Waldo Gerard, born October 7, 1900; elected to the Academy in 1955; died February 17, 1974.

Harold Hotelling, born September 29, 1895; elected to the Academy in 1970; died December 26, 1973.

*Alfred Harrison Joy, born September 23, 1882; elected to the Academy in 1944; died April 18, 1973.

Jerzy Knorski, foreign associate, born December 1, 1903; elected to the Academy in 1963; died September 14, 1973.

Gerard Peter Kuiper, born December 7, 1905; elected to the Academy in 1950; died December 23, 1973.

Thomas Lauritsen, born November 16, 1915; elected to the Academy in 1969; died October 16, 1973.

Robert Frederick Loeb, born March 14, 1895; elected to the Academy in 1946; died October 21, 1973.

*Samuel Marion McElvain, born December 9, 1897; elected to the Academy in 1949; died April 11, 1973.

Charles Snowden Piggot, born June 5, 1892; elected to the Academy in 1946; died July 6, 1973.

Alfred Sherwood Romer, born December 28, 1894; elected to the Academy in 1944; died November 5, 1973.

William Walden Rubey, born December 19, 1898; elected to the Academy in 1945; died April 12, 1974.

Karl Sax, born November 2, 1892; elected to the Academy in 1941; died October 8, 1973.

George Scatchard, born March 19, 1892; elected to the Academy in 1946; died December 10, 1973.

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* Notice received after Annual Meeting.

*Lee Irvin Smith, born July 22, 1891; elected to the Academy in 1944; died March 29, 1973.

Earl Wilbur Sutherland, Jr., born November 19, 1915; elected to the Academy in 1966; died March 9, 1974.

William Hay Taliaferro, born February 10, 1895; elected to the Academy in 1940; died December 21, 1973.

William Smith Tillett, born July 10, 1892; elected to the Academy in 1951; died April 4, 1974.

Artturi Ilmari Virtanen, foreign associate, born January 15, 1895; elected to the Academy in 1969; died November 11, 1973.

Selman Abraham Waksman, born July 2, 1888; elected to the Academy in 1942; died August 16, 1973.

Joseph Leonard Walsh, born September 21, 1895; elected to the Academy in 1936; died December 10, 1973.

David Meredith Seares Watson, foreign associate, born June 18, 1886; elected to the Academy in 1938; died July 23, 1973.

Biographical Memoirs Assigned Since the 1973 Annual Meeting

Leonard Carmichael, to Carl Pfaffmann.
Robert Brainard Corey, to Linus Pauling.
Thomas Lauritsen, to William A. Fowler.
Wolfgang Kohler, to Richard M. Held.
George Scatchard, to John Edsall.
William Hay Taliaferro, to Herman Eisen.

Biographical Memoirs Received Since the 1973 Annual Meeting

Paul Rufus Burkholder, by James G. Horsfall.
Arthur Louis Day, by Philip W. Abelson.
William Draper Harkins, by T. S. Young and R. S. Mulliken.
Vladimir N. Ipatieff, by Louis Schmerling and Vladimir Haensel.
Herbert Spencer Jennings, by T. M. Sonneborn.
Alfred Harrison Joy, by Olin C. Wilson.
Edward Calvin Kendall, by Dwight J. Ingle.
Armand Otto Leuschner, by Paul Herget.
Eugene Lindsay Opie, by Esmond R. Long.
John Rodman Paul, by Paul B. Beeson.
William Thomas Pecora, by Charles A. Anderson.
Richard Joel Russell, by Charles A. Anderson.
Jack Schultz, by Thomas F. Anderson.
Stanley Smith Stevens, by George A. Miller.
John Torrence Tate, by O. C. Nier and G. H. Van Vleck.
Melville Lawrence Wolfrom, by W. Z. Hassid.

Actions on Invitations to the Academy To Be Represented on Special Occasions

Inauguration of Walter Bernhard Waetjen as second President of Cleveland State University, Cleveland, Ohio, on April 30, 1973. Harland G. Wood.

Inauguration of Everett Varney Olsen as fourth President of Lowell Technological Institute of Massachusetts, Lowell, Massachusetts, on May 3, 1973. Ascher H. Shapiro.

Occasion of the Bicentennial Celebration of the Belgium Academy of Sciences, Letters and Fine Arts, Brussels, Belgium, on May 14–17, 1973. Detlev W. Bronk.

Occasion of the Centennial Celebration of the Anderson School of Natural History, Woods Hole, Massachusetts, on August 17, 1973.

*Notice received after Annual Meeting.

Dedication of the Copernicus Astronomical Center, Warsaw, Poland, on September 19, 1973. Antoni Zygmund.

Occasion of the Triennial Meeting of the German Academy of Natural Science, Leopoldina, Halle, Federal Republic of Germany, on October 11–14, 1973. Erwin Chargaff.

Occasion of the Golden Jubilee of Banaras Hindu University, Banaras, India, December, 1973. Pol Duwez.

Occasion of the Golden Jubilee of Israel Institute of Technology, Haifa, Israel, on December 3, 1973. Greetings.

Occasion of the 78th Annual Meeting of the American Academy of Political and Social Sciences, Philadelphia, Pennsylvania, on April 5–6, 1974. David Z. Beckler.

Elections

The elections at the annual meeting resulted as follows: Foreign Secretary for a four year term July 1, 1974 to June 30, 1978, George S. Hammond to succeed Harrison Brown.

Four members of the Council of the Academy for the three year term July 1, 1974 to June 30, 1977: C. B. Anfinsen, William A. Fowler, Roger Revelle, and Elizabeth S. Russell.

Foreign Associates: Pierre Raoul Aigrain, University of Paris, Paris, France; Aleksandr E. Braunstein, Institute of Molecular Biology of the U.S.S.R. Academy of Sciences, Moscow, U.S.S.R.; David Guthrie Catcheside, The Australian National University, Canberra, Australia; John Grahame Douglas Clark, University of Cambridge, Cambridge, England; Alan Lloyd Hodgkin, The Royal Society, London, England; Ryogo Kubo, University of Tokyo, Tokyo, Japan; Sir John McMichael, Royal Postgraduate Medical School, London, England; Jacques Oudin, Institut Pasteur, Paris, France; Sir George Porter, The Royal Institution, London, England; Igor R. Shafarevich, Mathematical Institute of the U.S.S.R. Academy of Sciences, Moscow, U.S.S.R.; Jan Tinbergen, Erasmus University, Rotterdam, The Netherlands; Nikolaas Tinbergen, Animal Research Group, Oxford, England.

Members: Richard Dale Alexander, Edward Anders, Richard Chatham Atkinson, Karl Frank Austen, William Osgood Aydelotte, John Backus, David Baltimore, Lloyd M. Beidler, Francis R. Boyd, Jr., Myron Kendall Brakke, Eugene Braunwald, Winslow Russell Briggs, Thomas Charles Bruice, Solomon Jan Buchsbaum, Orville Lamar Chapman, John Allen Clements, Gerhard Ludwig Closs, William Gemmell Cochran, Columbus Clark Cockerham, Lee Joseph Cronbach, Horace Willard Davenport, Clement Alfred Finch, Willis H. Flygare, Heinz Ludwig Fraenkel-Conrat, Ronald Freedman, Jacob Furth, Daniel Carleton Gajdusek, Ernest Peter Geiduschek, Ivar Giaever, Martin Gibbs, Robert Rowe Gilruth, Herman Heine Goldstine, Leo A. Goodman, Roy Walter Gould, Kenneth Ingvard Greisen, Jerome Gross, Roger Charles Louis Guillemin, Charles Francis Hockett, Hendrik Samuel Houthakker, Frederick Seymour Hulse, Leonid Hurwicz, John Dove Isaacs, Ali Javan, Elwood Vernon Jensen, Eric Richard Kandel, Bessel Kok, Norman

Myles Kroll, Harold Dwight Lasswell, Paul Felix Lazarsfeld, Wassily Leontief, Estella Bergere Leopold, Abba Ptachya Lerner, Richard Levins, Dan Leslie Lindsley, Jr., Frank James Low, Roger Lynds, Richard Stockton MacNeish, John Lee Margrave, Charles Frederick Mosteller, George Daniel Mostow, Hans Joachim Müller-Eberhard, Hamish Nisbet Munro, Theodore Mead Newcomb, Alex Benjamin Novikoff, Jeremiah Paul Ostriker, Chandra Kumar Naranbhai Patel, Ralph Gottfrid Pearson, William Gardner Pfann, Leo Joseph Postman, David Marshall Prescott, Clifford Ladd Prosser, Allen Emerson Puckett, Sarah Ratner, William Harrison Riker, Hans Ris, Abraham Robinson (elected posthumously), Herbert Ellis Robbins, Glenn Wade Salisbury, Rudi Schmid, Theodore William Schultz, William Rees Sears, Irwin Ira Shapiro, Robert Gerson Shulman, Leon Theodore Silver, Elias M. Stein, Dewitt Stetten, Jr., Philip Teitelbaum, Howard Martin Temin, Bert Lester Vallee, Kenneth Marshall Watson, John Stewart Waugh, George West Wetherill, Benjamin Widom, Jacob Wolfowitz, James Barnes Wyngaarden.

Report of the President

President Handler presented his report to members. Commenting on population growth, fuel shortages and growing concern about world supplies of other essential resources, Mr. Handler stated that, henceforth, the entire world must confront the economics of scarcity. He noted that success in coping with scarcity will be even more dependent on scientific and technological capability and that adequate investments in research and development should, as a minimum, provide options so as to avoid sharp discontinuities, minimize political threats and permit smoother transition to higher costs. Hopefully, he added, we can thus also defer indefinitely an otherwise inexorable reduction in living standards as formerly abundant low cost resources dwindle.

President Handler reported that the dollar volume of NRC business continues to increase at a compound rate of about 11 percent annually, as evidenced by its growth from $5 million in 1955 to $45 million in 1975. He pointed out that the most compelling new aspects of this activity are those studies mandated by Congress, which account for approximately $1.5 million of the budget for the current fiscal year. For Fiscal Year 1975, approximately $5 million is in various stages of negotiation, with another $1.5 million which will probably result from legislation virtually certain to be passed.

In summarizing the status of efforts to improve the capability of the National Research Council to serve the nation, Mr. Handler commented that these efforts were undertaken just in time to permit the Academy to play the larger role thrust upon it by government. He reported that the Council of the NAS had approved plans for the participation of both the IOM and the NAE in the reorganized NRC. Subject to ratification by the respective memberships of the NAS and NAE, the plan would retain both the medical and

engineering communities within the organization, thus making the combined services available to the nation.

In closing, President Handler invited members to express their thoughts regarding the limits to growth of the NRC. He explained that continued growth in the historic pattern, wherein the entire institution is funded through the combination of direct and indirect costs associated with individual projects, may offer serious financial hazard, particularly as it becomes necessary to increase the size of the core professional staff. That hazard could be mitigated by a substantial increase in the Academy's endowment and Mr. Handler reported that a campaign to do so was under consideration. While the Council is seeking to establish policies and guidelines for growth, President Handler emphasized that the membership can be immensely helpful both by participation on advisory committees and by identifying other individuals considered to be truly qualified for such service.

Report of the Vice President

The President introduced Saunders Mac Lane, Vice President of the Academy, for his report. Mr. Mac Lane began by referring to the statutory duties of the Vice President, particularly those in connection with the Council and Governing Board. In addition, he explained that he also serves as Chairman of the Report Review Committee (RRC) and reported briefly on activities related to this Committee. He noted that the purpose of the Report Review Committee is to review all potentially sensitive or especially significant Academy or Research Council reports. The process begins with the submission of a report review form, which proposes a review procedure for each report. The Report Review Committee decides which reports require a formal Academy review in addition to the review process of the original Assembly or Commission. A panel of reviewers is chosen, consisting of three, four or five members of the Academy. These reviewers prepare comments which are submitted to the authoring committee. Mr. Mac Lane stated that, in some cases, this brings about considerable changes and, in most cases, the authors are very appreciative. He explained that the Report Review Committee always reviews a classified report, and that two such reports were reviewed during the past year, and that these reviews appear to have been useful.

Referring to the variety of reports reviewed by the Report Review Committee, Mr. Mac Lane commented on fascinating aspects of several reports, in particular upon the report on "Potential for the Rehabilitation of Surface Mined Arid Lands" and the report on the content of lead in interior house paint. He concluded by concurring with President Handler's earlier comment, that the guidelines for reviewing reports of the Academy should be reviewed, and he indicated that the Report Review Committee itself had already spent a considerable amount of time in preliminary discussions of

this. In response to a question from a member regarding whether any reports are disallowed, it was explained that the Report Review Committee does not have actual veto power over a report, but simply acts as an advisory body to the President of the Academy.

Report of the Home Secretary

The membership of the National Academy of Sciences reached a peak of 1012 following the election of 95 new members at the 1973 Annual Meeting. Deaths and transfers to emeritus status brought membership down to 982 as of April 12, 1974. In addition, there are 20 Members Emeritus and 120 Foreign Associates. Since the last Annual Meeting, 4 members have transferred to emeritus status, and 28 members and 4 foreign associates have died. Included in this group is the loss of our oldest member, Charles Greeley Abbot, who died on December 17, 1973 in his 102nd year. With his passing George H. Whipple, age 95, became the oldest living member and W. D. Coolidge, age 100, the oldest living emeritus member.

The membership of the Academy is distributed by Class as follows:

Class I	Physical and Mathematical Sciences	419
Class II	Biological Sciences	288
Class III	Engineering and Applied Sciences	131
Class IV	Medical Sciences	57
Class V	Behavioral and Social Sciences	87

The Committee to examine the section structure within Class II, under the chairmanship of Clifford Grobstein, has reached conclusions for a new section structure within the Class. The recommendations of the Committee will be discussed in the 1974 meeting of Class II following which the Council may take action, preceded possibly by referendum among the membership of the Class. Copies of the Committee's report will be distributed to Class II members attending the Class meeting and are available to other Academy members who may be interested.

Significant changes in the Academy's Constitution and Bylaws, which became effective following action at the 1973 Autumn Meeting, affect the meetings of the Academy. Autumn Meetings and sessions of contributed papers are now no longer mandatory; but are scheduled at the discretion of the Council. The Council exercised its new authority by deciding not to schedule contributed papers at the 1974 Annual Meeting. The decision was partly based on the desire to eliminate conflicting programs in the hope of improving attendance at the scheduled sessions. In earlier years of the Academy the contributed-papers-opportunity was used primarily by newly elected members to present papers in their fields of interest. This feature has been preserved in part since the program for the 1974 Annual Meeting consists entirely of papers by or programs arranged by members elected at the 1973 Annual Meeting.

The small attendance at most Autumn Meetings of the Academy, usually ranging between 10 to 30 per cent of Annual Meeting registration, led to

the elimination of the mandatory requirement for such meetings. A decision will probably be reached during the Annual Meeting as to whether to schedule a 1974 Autumn Meeting.

The Council has decided to enlarge the Trust Fund Award Committees to a minimum of four members and to require a majority approval of the Committee with not more than one dissenting vote prior to the authorization of any of the established medals or prizes. In addition the Council desires to stimulate a broader base of nominations for the Academy's various awards so that Committees will be better able to serve as judges rather than proponents of the various individuals proposed for awards. In this connection the Home Secretary will circulate information to the entire membership during the coming summer about awards scheduled for the 1975 Annual Meeting including directions for making nominations.

Efforts begun three years ago to reduce the number of former members whose memoirs are still unpublished have produced a substantial backlog of manuscripts awaiting publication. An examination of schedules for manuscript review, editing, and publication has disclosed intolerable delays in several stages of the process. Editorial review and publishing has been under contract with a university for the past twenty years and it was concluded that a substantial part of the delays could be reduced by transferring responsibility for the activity to the Academy's publication office. This has been done and Volume 44, edited under contract and published by the Academy, and Volume 45, edited and published by the Academy, are expected to appear during this calendar year. Manuscripts are in hand for Volumes 46, 47, and part of 48, and editing is underway.

The former Reading Room in the southwest corner of the Academy building has been converted to a lounge and study for the use of members during their visits to Washington. Academy members are urged to become acquainted with the room and make use of it. Concurrently with this change the Home Secretary and his staff moved to the adjacent rooms on the first floor of the west wing. These offices are to the right and left of the west wing rotunda and members are urged to become familiar with them since a primary function of the Office of the Home Secretary is to provide assistance to members on Academy business.

Reports of Committees on Trust and Endowment Funds

Alexander Dallas Bache Fund

From January 1, 1973 through February 28, 1974 Bache Fund grants have been made as follows:

No. 525. To Dr. Mary T. Kalin Arroyo, New York Botanical Garden, New York, New York, in partial support of systematic and ecological studies of three genera of legumes in Brazil during 1973 ..... $1,190

No. 526. To Mr. Jeffrey W. Lang, Department of Ecology and Behavioral Biology, University of Minnesota, Minneapolis, Minnesota, in partial sup-

port of research on the behavior and ecology of the American crocodile during 1973 ---------- $1,250

No. 527. To Mr. Pham Xuan Quang, Department of Statistics, University of California, Berkeley, for mathematical research at Brookhaven National Laboratory during the summer of 1973 ---------- $800

No. 528. To Dr. Timothy C. Williams, Department of Biology, State University of New York, Buffalo, New York, in partial support of radar studies of bird migration over the western North Atlantic Ocean during 1973 ---------- $1,500

No. 529. To Dr. Steve Golubic, Biological Science Center, Boston University, Boston, Massachusetts, in partial support of field research on recent stromatolites in Shark Bay, Australia, during the summer of 1973 -- $1,000

No. 530. To Dr. L. H. Rolston, Department of Entomology, Louisiana State University, Baton Rouge, Louisiana, in partial support of systematic studies of the genera *Aerosternum* and Mormidea (Hemiptera) at the British Museum during 1973 ---------- $500

No. 531. To Mr. Ronald L. Rutowski, Section of Neurobiology and Behavior, Cornell University, Ithaca, New York, in partial support of research on the Use of Visual and Chemical Signals in the Courtship Behavior of *Eurema lisa* (Lepidoptera) during 1974 ---------- $500

The financial status of the Bache Fund as of February 28, 1974, was as follows: Capital contributions, $60,000; Addition from earned income, $41,500; Realized capital gain, $43,051; Short term investment, $14,700; Cash, $5,517; *Total equity,* $164,768.

The Board of Directors of the Bache Fund has undergone a complete turnover during the past two years owing to the resignation of Alfred E. Emerson and Lawrence R. Blinks in 1972 and Saunders Mac Lane in 1973. The newly appointed Board wishes to encourage members of the Academy to stimulate outstanding young scientists from all fields to apply for small grants to provide research support not available from other sources. We believe that such grants can often act as "seed money" to aid in opening up important new lines of investigation.

DONALD R. GRIFFIN, *Chairman.*

John J. Carty Fund

The John J. Carty Medal is usually awarded every three years. The last award (to Professor James D. Watson) was made in 1971, so the Medal could have been awarded in 1974. No award is being made this year, but the Committee expects to make a recommendation to the Council at the end of the calendar year 1974.

The financial status of the Carty Fund as of February 28, 1974, is outlined as follows: Capital contribution, $25,000; Addition from earned income, $10,000; Realized capital gain, $26,175; Short term investments, $5,000; Cash, $6,586; *Total equity,* $72,761.

LUIS W. ALVAREZ, *Chairman.*

Arthur L. Day Bequest

The Arthur L. Day Bequest was given to the Academy ". . . for advances in the studies of the physics of the earth." The Council of the Academy approved the creation of the Day Fund Committee with responsibilities for the appropriate use of the income of the Fund, and for guiding a Selection Committee which would choose specific projects to be added. The Council approved two activities to support; namely, the Arthur L. Day Prize and Lectureship for distinguished work in geophysics, and a broad program of project support of international collaboration on the physics of the earth. This operates by making grants to American research men and specific support of their joint work with foreign colleagues, and especially the provision of travel expenses, assistance, and equipment for their joint work abroad.

The Selection Committee now consists of: George E. Backus, Chairman; Bruce A. Bolt, Horace R. Byers, Jule G. Charney, and O. G. Villard.

The status of the funds available to the Committee as of February 28, 1974, was as follows: Capital contribution, $1,398,474; Addition from earned income, $108,000; Realized capital gain, $170,398; Short term investments, none; Cash, $31,250; *Total equity,* $1,708,122.

For the trustees:

MERLE A. TUVE, Chairman.

Since the last annual report to the Academy, the Committee on Selection of the Arthur L. Day Fund has approved the following grants:

No. 21. Dr. George R. Carruthers, Hurlbert Center for Space Research, Naval Research Laboratory, and Dr. David Gigney, Department of Physics, University of Adelaide, South Australia, to cover Dr. Gigney's travel costs and per diem in connection with integration of instrumentation being developed in Australia into the work being done in the United States by Dr. Carruthers ---------- $3, 160

No. 22. Dr. Francis T. Wu, Department of Geological Sciences, State University of New York, Binghamton, and Dr. Iaakov Karcz of the Israeli Geological Survey, for their collaborative work on microearthquakes and recent crustal activity between the Mediterranean and the Dead Sea Rift ---------- $2, 350

No. 23. Committee on Space Research (Z. Niemirowicz, Executive Secretary) a single contribution to a reserve fund for COSPAR with the understanding that an effort be made by officers of COSPAR to secure additional contributions from other sources having an interest in the scientific program and objectives of the Committee. (Approved by the Council of the Academy.) ---------- $15, 000

No. 24. Dr. Victor Vacquier, Marine Physical Laboratory, University of California, San Diego, La Jolla, California, in continuing support of investigations concerning geothermal heat flow and interpretation of data

accumulated in his work in collaboration with Fr. Ramon Cabre of the Observatorio San Calixto, Bolivia. The work is to be interpreted by Dr. Vacquier in Santa Cruz $4,500

No. 25. Dr. L. T. Aldrich, Carnegie Institution of Washington and Professor A. Rodiguez B., Universidad Nacional de San Agustin, Arequipa, Peru, in support of students and travel and equipment costs for a seismic study of the central Andes, aimed at elucidating questions in plate tectonics $21,600

No. 26. Dr. Bruce A. Bolt, University of California, Berkeley, and Nguyen-Hai, Director of the National Seismological Laboratory of South Vietnam, in support of travel and field expenses for seismological studies in South Vietnam $9,180

For the Selection Committee:

GEORGE E. BACKUS, *Chairman.*

Henry Draper Award Fund

The Committee on the Henry Draper Award Fund has recommended that the Henry Draper Medal and Award for 1974 be awarded to Dr. Lyman Spitzer, Jr., of Princeton University for his vision and distinguished achievements in space astronomy and for his many outstanding contributions to the physics of plasmas on earth and in interstellar space.

The financial status of the Henry Draper Fund as of February 28, 1974 was as follows: Capital contribution, $6,000; Addition from earned income, $11,000; Realized capital gain, $11,030; Short term investments, $2,300; Cash, $3,071; *Total equity,* $33,401.

LEO GOLDBERG, *Chairman.*

Daniel Giraud Elliot Fund

The financial status of the Daniel Giraud Elliot Fund as of February 28, 1974 was as follows: Capital contribution, $8,000; Addition from earned income, none; Realized capital gain, $8,097; Short term investments, $1,900; Cash, $1,855; *Total equity,* $19,852.

S. DILLON RIPLEY, *Chairman.*

Gibbs Brothers Award Fund

The Committee on the Gibbs Brothers Award Fund is happy to report its unanimous choice of Mr. Phillip Eisenberg as its candidate to the Council of the Academy for an award in 1974.

The financial status of the fund as of February 28, 1974, was as follows: Capital contribution, $24,000; Addition from earned income, $4,000; Realized capital gain, $5,680; Short term investments, none; Cash, $1,640; *Total equity,* $35,320.

PHILIP SPORN, *Chairman.*

Wolcott Gibbs Fund

During the period March 1, 1973 through February 28, 1974 the following grants were made from the Fund:

No. 45. To Dr. A. C. Jain, University of Jammu and Kashmir, India, for equipment and supplies, $500.

No. 46. To Charles W. Donaldson, Covenant College, Lookout Mountain, Tennessee, for investigation into the transmission of substituent effects in polynuclear aromatic ring systems, $800.

The following grants to Indian researchers were authorized by the Directors of the Fund in 1969, but were not finalized until 1972. Because of a delay in the receipt of necessary documentation, however, these grant payments were not included in last year's report of the Fund. They are being reported at this time for the record:

No. 43. To R. C. Paul, Panjab University, India, for material and equipment (three payments), April 3, 1972, $40.88; April 3, 1972, $42.51; August 22, 1972, $199.42.

No. 44. To Dr. R. C. Mehrotra, University of Kajasthan, India, for chemical supplies (two payments), March 31, 1972, $313.01; April 19, 1972, $298.86.

The financial status of the Wolcott Gibbs Fund as of February 28, 1974, was as follows: Capital contributions, $5,173.00; Addition from earned income, $8,453.00; Realized capital gain, $10,776.00; Short term investments, $1,000.00; Cash, $600.00; *Total equity*, $26,002.00.

JAMES S. COLES, *Acting Chairman.*

Benjamin Apthorp Gould Fund

Unless circumstances make it desirable to proceed in another manner, the Board of Directors of the Gould Fund recommends every other year the award of the Benjamin Apthorp Gould Prize to the Council of the National Academy of Sciences. A much-applauded award was made in 1973 to Dr. Kenneth I. Kellermann. The Board of Directors does not wish to make a nomination this year.

The financial status of the Fund, as of March 15, 1974 was as follows: Capital contribution, $40,000; Addition from earned income, $28,578; Realized capital gain, $29,077; Short term investments, $3,690; Cash, $5,533; *Total equity*, $106,878.

B. J. BOK, *Chairman.*

Marcellus Hartley Award Fund

The Committee plans to provide a nominee for the Public Welfare Medal for 1975. No award is contemplated for 1974.

The financial status of the Fund as of February 28, 1974 is as follows: Capital contribution, $1,168.00; Addition from earned income, $32.00; Realized capital gain, $1,156.00; Short term investments, none; Cash, $3,391.00; *Total equity*, $1,035.00.

FREDERICK SEITZ, *Chairman.*

Hunsaker Fund

The National Academy of Sciences Award in Aeronautical Engineering consists of an honorarium of $4,000, awarded once every five years. This was

established through the Hunsaker Fund by a gift of Mr. and Mrs. Jerome C. Hunsaker and accepted by the Council of the Academy on October 1, 1966.

The first award was presented in 1968 and the second award was made during 1973.

The financial status of the Hunsaker Fund as of March 12, 1974, was as follows: Capital contribution, $24,750; Addition from earned income, $9,000; Realized capital gain, $7,401; Short term investments, none; Cash, $1,385; *Total equity,* $39,766.

RAYMOND L. BISPLINGHOFF, *Chairman.*

Jessie Stevenson Kovalenko Award Fund

Since the prize is awarded once every three years, the committee is now considering candidates. The total equity in the fund has increased by $4,061. There have been no expenses. Capital contribution, $43,741; Addition from earned income, $7,000; Realized capital gain, $31,432; Short term investments, none; Cash, $2,420; *Total equity,* $84,593.

IRVINE H. PAGE, *Chairman.*

Marsh Fund

The Marsh Fund of the National Academy of Sciences was established in the Will of the late O. C. Marsh to promote original research in the natural sciences.

The income from this Fund allows the Academy to make small grants of up to about $1,000 in support of worthy original research projects.

Review of applications has been placed on a more formal basis. Application received by March 1 or September 1 will be reviewed in April or October and awards announced on May 1 or November 1.

Since the last report to the Academy, the Committee on the Marsh Fund has approved the following grants.

No. 152. To Dr. W. A. Clemens, Department of Paleontology, University of California, Berkeley, for the furtherance of his study of Latest Cretaceous and Early Paleocene terrestrial faunas, $1,380.

No. 153. Dr. Stanley I. Dodson, Department of Zoology, University of Wisconsin, Madison, for his study of Fertility and Genetic Relationships among Populations of the Fairy Shrimp *Streplocephalus texanus,* $1,465.50.

The financial status of the Marsh Fund, as of February 28, 1974, was: Capital contribution, $10,000; Addition from earned income, $12,100; Realized capital gain, $20,285; Short term investments, none; Cash ($49); *Total equity,* $42,336.

JOHN D. BALDESCHWIELER, *Chairman.*

George P. Merrill Fund

The Committee on the George P. Merrill Fund has not yet chosen a nominee for an award in 1974 but will do so before the end of the current fiscal year.

The financial status of the George P. Merrill Fund as of February 28, 1974, was as follows: Capital contribution, $10,000; Addition from earned income, none; Realized capital gain, $1,925; Short term investments, $500; Cash, $595; *Total equity,* $13,020.

J. A. VAN ALLEN, *Chairman.*

Murray Award Fund

The Agassiz Medal was granted in 1973 in connection with the Centennial celebration of the Agassiz-Anderson School of Natural History sponsored by the Marine Biological Laboratory and the Woods Hole Oceanographic Institution during August 13th–17th, 1973. The award was given to Dr. John H. Steele of Aberdeen, Scotland.

The financial status of the Murray Fund as of February 28, 1974 was as follows: Capital contribution, $6,000; Addition from earned income, $6,000; Realized capital gain, $10,313; Short term investments, none; Cash, $552; *Total equity,* $21,761.

FRANK PRESS, *Chairman.*

NAS Award In Applied Mathematics and Numerical Analysis

This award, on the average, is to be given at intervals greater than one year, and an award was made in 1973 to Samuel Karlin. Accordingly, the Committee did not take action this year. Short term investments, $22, 800.00; Cash, $1,630.78; *Total equity,* $24,430.78.

FRITZ JOHN, *Chairman.*

NAS Award for Environmental Quality

Members of the selection committee, appointed by President Handler, recommended that the 1974 NAS Award for Environmental Quality be made to G. Evelyn Hutchinson of Yale University, New Haven, Connecticut. The recommendation was approved by the Council of the Academy.

An honorarium of $5,000 comprises the award, which will be presented to Professor Hutchinson on April 22, 1974.

FRANKLIN A. LONG, *Chairman.*

Mary Clark Thompson Award Fund

The Mary Clark Thompson Gold Medal was awarded to Hollis D. Hedberg in 1973. This award is made every three years, and will be awarded again in 1976.

The financial report of the fund as of February 28, 1974, was as follows: Capital contribution, $10,000; Addition from earned income, $700; Realized capital gain, $10,125; Short term investments, none; Cash, $75; *Total equity,* $20,750.

MARLAND P. BILLINGS, *Chairman.*

G. K. Warren Prize

The G. K. Warren Prize administered by the National Academy of Sciences was established through a fund created by the will of Emily B. Warren in 1969. According to the bequest, the income from the fund shall:

Be used as an award to be known as the "G. K. Warren Prize," . . . to an individual for noteworthy and distinguished accomplishment in any field of science coming within the scope of the charter of the National Academy of Sciences and, insofar as in its discretion is practicable, in fluviatile geology.

The first NAS Committee drafted the following statement of specifications for the Warren Award:

The Warren Prize will be for either a paper or a series of papers which represents distinguished contribution to fluvial morphology and closely related aspects of the geological sciences. The Warren Prize will be for scientific contribution, but this should not be interpreted as favoring senior men at the end of a distinguished career. Mid-career candidates, whose contributions have been considerable, will be given priority, though, when circumstances justify it, even younger people or even more senior people than mid-careerists may be considered."

The second Committee was in accord with earlier recommendations:

That "fluviatile geology" be liberally interpreted, inasmuch as understanding of fluviatile geology can be advanced through research on other kinds of streams such as glaciers, and those in the oceans and the atmosphere.

It is the present policy of the Academy to make the G. K. Warren Prize of $1,000 every fourth year. The first award, in 1969, went to R. A. Bagnold and the second, in 1973, to Luna B. Leopold. The next award will probably be made in 1977. The present committee consists of William W. Rubey (1975), Abel Wolman (1976), and Hollis D. Hedberg (1976).

The statement of the Trust Fund Balance as of February 28, 1974, was as follows: Capital contributions, $15,000; Addition from earned income, $1,500; Realized capital gain $3,053; Short term investments, none; Cash $442; *Total equity,* $19,995.

HOLLIS D. HEDBERG, *Chairman.*

Charles Doolittle Walcott Fund

The financial status of the Walcott Fund, as of February 28, 1974, was as follows: Capital contribution, $5,000; Addition from earned income, none; Realized captial gain, $5,011; Short term investments, $1,800; Cash, $683; *Total equity,* $11,128.

The next award of the Charles Doolittle Walcott Medal is due in 1977.

ERNST MAYR, *Chairman.*

James Craig Watson Award Fund

In the period March 1, 1973 to March 1, 1974 the James Craig Watson gold medal was not awarded.

The financial status of the Fund, as of February 28, 1974, was: Capital contribution, $25,000; Addition from earned income, $28,071; Realized capital gain, $27,818; Short term investments, $4,600; Cash, $4,559; *Total equity,* $90,048.

PAUL HERGET, *Chairman.*

Report of the Foreign Secretary

The Foreign Secretary presented his report which has since been mailed to all members. Noting that this was his final report to the members as Foreign Secretary, Mr. Brown reviewed the highlights of the last 12 years.

He reported that, through the Board on International Organizations and Programs, U.S. inputs to the International Council of Scientific Unions and its constituent unions have been greatly intensified and ICSU itself has been strengthened. Inputs to other international bodies, both nongovernmental and intergovernmental, have likewise been strengthened. During the past 12 years, some 850 individuals served on U.S. National Committees for some 30 international organizations in which the Academy exercises membership on behalf of the U.S. scientific community. During this same period, over 1,000 U.S. scientists and engineers served as Academy delegates at some 130 general assemblies or other key decision-making meetings of these international bodies. Fifty thousand U.S. scientists participated in international congresses along with 160,000 colleagues from other countries.

Mr. Brown spoke briefly about progress in securing visas for foreign scientists to participate in international meetings held in the United States, the Academy's continuing relationship with counterpart organizations in Western Europe and the establishment of scientific exchange programs with Eastern European countries. Referring to the most recent exchange program negotiated last June with the People's Republic of China, he reported that some 100 scholars from China have already visited the United States and 80 U.S. scholars have visited China under that program.

Under the supervision of the Board on Science and Technology for International Development, Mr. Brown reported that programs with colleagues in developing countries had been undertaken in six Latin American countries, five Asian and three African. Viewed as a whole, Mr. Brown stated that these efforts have been remarkably successful, attributable in no small measure to the techniques developed with overseas colleagues for joint deliberation and decision-making.

Mr. Brown emphasized the close working relationship which had evolved with the Foreign Secretary of the NAE, and expressed confidence that this cooperation would continue effectively under the new NRC reorganization.

In closing, Mr. Brown expressed gratitude to the many individuals and organizations whose intellectual and financial assistance had contributed so much to the success of the Academy's international activities.

Following the ovation for the Foreign Secretary as he left the podium, Mr. Piore proposed a resolution, which was unanimously adopted, expressing appreciation and gratitude to Harrison Brown for his diligent efforts in strengthening the international activities of the Academy and recognizing

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that the prestige currently accorded to the NAS by foreign academies is a direct reflection of the personal dedication of Mr. Brown through his twelve years of service as Foreign Secretary.

Report of the Treasurer

Noting that, during the past two years, the market value of the endowment has dropped from approximately $22 million to $18 million, Mr. Piore pointed out that this loss in market value was not as great as some other institutions of comparable functions or some universities. He explained that the philosophy of the Finance Committee was one of concern with the long term growth of the endowment.

Mr. Piore reported that the Academy was currently operating at a level of approximately $44 million and, in the next fiscal year, this would increase to around $47 million. He outlined the expenditure of the $44 million in broad terms as follows: $1 million which comes from the National Science Foundation and goes to the International Institute of Applied Systems Analysis in Vienna; $200,000 in dues to other international organizations; $6.5 million for fellowships; $2.5 million in subcontracts and $6 million associated with the operation of the Atomic Bomb Casualty Commission in Japan, leaving a balance of approximately $28 million for the normal "advisory" activities of the Academy.

Referring in particular to ad hoc projects which involve large sums of money and require substantial temporary increases in the Academy staff, the Treasurer expressed concern over the rate at which the Academy was growing and its responsibilities to staff members when such ad hoc projects terminate. He concluded by stressing the need to increase the Academy's endowment and reported that this matter was under active consideration by the Council.

The Treasurer also announced the appointment of the members of the Auditing Committee as follows:

Caryl P. Haskins, Chairman (term expires December 31, 1974), Wallace R. Brode (term expires December 31, 1975), and Hatten S. Yoder (term expires December 31, 1976).

Report of the Bicentennial Committee

Detlev W. Bronk, Chairman of the Bicentennial Committee reported that the Committee had met twice since its formation almost a year ago to consider the role of the Academy in the celebration of the Bicentennial of the United States. He stated the Committee generally believes that activities relating to the Bicentennial should deal with highly significant themes and critcal issues involving science, should reach a wide audience and, hopefully, increase public understanding of science. Mr. Bronk enumerated some of the broad central themes which the Committee has considered for the Academy's participation: Science as a Symbol of the Freedom in which

it is Rooted, the Nature and Spirit of Science, Critical Issues We Face as We Enter Our Third Century, Our Changing Status in the World Community. The Committee proposes that the Academy begin its observance of the Bicentennial year at the Autumn Meeting in 1975, devoted to one or more significant themes such as those just cited. It has been suggested that this meeting receive broad national coverage by means of television and video tapes.

Mr. Bronk stated that the Committee proposes that the Annual Meeting of the Academy of 1976 emphasize international aspects of science—historic, present and future. He explained that invitations to foreign scientists to visit the Academy during the Bicentennial could in many instances be joined with the invitations of the American Philosophical Society to attend their Bicentennial meeting during the preceding week. Noting general agreement among the Committee that it would be appropriate for the Academy to encourage international scientific organizations to hold their 1976 meetings in this country when feasible, he stated that invitations have already been extended to the General Assembly of ICSU and to COSPAR. Dr. Bronk elaborated on other ideas generated within the committee, including a series of Academy Bicentennial lectureships, through which outstanding science speakers would be available for nationwide tours—possibly with the co-sponsorship of respective state academies of science. He concluded with a recommendation from the Committee that great emphasis should be placed upon two general themes—The Role of Science in Modern Society, and the Role of Science in Furthering International Understanding.

Report on the Proceedings

A record influx of manuscripts (1038, nearly 21% greater than 1972), combined with a major turnover of editorial staff and ancillary personnel, caused the *Proceedings* to fall significantly behind its usual publication schedule in 1973; 810 papers were published in 1973 (compared to 721 published in 1971 and 856 in 1972). Thanks however to truly outstanding efforts by the editors and staff, the *Proceedings* will be back to a nearly normal publication schedule by the May, 1974 issue. Nearly as many papers will have been published in the first five months of 1974 as were published in all of 1970.

The receipt of papers in 1974 thus far closely parallels that experienced in 1973; the number is, perhaps, beginning to level off.

The biological sciences continue to predominate in the pages of the *Proceedings*. Within the biological sciences one may note a slight shift toward the biology of cells and of higher organisms. The proportion of articles concerned with mathematics and the physical sciences remains steady. Very few contributions are received as yet from the behavioral and social sciences. I hope this will increase.

With a return to a more normal state of publication, stronger efforts will be made to obtain and publish the contents of the Academy symposia. In

addition I believe that quite considerable material of interest to Academy members—particularly concerning broader aspects of science—is presented at meetings of Academy committees and contained in reports of the Academy, the Institute of Medicine, etc. I would hope that we can make much material more widely available.

The fiscal balance of the *Proceedings* is delicate; the incremental cost of the increased publication does not appear to be fully met by the incremental income. The scheduled increase in subscription price, to take effect in 1975, will help, but the accounts should be carefully watched.

ROBERT L. SINSHEIMER,
Chairman, Board of Editors.

Nominating Committee for 1975

Mr. Astin reported that, in addition to the regular expiration of terms of four councilors during the next year, the terms of the President and Home Secretary would also expire. He also noted that nominating procedures for a President are quite different from those involving other officers or councilors. To deal with the forthcoming nominations, the Council agreed to the appointment of an ad hoc group to determine recommendations for the membership of the Nominating Committee for 1974–75. Mr. Astin announced that a complete list of the Nominating Committee would be provided to all members of the Academy as soon as acceptances are received from the individuals who were recommended by the ad hoc committee of the Council.

Report of the Committee on Sectional Structure of Class II

President Handler introduced Clifford Grobstein who reported that the Committee had presented its recommendations to the Council at its meeting on April 21. The Council approved the recommendations, subject to approval by the membership of Class II at its meeting on Tuesday, April 23.

1974 Autumn Meeting Plans

The Home Secretary reported that, as a result of changes in the Constitution and Bylaws, Autumn Meetings are no longer required for the Academy. Noting that attendance at Autumn Meetings had been quite disappointing, the Home Secretary announced that the Council had voted not to schedule an Autumn Meeting for 1974. He further stated that one of the Academy forums would be scheduled about the time of the usual Autumn Meeting and all members of the Academy would be notified. The Home Secretary explained that this was a decision with regard to the year 1974 only and recalled an earlier comment made by Dr. Bronk regarding plans for a 1975 Autumn Meeting in connection with the Bicentennial Celebration In response to a question, the Home Secretary reported that the dates for the 1974 Annual Meeting are April 21, 22 and 23, 1975.

Organization of the National Research Council

President Handler referred to material which had previously been mailed to all members regarding the joint operation of the NRC by the NAS and NAE. He asked the Home Secretary to present the matter for consideration by the membership. Mr. Astin reported that relatively few responses had been received as a result of his mailing to the members dated March 27, 1974. He further reported that, at its meeting on Sunday, April 21, 1974, the Council unanimously recommended that the members present at the Business Session of the Academy of Tuesday, April 23, 1974, acting as a Committee of the Whole, endorse the adoption and implementation of the *Statement of Principles Underlying Joint Operation of NRC by the NAS and NAE* dated October 24, 1973, and recommend its approval by the entire membership through mail ballot. In order to implement the recommendation of the Council, the Home Secretary moved that the meeting be resolved into a Committee of the Whole for discussion. The motion was seconded and unanimously passed. The Home Secretary then presented to the Committee of the Whole the following resolution:

> The members of the National Academy of Sciences present at the Business Session of the Academy on Tuesday, April 23, 1974, endorse the adoption and implementation of the *Statement of Principles Underlying Joint Operation of NRC by the NAS and NAE* dated October 24, 1973, and recommend its approval by the entire membership through mail ballot.

In response to a request for a review of the background on this matter, Mr. Piore summarized the series of events over the past few years which resulted in the document under consideration by the membership. Councilors Pitzer, Westheimer and Branscomb also commented on the proposal and background. Following Mr. Piore's comments and further discussion among the members regarding the document and the background, the members unanimously voted to adopt the resolution presented by the Home Secretary. One hundred and eighty members of the Academy were recorded as being present at this time. Following this action, on a motion by the Home Secretary, the group dissolved from a Committee of the Whole and reconstituted as the Academy Business Session.

It was explained that this action would be transmitted to all members of the Academy by the Home Secretary with a mail ballot and a request that the ballot be returned no later than June 1. At the same time, reference was made to a letter from John R. Hogness, President of the Institute of Medicine, with regard to the Institute's participation in the governance of the NRC. It was noted that this letter and the Statement of Principles previously referred to would be included in the mailing to members with a report on the action taken at the Business Session.

SUNDAY EVENING CONCERT

On Sunday evening, April 21, a concert of Brahms, Mozart, and Debussy was presented by the Guarneri String Quartet in the Academy Auditorium for members and their guests.

AWARD CEREMONY

On the evening of April 22, 1974, the National Academy of Science honored five scientists for outstanding achievements in their respective fields, during a ceremony which was held in the Academy Auditorium. In addition, those members elected in 1973 were presented to the membership by the Home Secretary, Allen V. Astin. After signing the Members' Book, the newly elected members were greeted by President Handler to the applause of the membership.

The Draper Medal for investigations in astronomical physics was presented to Lyman Spitzer, Jr. of the Princeton University Observatory in recognition of his "vision and distinguished achievements in space astronomy and for his many outstanding contributions to the physics of plasmas on earth and in the interstellar medium."

David Baltimore of the Massachusetts Institute of Technology received the U.S. Steel Foundation Award in Molecular Biology for recent notable discovery in molecular biology. Dr. Baltimore was recognized as "a distinguished leader in virus research who by his discoveries on the reproduction and enzymology of RNA viruses has greatly advanced the science of molecular biology."

The Gibbs Brothers Medal for outstanding contributions to the field of naval architecture and marine engineering was presented to Phillip Eisenberg of Hydronautics, Incorporated. Mr. Eisenberg was cited for his "outstanding work on cavitation, cavitation damage, naval hydrodynamics and structural problems; and his fruitful efforts in naval engineering, research and public service."

Renato Dulbecco of the Imperial Cancer Research Fund was the recipient of the Selman A. Waksman Award in Microbiology for outstanding contributions in microbiology. This award was made in recognition of Dr. Dulbecco's "extension to animal viruses the precise quantitative methods that had been developed with bacterial viruses, thereby revealing the integration of tumor viruses into host chromosomes."

The NAS Award in Environmental Quality in honor of Frederick Gardner Cottrell for outstanding contributions to improve the quality of environment, or the control of pollution by man, was presented to G. Evelyn Hutchinson of Yale University. Dr. Hutchinson was recognized for his "scientific contributions to limnology and ecology and especially for his continuing public advocacy, for a period of over thirty years, of the desperate need for man to understand, preserve and protect the environment in which he lives."

The third National Academy of Sciences Award for Distinguished Service for exceptional achievement as a member of the National Academy of Sciences-National Research Council professional staff was presented to Robert Eugene Green.

The award ceremony was followed by a buffet supper and reception given by President and Mrs. Handler in honor of the award recipients. This reception was held in the Great Hall of the Academy.

ACADEMY DINNER

The annual Academy dinner for members and their guests was held on Tuesday, April 23, in the Presidential Room of the Statler Hilton. Dr. Harrison Brown, Foreign Secretary of the Academy, was the guest speaker. The dinner was preceded by a reception given in the Senate Room by President and Mrs. Handler.

SCIENTIFIC PROGRAM

This year's program was in recognition of the 50th anniversary of tne dedication of the Academy's building on Constitution Avenue and reflected a custom prevalent at the time of the dedication. The Academy returned to the tradition of presenting sessions of invited papers to be given by recently elected members.

Monday, April 22

(Auditorium)

INVITED PAPERS ON THE NATURAL SCIENCES

Chairman: HERBERT FRIEDMAN
United States Naval Research Laboratory
Washington, D.C.

DAVID PINES, University of Illinois, Urbana, Illinois: *Neutron Star "Geology": Starquakes and Stellar Wobble.*

ROBERT G. PARR, Johns Hopkins University, Baltimore, Maryland: *The Description of Molecular Structure.*

GORDON G. HAMMES, Cornell University, Ithaca, New York: *Molecular Regulation of Enzyme Activity.*

(Auditorium)

INVITED PAPERS MAINLY ON THE SOCIAL SCIENCES

Chairman: CARL PFAFFMANN
Rockefeller University
New York, New York

W. T. EDMONDSON, University of Washington, Seattle, Washington: *The Response of Lake Washington to Large Changes in Nutrient Income.*

OTIS DUDLEY DUNCAN, University of Arizona, Tucson, Arizona: *Developing Social Indicators.*

FRANCO MODIGLIANI, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Family Savings and the Wealth of Nations.*

(Auditorium)

Wednesday, April 24

A SYMPOSIUM ON ORGANIZATION AND TRANSCRIPTION OF THE EUKARYOTIC GENOME

Chairman: DONALD D. BROWN
Carnegie Institution of Washington
Baltimore, Maryland

HARVEY F. LODISH, Massachusetts Institute of Technology, Cambridge, Massachusetts: *Synthesis of Messenger RNA and Chromosome Structure.*

ROBERT P. PERRY, Institute of Cancer Research, Philadelphia, Pennsylvania: *The Origin and Fate of Messenger RNA in Eukaryotic Cells.*

PHILIP LEDER, National Institutes of Child Health and Human Development, Bethesda, Maryland: *Organization and Regulated Expression of Specific Mammalian Genes.*

IGOR B. DAWID, Carnegie Institution of Washington, Baltimore, Maryland: *The Mitochondrial Genome in Animals.*

ACT OF INCORPORATION

AN ACT TO incorporate the National Academy of Sciences

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. B. Barnard,[1] at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden,[2] Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren,[2] United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Englemann, Saint Louis, Missouri; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Giless,[3] United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. Le Conte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherford, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut; Benjamin Silliman, Junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California; their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted,* That the National Academy of Sciences shall consist of not more than fifty ordinary members, and the said corporation hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted,* That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States.

GALUSHA A. GROW,
Speaker of the House of Representatives.
SOLOMON FOOT,
President of the Senate pro tempore.

Approved, March 3, 1863.
ABRAHAM LINCOLN, *President.*

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[1] The correct name of this charter member was F. A. P. Barnard.
[2] Declined.
[3] The correct name of this charter member was J. M. Gilliss.

AMENDMENTS

AN ACT To amend the act to incorporate the National Academy of Sciences

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences approved March third, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said Academy as provided in said act.

Approved, July 14, 1870.

AN ACT To authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, and its several supplements be, and the same is hereby, authorized and empowered to receive bequests and donations and hold the same in trust, to be applied by the said Academy in aid of scientific investigations and according to the will of the donors.

Approved, June 20, 1884.

AN ACT To amend the act authorizing the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes, approved June twentieth, eighteen hundred and eighty-four, be, and the same is hereby, amended to read as follows:

"That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, be, and the same is hereby, authorized and empowered to receive by devise, bequest, donation, or otherwise, either real or personal property, and to hold the same absolutely or in trust, and to invest, reinvest, and manage the same in accordance with the provisions of its constitution, and to apply said property and the income arising therefrom to the objects of its creation and according to the instructions of the donors: *Provided, however,* That the Congress may at any time limit the amount of real estate which may be acquired and the length of time the same may be held by said National Academy of Sciences."

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, May 27, 1914.

CONSTITUTION

[As amended and adopted Apr. 17, 1872, and further amended Apr. 20, 1875; Apr. 21, 1881; Apr. 19, 1882; Apr. 18, 1883; Apr. 19, 1888; Apr. 18, 1895; Apr. 20, 1899; Apr. 17, 1902; Apr. 18, 1906; Nov. 20, 1906; Apr. 17, 1907; Nov. 20, 1907; Apr. 20, 1911; Apr. 16, 1912; Apr. 21, 1915; Nov. 11, 1924; Nov. 9, 1925; Oct. 18, 1927; Nov. 18, 1929; Sept. 18, 1930; Apr. 24, 1933; Apr. 27, 1936; Apr. 28, 1937; Apr. 22, 1940; Oct. 26, 1942; Apr. 26, 1949; Nov. 15, 1960; Oct. 12, 1964; Oct. 25, 1971; Oct. 23, 1973.]

Preamble

Empowered by the act of incorporation enacted by Congress and approved by the President of the United States, on the 3d day of March A.D. 1863, and in conformity with amendments to said act approved July 14, 1870, June 20, 1884, and May 27, 1914, the National Academy of Sciences adopts the following amended constitution and bylaws:

Article I. Of Members

Section 1. The Academy shall consist of members, members emeriti, and foreign associates. Members must be citizens of the United States.

Article II. Of the Officers and Organization

Section 1. The officers of the Academy shall be a president, a vice president, a foreign secretary, a home secretary, and a treasurer.

The president shall be elected for a term to be established in each individual case by the Council and may be reelected. The election of the president shall be by a mail ballot conducted prior to the annual meeting next preceding the July 1 on which he is to take office.

The vice president, the home secretary, the foreign secretary, and the treasurer shall be elected for terms of four years and may be reelected. The election of these officers shall be by a mail ballot conducted as further provided in the bylaws prior to the annual meeting next preceding the July 1 on which they are to take office.

The date of expiration of the terms of all offices shall be June 30. Should a vacancy occur in any office, except that of the president, the Council may appoint an officer to serve until June 30, following the annual meeting at which his successor is elected. Should the office of president become vacant, the vice president shall carry out his duties until the Council can arrange for an election to take place.

COUNCIL

Section 2. The officers of the Academy, together with twelve members to be elected by the Academy, and the chief executive officer of the National Research Council (provided he be a member of the Academy) shall constitute a Council for the transaction of such business as may be assigned to it by the constitution, the bylaws, or the Academy.

EXECUTIVE COMMITTEE

Section 3. There shall be an executive committee of the Council of the Academy, composed of seven members, consisting of the president and vice president of the Academy, the chief executive officer of the National Research Council (provided he be a member of the Academy), the home secretary of the Academy, the treasurer of the Academy, and additional members of the Council of the Academy appointed by the president.

Their terms as members of the executive committee shall be coterminous with the term of their other office.

Except those powers dealing with nominations to membership in the Academy, the executive committee between the meetings of the Council shall have all the powers of the Council of the Academy, unless otherwise ordered by the Council.

The president and home secretary of the Academy shall, respectively, be chairman and secretary of the executive committee.

SECTIONS

Section 4. The Academy shall be divided by the Council into sections representing the principal branches of scientific research. Each section shall elect its own chairman to serve for three years. The chairman shall be responsible to the Academy for the work of his section.

FINANCE COMMITTEE

Section 5. There shall be a finance committee, of which the treasurer shall be chairman, consisting of the president of the Academy (or in his absence the vice president), the treasurer, the chief executive officer of the National Research Council (provided he be a member of the Academy), and not more than six other members of the Academy appointed by the president, one of whom shall be a member of the executive board of the National Research Council.

It shall be the duty of the finance committee to provide for the safe custody of all financial resources of the Academy and to determine all matters relating to the purchase and sale of securities held absolutely or in trust.

PRESIDENT

Section 6. The president of the Academy, or, in case of his absence or inability to act, the vice president, shall preside at the meetings of the Academy, of the Academy Council, and of the executive board of the National Research Council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members or other persons especially

conversant with the subjects, and report thereon to the Academy at its meeting next ensuing; and, with the Council, shall direct the general business of the Academy.

GOVERNMENT REQUESTS

The president shall be ex officio a member of all committees empowered to consider questions referred to the Academy by the Government of the United States.

SECRETARIES

Section 7. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and Council in cases of doubt, and reporting their action to the Academy at one of the stated meetings in each year.

TREASURER

Section 8. The treasurer shall attend to all receipts and disbursements of the Academy, giving such bond and furnishing such vouchers as the Council may require. He shall collect all dues, assessments, and subscriptions, and keep a set of books showing a full account of receipts and disbursements and the condition of all funds of the Academy. He shall be the custodian of the corporate seal of the Academy.

NATIONAL RESEARCH COUNCIL

Section 9. Pursuant to the Executive Order issued by the President of the United States, May 11, 1918, and with the duties therein specified, the Academy shall perpetuate the National Research Council.

Article III. of the Meetings

Section 1. The Academy shall hold one stated meeting called the annual meeting, in April of each year in the city of Washington and such other meetings as may be scheduled by the Council. The Council shall have the power to determine the location for such other meetings, and to fix the date of each meeting. The members shall be notified of such other scheduled meetings at least sixty (60) days in advance of the fixed date for such meeting.

The Council shall define the objectives and general content of all meetings and shall establish, under direction of the home secretary, committees on arrangements for the meetings as it deems appropriate.

Article IV. of Elections and Regulations

Section 1. All elections of officers and members shall be by ballot, and each election shall be held separately.

Section 2. The Council shall have general supervision over the election of the officers of the Academy. It shall set the dates for holding the elections and shall appoint any necessary nominating committees.

ELECTION PROCEDURE

Section 3. Election of members shall be held at the annual meeting in Washington in the following manner: There shall be two ballots—a preference ballot, which shall be transmitted by mail, and a final ballot, to be taken at the meeting.

Article V. of Reports

ANNUAL REPORT

Section 1. An annual report shall be presented to Congress by the president and shall contain the annual reports of the treasurer and the auditing committee, a suitable summary of the reports of the committees in charge of trust funds, and a record of the activities of the Academy for the fiscal year immediately preceding, and other appropriate matter. This report shall be presented to Congress by the president after authorization by the Council. It shall also be presented to the Academy at the annual meeting next following.

TREASURER'S REPORT

Section 2. The treasurer shall prepare a full report of the financial affairs of the Academy at the end of the fiscal year. This report shall be submitted to the Council for approval and afterward presented to the Academy at the next stated meeting. He shall also prepare a supplementary financial statement to December 31 of the ensuing fiscal year for presentation at the annual meeting.

GOVERNMENT REQUESTS

Section 3. Propositions for investigations or reports by the Academy shall be submitted to the Council for approval, except those requested by the Government of the United States which shall be acted on by the president, who will in such cases report their results to the Government as soon as obtained.

Article VI. of Trust Funds and Their Administration

TRUSTS

Section 1. Devises, bequests, donations, or gifts having for their object the promotion of science or the welfare of the Academy may be accepted by the Council for the Academy. Before the acceptance of any such trust the Coun-

cil shall consider the object of the trust and all conditions or specifications attaching thereto. The Council shall make a report of its action to the Academy.

MEDALS

Section 2. Medals and prizes may be established in accordance with the provisions of trusts or by action of the Academy.

TRUST FUND COMMITTEES

Section 3. Unless otherwise provided by the deed of gift, the income of each trust fund shall be applied to the objects of that trust by the action of the Academy on the recommendation of a standing committee on that fund.

Article VII. of Additions and Amendments

Section 1. Additions and amendments to the constitution shall be made only at a stated meeting of the Academy. Notice of a proposition for such a change must be submitted to the Council, which may amend the proposition and shall report thereon to the Academy. Its report shall be considered by the Academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated meeting, and if it receives two-thirds of the votes cast it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the members were present.

BYLAWS

Revised and adopted Apr. 25, 1950; amended Apr. 26, 1954; Apr. 28, 1959; Apr. 26, 1960; Apr. 24, 1962; Nov. 30, 1962; Oct. 12, 1964; Apr. 27, 1965; Oct. 11, 1965; Apr. 26, 1966; Oct. 17, 1966; Oct. 23, 1967; Apr. 23, 1968; Apr. 27, 1971; Oct. 25, 1971; Apr. 23, 1973; Oct. 23, 1973.

[In accordance with a resolution of the Academy taken at its meeting on April 21, 1915, the bylaws are arranged in groups, and each group is numbered to correspond with the article of the constitution to which it relates.]

I. Of Members

1. The holders of the medal for eminence in the application of science to the public welfare shall be notified, like members, of the meetings of the Academy and invited to participate in its scientific sessions.

2. The Academy may elect not more than twelve foreign associates each year.

3. A foreign associate of the Academy who becomes a citizen of the United States shall have all the privileges and duties of a member of the Academy

unless he shall request otherwise, and shall be included in the list of members in the section of his choice.

4. Members who wish to be relieved of the duties of active membership may, at their own request, be transferred to the roll of members emeriti by a vote of the Council.

5. Members emeriti and foreign associates shall have the privilege of participating in the meetings and of reading and communicating papers and shall be entitled to a copy of the publications of the Academy, but shall not be subject to its assessments.

6. Resignations from membership shall be addressed to the home secretary and reported by him to the Council.

Not earlier than four years after a member's resignation the Council, by a two-thirds vote, may provide for reinstatement to membership.

On recommendation of the Council, approved by a two-thirds vote at a business session of the Academy, a member who has not paid his dues for four years shall be declared to have forfeited his membership and his name shall be dropped from the roll.

II. Of the Officers and Organization

COUNCIL OF THE ACADEMY

1. Stated meetings of the Council shall be held at least four times annually, and six members shall constitute a quorum for the transaction of business. Special meetings of the Council may be convened at the call of the president and two other members of the Council or of four members of the Council.

The Council shall have the power to fix the compensation and allowances of the president of the Academy and of other officers for whom the Council may find it desirable to provide compensations and allowances.

The Council shall adopt the annual general budget of the Academy and of the National Research Council, and shall have the power to appoint and to fix the salaries of the personnel (such as chief executive officer of the National Research Council, executive secretary, business manager, or other personnel) that may be deemed necessary for the conduct of the affairs of the Academy.

The Council shall designate which of its members and officers, in addition to the president and vice president, shall represent the Council in the governance of the National Research Council.

EXECUTIVE COMMITTEE

2. In the absence of the president and the vice president or home secretary, the executive committee may select from among its members a chairman or a secretary pro tempore.

The executive committee shall keep regular minutes and shall report all of its proceedings to the Council of the Academy for their information.

Meetings of the executive committee shall be held at any time, on call of the chairman, on reasonable notice.

Four members of the executive committee shall constitute a quorum. Letter ballots shall not be valid unless ratified at a meeting.

SECTION CHAIRMEN

3. The term of service of each chairman of a section shall be three years, to date from July 1 next following his election. Chairmen of sections shall be chosen by mail ballot, the member receiving the highest number of votes cast to be deemed elected. It shall be the duty of each retiring chairman to conduct the election of his successor, in the autumn of his last year of service, and to report the results of the election to the home secretary. Should any section fail to elect a chairman, the president is empowered to appoint a temporary chairman to serve until July 1 next following. No chairman shall be eligible for reelection for two consecutive terms.

CLASSES AND CLASS OFFICERS

4. After consideration of recommendations from the Council, the Academy may establish several classes, each of which shall be composed of members of one or more sections grouped according to the relationships among their respective branches of research. With the concurrence of the home secretary, a member may transfer from one class to another without changing his sectional affiliation; but after transfer he may not serve as a representative of his section in any committee of the class to which his section is assigned.

Each class shall hold an annual meeting at the time of the annual meeting of the Academy.

Each class shall elect from its own membership by mail ballot a chairman and a secretary from nominations made at the annual meeting of the class. The chairman and secretary shall serve for three years from the July 1 following their election. Should either office become vacant, the president is empowered to appoint a temporary chairman or secretary to serve until a successor is elected. No chairman shall succeed himself.

SECRETARIES

5. It shall be the duty of the home secretary to give notice to the members of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

It shall be the duty of the home secretary to keep the minutes of each business and scientific session, and after approval to enter these upon the permanent records of the Academy.

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The home secretary shall keep a record of all grants of money or awards of prizes or medals made from trust funds of the Academy. The record for each grant of money shall include the following items: Name of fund, date and number of the grant, name and address of recipient, amount of grant, and date or dates of payment, purpose of grant, record of report of progress.

6. The foreign secretary shall be responsible for conducting business with foreign Academies and shall supervise the nomination of foreign associates.

TREASURER

7. The treasurer shall, upon appropriate authority, defray all the proper expenses of committees appointed to make scientific investigations at the request of departments of the Government, and in each case look to the department requesting the investigation for reimbursement to the Academy.

The treasurer is authorized to act ex officio as the treasurer of the National Research Council.

8. All investments and reinvestments of either principal or accumulations of income of the trust and other funds of the Academy shall be made by the treasurer, in accordance with the policies specified by the finance committee, in the corporate name of the Academy, in the manner and in the securities designated or specified in the instruments creating the several funds, or in the absence of such designation or specification, in bonds of the United States or of the several States, or in bonds or notes secured by first mortgages on real estate, in investments legal for savings banks under the laws of Massachusetts or New York, or in other securities recommended by the financial adviser. Notwithstanding the foregoing, the treasurer, or in case of his absence or inability to act, the president, shall have authority to execute investment transactions upon the written recommendation of the financial adviser without prior consultation with or approval by the finance committee, provided, however, that all such transactions promptly shall be reported to the finance committee. The treasurer shall report to the Council on the status of the funds invested for each trust fund committee, the amount of accumulated income, and the amount available for making awards as provided by the trust. On the basis of this report the Council shall allocate to the various trust fund committees an amount sufficient for making awards in that year.

The treasurer may invest the capital of all trust funds of the Academy which are not required by the instruments creating such funds to be kept separate and distinct in a consolidated fund, and shall apportion the income received from such consolidated fund among the various funds composing the same in the proportion that each of said funds shall bear to the total amount of funds so invested: *Provided, however,* That the treasurer shall at all times keep accurate accounts showing the amount of each trust fund, the proportion of the income from the consolidated fund to which it is entitled, and the expenses and disbursements properly chargeable to such fund.

The treasurer shall have authority, under policies specified by the finance

committee, to sell, transfer, convey, and deliver in the corporate name and for the benefit of the Academy any stocks, bonds, or other securities standing in the corporate name.

FINANCE COMMITTEE

9. It shall be the duty of the finance committee to prepare and present to the Council of the Academy the annual general budget of the Academy and of the National Research Council.

The finance committee shall be empowered, subject to the approval of the Council, to employ competent investment counsel (hereinafter called the financial adviser) to advise with the committee upon the purchase and sale of all securities, mortgages, or other investments.

10. On the recommendation of the finance committee, the Council shall contract with a bank, trust company, or corresponding fiduciary institution, to serve as the custodian of securities, including all of the Academy's personal property and property held in trust in the form of bonds, mortgages, and other securities, to collect the income from them, to protect the Academy in respect to expirations, reissues, and notifications, and to buy or sell securities on the order of the treasurer, in accordance with policies specified by the finance committee.

CONTRACTS

11. No contract shall be binding upon the Academy which has not been first approved by the Council.

DUES

12. The assessments required for the support of the Academy shall be fixed by the Academy on the recommendation of the Council and shall be payable within the fiscal year for which they are assessed.

III. Of the Meetings

1. Scientific sessions of the Academy, unless otherwise ordered by a majority of the members present, shall be open to the public; sessions for the transaction of business shall be closed.

2. The home secretary shall make provision for the registration of members in attendance at a meeting, and the names of the members who registered shall be entered in the minutes of the meeting.

3. At a business session forty members shall constitute a quorum and only members shall vote.

4. No member whose dues are in arrears shall vote at any business meeting of the Academy.

5. At the business sessions of the Academy the order of procedure shall be as follows:

(1) Chair taken by the president, or, in his absence, by the vice president.

(2) Minutes of the preceding session approved.

(3) Stated business.

(4) Reports of the president, vice president, secretaries, treasurer, and committees.

(5) Business from Council.

(6) Other business.

The rules of order of the Academy shall be Robert's Rules of Order Revised, unless otherwise provided by the constitution or bylaws of the Academy.

In the absence of any officer, a member shall be chosen to perform his duties temporarily, by a plurality of viva voce votes, upon open nomination.

DEATHS

6. At each meeting the president shall announce the death of any members since the preceding meeting. As soon as practicable thereafter, the home secretary shall designate a member to write, or to secure from other source approved by the home secretary, a biographical notice of each deceased member.

IV. Of Elections and Regulations

OFFICERS AND COUNCIL OF THE ACADEMY

1. Election of the Council of the Academy: Four members of the Council shall be elected annually to serve for three years from the next July 1. The election of members of the Council shall be by mail ballot conducted prior to the annual meeting next preceding the July 1 on which they are to take office. Should a vacancy in the Council occur, it shall be filled for the unexpired term at the next annual election of the Academy, except that the Council may make an interim appointment to this vacancy from among the members to serve until the vacancy is filled by election.

2. Nominating Committee: At or before each annual meeting, the Council shall appoint a nominating committee of not fewer than nine members to serve for the ensuing year. No officer of the Academy or member of the Council shall be a member of the nominating committee during his term of office. In the appointment of the nominating committee due regard shall be given to broad representation of the Academy's geographic distribution and scientific interests. Notice of the membership of this committee shall be sent by the home secretary to all members of the Academy.

3. Nominations of Officers (other than president) and Council Members: At least five months before the annual meeting of the Academy, a request for nominations to be submitted within six weeks for offices other

than the president, and for positions on the Council that will fall vacant shall be circulated by the home secretary to the membership at large. Nominations from the membership shall be made in writing and signed by seven members, who have verified that their candidate is willing to serve if elected. Only one nominator for any candidate may be an officer of the Academy or member of the Council, at least one nominator must be from a class other than that of the nominee, and residents from at least three states must be represented among the nominators. No nominee for officer of the Academy, other than president, shall be more than 68 years of age at the time of his election.

At a time and place designated by the home secretary, the nominating committee shall meet and prepare a slate of nominees for offices and Council positions to fall vacant. The slate shall include, but need not be limited to, all eligible persons nominated in writing by the membership as provided above. The committee shall also assure itself of the availability of the persons nominated for the respective office or Council position. The nominating committee shall see that at least one qualified person is nominated for the position of officer of the Academy to fall vacant and any candidate nominated by the nominating committee shall be so designated on the ballot. The nominating committee shall see that the slate of nominees for positions on the Council to fall vacant shall include not fewer than twice as many nominees as there are positions to be filled and that the geographic distribution and scientific interests of the Academy are broadly represented on the slate.

The home secretary shall prepare and mail to all members of the Academy a secret ballot containing the slate of nominees submitted to him by the nominating committee for offices and Council positions to fall vacant and shall accompany such ballot by a brief biography listing the professional accomplishments of each nominee. This ballot shall be sent to the entire membership at the same time that the preference ballot for election of members is distributed by the home secretary.

The ballot shall be marked by each member and thus inscribed shall be sealed in an envelope, which shall be enclosed in another bearing the name of the sender, and transmitted to the home secretary. The home secretary shall cause only those ballots to be tabulated that he receives at least two weeks in advance of the annual meeting and shall certify the results to the Council.

With respect to the election of officers of the Academy, other than president, the Council shall declare as elected the candidate receiving a majority of the votes cast. If no majority is received by a candidate, those two nominees receiving the highest votes shall be presented to the membership of the Academy at the annual meeting and the candidate receiving a majority vote of the members present and voting shall be declared elected.

With respect to the election of members of the Council, the Council shall declare as elected the four candidates receiving the highest number of votes

among those receiving a majority of the ballots cast. If fewer than four candidates are so elected, an additional ballot of the members present and voting at the annual meeting shall be held to elect the remaining Council members. The number of candidates on the slate shall be at least twice the number of remaining vacancies and the candidates on that slate shall be selected from the remaining candidates on the first ballot in order of number of votes received. A tie vote shall be resolved by an additional ballot.

4. Nomination of a President: When a president is to be nominated, the nominating committee shall consult with the section chairmen with respect to the qualifications of its proposed nominee. The committee shall assure itself that its proposed nominee will be able to serve if elected and will be agreeable to the terms of compensation established by the Council.

Before October 15 following its appointment the nominating committee shall present its nominee, together with the views of the section chairmen, to the Council. The committee shall also recommend a length of term for which the nominee has agreed to serve. If the Council approves the nomination it shall be placed on the ballot and designated as the nomination of the nominating committee and the Council. The home secretary shall promptly inform the membership of the identity of the nominee.

Additional nominations, each supported by the signatures of not fewer than fifty members of the Academy, may be submitted to the home secretary at any time before December 1 immediately preceding the election, and such nominations shall be included on the ballot along with the nomination of the nominating committee and the Council. With each such nomination there must be submitted to the home secretary evidence that the nominee is willing and able to serve under such terms as may be established by the Council.

In setting the term of office for a president, the Council shall consider each nominee separately, but no term shall be longer than six years. Furthermore, no individual shall serve for more than twelve years nor after he has reached the age of seventy years.

5. Election of a President: Prior to December 15 next preceding the June in which the office of president is to fall vacant, the home secretary shall mail to all members of the Academy a secret ballot containing the name of the nominee approved by the Council and designated as such, along with the names of other properly certified nominees.

To be valid, ballots must be returned to the home secretary by January 15, and election shall be by a majority of those voting. In case no candidate receives a majority, the Council shall arrange for additional ballots, and may, if there are more than two nominees, remove from the ballot the name of the nominee receiving the smallest number of votes on the previous ballot.

CLASS MEMBERSHIP COMMITTEES

6. Each class shall have a membership committee broadly representative of the various disciplines included in the class. Committee members shall not serve for more than two successive years, and shall be selected as follows:

(1) One member representing each section included in the class, elected annually by the section at the time of the informal nominating ballot for Academy membership. In the event he cannot serve, the chairman of the section shall appoint an alternate;

(2) Six members-at-large, no more than two of whom (unless the class has fewer than three sections) shall be from the same section, elected annually by mail ballot of the entire class from a list of candidates nominated at the annual meeting of the class. In the event a member-at-large cannot serve, the chairman of the class shall appoint an alternate;

(3) Three members designated annually by the Council before December 31. In the event a Council designee cannot serve, the president shall appoint an alternate.

TEMPORARY NOMINATING GROUPS

7. The Council, after consultation with the chairmen of the sections and the chairmen of the classes, may organize temporary nominating groups either by subdividing a present section into two or more groups or by forming new intersectional or extrasectional groups. Such temporary nominating groups may then nominate new members in accordance with the rules laid down for sections.

A member who has been asked to serve on a temporary nominating group by the Council shall retain membership in his section and class and shall continue to be entitled to the voting privileges of such membership.

When a temporary nominating group is organized by the Council, the member of the group who is designated as chairman by the Council shall immediately notify all members of the Academy in that group of their assignment by the Council as members of the group, listing all members of the group in this notification, and shall further transmit to all members of the group the specifications, as prepared by the Council, of the special branch of science which the group is to canvass. He shall then obtain from other members of the groups, before October 1, proposals of names of persons in that special branch of science to be considered in the election of new members by the Academy. Such proposals shall be submitted to the group for informal ballot at an assembled meeting called by the chairman not later than November 1. The informal and formal ballots shall be governed by the same rules as ballots of sections. *The chairman shall report*

to the home secretary the results of the formal ballot of the group under the same rules as apply to sections, together with a recommendation as to the class to which each nomination should be referred for consideration by the class membership committee.

VOLUNTARY NOMINATING GROUPS

8. A group of twenty or more members of the Academy may nominate a candidate provided that no more than five members of such group shall be affiliated with any one institution, and no more than twelve members shall be from any one section of the Academy, and that no member shall sign his name on more than one voluntary nominating group petition in any one year. Each such nomination, acompanied by a properly edited statement of the nominee's scientific accomplishments and a list of his principal contributions to science, shall be submitted by the group to the home secretary prior to December 15, together with a recommendation as to the class to which the nomination should be referred for consideration by the class membership committee. At least five members of this group shall be from this class.

ANNUAL ELECTION QUOTAS

9. The Council shall recommend to the Academy each year the total number of new members, together with the quota of new members for each class, to be elected in the following year, within the maximum number of new members established in the bylaws. The recommended numbers shall be open for discussion at the annual meeting of the Academy prior to their determination by the Council.

The class membership committees shall report to the Council, at the time the preference lists are submitted to the home secretary, on the number and quality of the nominees and on such other matters as they deem relevant for consideration by the Council in establishing quotas for the following year.

NOMINATIONS TO MEMBERSHIP

10. Nominations to membership in the Academy shall be made in writing and approved by two-thirds of the members voting in a section on the branch of research in which the person nominated is eminent, or by a majority (however distributed) of the members voting in any two sections, or by a voluntary nominating group, or by a majority of the Council.

Persons nominated to the Academy and rejected by the Academy at the ensuing election may not be further considered by the class membership committees until they again have been proposed for nomination in the prescribed manner in a calendar year subsequent to that in which they were rejected by the Academy. Persons nominated to the Academy but not voted upon by the Academy at the ensuing election may be renominated

in the year following the previous nomination; but if again not voted upon, they shall not be further considered by the class membership committees until they have been proposed for nomination in the prescribed manner in a calendar year subsequent to that in which they last failed to be voted upon by the Academy.

Sectional and intersectional nominations to membership shall be secured in accord with the procedures specified below.

PROPOSALS FOR NOMINATION

11. (1) Intersectional: Proposals for nomination to membership may be made in writing by any five members of the Academy or on their behalf by one of the chairmen of the cognate sections and addressed to the home secretary; each such proposal shall be accompanied by a record of the scientific activities of the person proposed and by a list of his principal contributions to science, in triplicate; and with a statement as to the sections to which the name proposed shall be submitted for consideration. Such proposals as have been received by the home secretary prior to September 15 shall be sent by him to the chairman of each section designated, no later than October 1, with a copy of the record and list of contributions.

(2) Sectional: Proposals for nomination to membership shall be in writing and shall be sent to the chairman of the section not later than October 1. The proposal for nomination of any individual will be accepted for consideration by the section only if it is accompanied by a list of titles and references of the more important published scientific articles of the individual and by a factual summary, not over 250 words in length, of his accomplishments.

Each section chairman shall edit material thus received and, at the time of the informal ballot, distribute it, together with the material from the home secretary, relative to intersectional proposals, to the members of the section. The home secretary's office, if called upon, will assist the chairmen of the sections in the multigraphing of this material.

Each chairman shall keep a record of the names listed on the informal ballot and shall strike from the lists those names which either (1) had been on the list in the previous year and received the votes of less than ten percent of the members voting on the informal ballot, or (2) had been on the list for three consecutive years without receiving in any one of these years the votes of so many as one-fourth of the members voting on the informal ballot, or (3) had been on the list for five consecutive years without receiving in any one of these years the votes of so many as one-half of the members voting on the formal ballot. A proposal for nomination which is thus stricken from the list of the informal ballot shall not again be considered by the section (or sections) before the second calendar year following the year in which it was last listed, and shall be considered then only if again proposed for nomination in the appropriate manner.

At an appropriate time each year, each section chairman shall bring to the attention of the members of the section a list of all names which have been submitted to him, by members of the Academy or by others, as worthy of being proposed for nomination, inquiring for which of these names each section member is willing to prepare a proposal for nomination. Sections may adopt procedures to avoid unprofitable repetitions in succeeding years.

NOMINATION BALLOTS

12. The chairman of each section of the Academy shall submit to the members of his section, not later than November 1 of each year, an informal ballot containing in alphabetical order and without indications of rank on ballots of the previous year, the names of all persons remaining on the list or added thereto in accordance with the provisions above defined. Each member of the section shall be expected to return his ballot to the chairman within two weeks, with his signature and with crosses against the names of those persons whom he is prepared to endorse for nomination. The vote resulting from this ballot shall be regarded as informal.

The chairman shall then submit to the members of his section a new ballot showing the results of the informal vote; and each member shall be expected to return this ballot to the chairman with his signature and with crosses placed against the names of those persons whom he judges to be worthy of nomination.

In order to secure an adequate number of nominations the chairman, when necessary, shall obtain by personal solicitation a fuller vote of his section or shall submit to the section a supplementary formal ballot.

The chairman shall then certify to the home secretary, prior to January 1, the names of all persons who have been voted for on the formal ballots, together with a statement of the number of votes each candidate received and of the number of members voting. Of these, all persons who receive the votes of two-thirds of the members voting in any one section, or the votes of one-half (however distributed) of the members voting in any two sections, shall be considered nominated.

A properly edited statement of the accomplishments of each individual nominated to the Academy by the sections shall be sent by the section chairman to the home secretary along with the nominations of the section. The home secretary shall establish guidelines to be used in the preparation of supporting statements for each nomination. These statements shall be reproduced and distributed to the members of the Academy at the time of the preference ballot.

PREFERENCE LISTS

13. The home secretary shall convene the class membership committees before March 1 to consider in detail the qualifications of each nominee. Each committee shall be chaired by its class chairman and in his absence by the class secretary. In the absence of both each committee shall then

elect its own chairman. The home secretary shall provide each committee with statements of the accomplishments of each nominee. Where appropriate, consideration of individual nominees may be transferred from one class membership committee to another; differences of opinion between committees on this point shall be decided by the home secretary.

From all the nominees assigned to it, each class membership committee shall prepare a preference list in which the nominees shall be entered in the order determined by the committee, up to a total of 150% of the quota previously assigned to the class by the Council, as this limit may be interpreted by the home secretary in his discretion and specified to the committee by him. The list shall then be certified by the committee chairman to the home secretary.

PREFERENCE BALLOT

14. The home secretary shall then distribute to the entire membership a ballot containing separately the preference list of each class membership committee, accompanied by (a) a copy of the statement of accomplishments of each nominee, and (b) a record of the voting in each section and temporary nominating group.

On the ballot so distributed by the home secretary, each member shall select and indicate those names which he prefers, to an extent not greater than one-half nor less than one-third of each list, as these limits shall be interpreted by the home secretary in his discretion and announced by him.

The ballot thus inscribed shall be sealed in an envelope, which shall be enclosed in another bearing the name of the sender, and which shall be transmitted to the home secretary. The home secretary shall cause only those ballots to be tabulated that he receives at least two weeks in advance of the annual meeting. If in any case it is impossible to determine who cast the ballot, or if more or fewer names have been selected than the numbers specified by the home secretary, the ballot shall be rejected; but minor defects in a ballot shall be disregarded when the intent of the voter is obvious.

FINAL LISTS

15. On the basis of the preference ballot for each class the home secretary shall prepare two combined lists: on the first the nominees shall be entered in the order of the number of votes received by each in the preference ballot, provided that the total number of nominees so entered for each class shall not exceed the quota previously fixed for that class by the Council; on the second the remaining nominees shall be entered in the order of the number of votes received by each in the preference ballot.

FINAL BALLOT

16. The final lists shall be presented to the membership of the Academy at the annual meeting. If because of a tie vote on the preference ballot it is impossible for the home secretary to determine on which list a nominee

should appear, the determination shall be made by a majority vote of the members present. The president, acting for the Council, may request permission to exchange a name on the second list for one on the first list, or to add a name from the second list to the first list, on grounds of the general interests of the Academy, without regard to previously assigned quotas, provided that the total number on the first list shall not thereby exceed the maximum number that may be elected, as established by the bylaws. If a majority of the members present favor the proposed change it shall be made. The chairman of any section or any temporary nominating group may request permission to interchange any nominees of his section or temporary nominating group between the first list and the second, without altering in any way the positions of other nominees. If a majority of the members present favor such an interchange it shall be made.

Those on the first list, as modified in accordance with the previous paragraph, may then be declared elected by a two-thirds vote of the members present and voting; provided, however, that any member may call for discussion of any nominee on the first list, and such nominee shall be removed from the first list unless a two-thirds majority of the members present and voting oppose his removal. A nominee removed from the first list in this way may not be replaced by another. The vote shall then be taken on the remainder of the first list. Nominees who have been removed from the first list for discussion as provided above shall then be voted on individually by ballot in the order of the number of votes received by each in the preference ballot, and any such nominee shall be declared elected if he receives two-thirds of the votes cast. Unless terminated earlier as provided below, the election shall terminate when all the nominees on the first list, modified as provided above, together with all those removed from the first list for discussion as provided above, have been voted upon.

If the first list, after modification as provided above, does not receive a two-thirds vote of the members present and voting, a ballot shall be taken on each of the nominees on the modified first list, and on those removed from the first list for discussion, in the order of the number of votes received by each in the preference ballot. Each nominee who receives two-thirds of the votes cast shall be declared elected. If, however, a nominee has received a majority of the votes of those members voting in the preference ballot, he may be declared elected by a two-thirds voice vote.

In no case shall a nominee be declared elected if he receives fewer than one hundred votes in all.

It shall be in order at any point in the course of an election to move that the election be closed. If two-thirds of those present vote in favor of such motion, it shall prevail, and the election shall thereupon terminate.

The sizes of quotas shall be held strictly confidential, as shall all discussions of the claims and qualifications of nominees at meetings of the Acad-

emy, and remarks and criticism then made may be communicated to no person who was not a member of the Academy at the time of the discussion.

Should a nominee listed on the preference ballot die after the meeting of the class membership committee he may be elected posthumously by a majority vote of the members present and voting without reference to quotas. There shall be no other posthumous election.

TOTAL NUMBER ELECTED

17. Not more than 75 members shall be elected at the 1972 annual meeting. Not more than 100 members shall be elected at the 1973 annual meeting. Not more than 95 members shall be elected at the 1974 annual meeting. Not more than 85 members shall be elected at the 1975 annual meeting. Not more than 75 members shall be elected at the 1976 annual meeting. Not more than 60 members shall be elected at the 1977 annual meeting and in later years.

FOREIGN ASSOCIATES

18. Foreign associates may be nominated by the Council and may be elected at the annual meeting by a two-thirds vote of the members present.

ACCEPTANCE OF ELECTION

19. Every member elected shall accept his membership, personally or in writing, before the close of the next stated meeting after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

Members of the Academy are permitted to choose the section with which they wish to be affiliated, and no one shall be a member of more than one section; but this does not preclude service on a temporary nominating group at the request of the Council. Members may also change their sectional affiliation by notification to the home secretary but such changes cannot be made oftener than once every three years unless the change is to a newly established section or to a section newly assigned to a new or different class.

V. Of Scientific Communications and Reports

1. The Council shall from time to time schedule sessions for contributed papers at scientific meetings of the Academy at which any member shall have the right to read a paper with notice of the same having been previously given to the home secretary.

2. Persons who are not members may read papers in scientific sessions of the Academy on invitation of the Council or of the home secretary, or on recommendation by an Academy member and approval by the home secretary.

PUBLICATIONS

3. The Academy may provide for the publication, under the direction of the Council, of Proceedings, Scientific Memoirs, Biographical Memoirs, and Reports.

4. The Proceedings shall be primarily a medium of first publication for original articles, in brief form, of permanent scientific value.

The Scientific Memoirs shall provide opportunity for the publication of longer and more detailed scientific investigation.

The Biographical Memoirs shall contain an appropriate record of the life and work of the deceased members of the Academy.

The publication of the Proceedings, Scientific Memoirs and Biographical Memoirs shall be under the general charge of the Council, which shall have final jurisdiction upon all questions of policy relating thereto.

TREASURER'S REPORT

5. The annual report of the treasurer shall be prepared in accordance with generally accepted accounting standards for the fiscal year of the Academy which shall end on June 30 of each year. It shall be presented to the Academy at the next stated meeting after approval by the Council and shall be published with that of the president to Congress and distributed to the members of the Academy in printed form.

AUDITING COMMITTEE

6. The accounts of the treasurer shall, between July 1 and October 31 of each year, be audited by public accountants employed by an auditing committee of three members appointed by the president at the annual meeting of the Academy. The public accountants shall report to the committee, which shall in turn present the report of audit to the Academy at the time of the presentation of the treasurer's report, together with such comments and recommendations as the committee may deem appropriate. The committee may cause to be made any other examinations of the financial records, the accounting records, and the system of internal control of the Academy which, in its judgment, are necessary for the determination of the adequacy and accuracy of the treasurer's accounts.

VI. Of Trust Funds

STANDING COMMITTEES—RESEARCH FUNDS

1. Standing committees of the Academy on awards shall consist of at least three or not more than five members. In order to secure continuity and rotation in office in such committees, when not in conflict with the provisions of the deeds of gift, the members of the committee shall be appointed for staggered terms, each term of appointment to cover at least one award.

2. The annual reports of the committees on research funds shall, so far as the Academy has authority to determine their content, be in such form as to furnish the home secretary the information he needs to discharge the duties assigned him by these bylaws (II.5).

3. The committees on awards from trust funds shall be empowered to evaluate recommendations and to determine the recipients of the awards provided by the trust fund, consistent with the allocation of funds as determined by the Council.

VII. Amendments

1. On resolution of the Academy, on resolution of the Council, or on written proposal signed by five members, these bylaws may be amended at any stated or special meeting of the Academy by a majority of the votes cast, provided thirty days' notice of the substance of the amendment be sent to all members.

ORGANIZATION OF THE ACADEMY

JULY 1, 1974

OFFICERS

	Term expires
President—PHILIP HANDLER	June 30, 1975
Vice-President—SAUNDERS MAC LANE	June 30, 1977
Home Secretary—ALLEN V. ASTIN	June 30, 1975
Foreign Secretary—GEORGE S. HAMMOND	June 30, 1978
Treasurer—E. R. PIORE	June 30, 1976

Executive Officer
John S. Coleman

Comptroller
Aaron Rosenthal

Business Manager
Bernard L. Kropp

COUNCIL

Anfinsen, C. B.	(1977)	*Mac Lane, Saunders	(1977)
*Astin, Allen V.	(1975)	*McCarty, Maclyn	(1976)
Babcock, Horace W.	(1976)	*Piore, E. R.	(1976)
Branscomb, Lewis M.	(1975)	Pitzer, Kenneth S.	(1976)
*Cloud, Preston	(1975)	*Revelle, Roger	(1977)
Eagle, Harry	(1975)	Russell, Elizabeth S.	(1977)
Fowler, William A.	(1977)	Westheimer, Frank H.	(1975)
Hammond, George S.	(1978)	Williams, Carroll M.	(1976)
*Handler, Philip	(1975)		

* Members of the Executive Committee of the Council of the Academy.

N. A. S. ORGANIZATION

SECTIONS

The Academy is divided into the following Sections, to which members are assigned at their own choice:

(1) Mathematics
(2) Astronomy
(3) Physics
(4) Engineering
(5) Chemistry
(6) Geology
(7) Botany
(8) Zoology
(9) Physiology
(10) Microbiology
(11) Anthropology
(12) Psychology
(13) Geophysics
(14) Biochemistry
(15) Applied Biology
(16) Applied Physical and Mathematical Sciences
(17) Medical Sciences
(18) Genetics
(19) Social, Economic, and Political Sciences

In the alphabetical list of members, the number in parentheses, following year of election, indicates the Section to which the member belongs.

CLASSES

The members of Sections are grouped in the following Classes:

I. Physical and Mathematical Sciences (Sections 1, 2, 3, 5, 6, 13).
II. Biological Sciences (Sections 7, 8, 9, 10, 14, 18).
III. Engineering and Applied Sciences (Sections 4, 15, 16).
IV. Medical Sciences (Section 17).
V. Behavioral and Social Sciences (Sections 11, 12, 19).

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Zygmund, Antoni, 1960 (1), Department of Mathematics, University of Chicago, Chicago, Illinois 60637

Number of Members July 1, 1974: 1065

PUBLIC WELFARE MEDALISTS

(Conferral year shown in parentheses)

Bronk, Detlev Wulf (1964), Rockefeller University, New York, New York 10021

Doolittle, James Harold (1959), 5225 Wilshire Boulevard, Los Angeles, California 90036

Gardner, John William (1966), 5325 Kenwood Avenue, Chevy Chase, Maryland 20015

Harrar, J. George (1963), 30 West 54th Street, New York, New York 10019

Hill, Lister (1969), United States Post Office, Montgomery, Alabama 36104

Killian, James R., Jr. (1956), Massachusetts Institute of Technology, Room 9-235, Cambridge, Massachusetts 02139

Lilienthal, David Eli (1954), 88 Battle Road, Princeton, New Jersey 08540

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MEMBERS

Moe, Henry Allen (1958), Clark Foundation, 30 Wall Street, New York, New York 10005

Shannon, James Augustine (1962), Rockefeller University, New York, New York 10021

Weaver, Warren (1957), Second Hill RR 3, New Milford, Connecticut 06776

MEMBERS EMERITI

Bleakney, Walker, 1959 (3), 4681 La Espada Drive, Santa Barbara, California 93111

Blomquist, Alfred Theodore, 1960 (5), Department of Chemistry, Cornell University, Ithaca, New York 14850

Bradley, Wilmot Hyde, 1946 (6), Pigeon Hill Road, Milbridge, Maine 04658

Bramlette, Milton Nunn, 1954 (6), Scripps Institution of Oceanography, La Jolla, California 92037

Buddington, Arthur Francis, 1943 (6), Department of Geological and Geophysical Sciences, Princeton University, Princeton, New Jersey 08540

Coggeshall, Lowell Thelwell, 1949 (17), Route 2, Foley, Alabama 36535

Coolidge, William David, 1925 (3), 1480 Lenox Road, Schenectady, New York 12308

Corner, George Washington, 1940 (17), American Philosophical Society, 104 South Fifth Street, Philadelphia, Pennsylvania 19106

Dubos, René, 1941 (17), Rockefeller University, New York, New York 10021

Gilluly, James, 1947 (6), 975 Estes Street, Lakewood, Colorado 80215

Hammett, Louis Plack, 1943 (5), 288 Medford Leas, Medford, New Jersey 08055

Johnson, John Raven, 1948 (5), Deer Valley Farm, Townshend, Vermont 05353

Keyes, Frederick George, 1930 (5), 15 Berkeley Street, Cambridge, Massachusetts 02138

Kunitz, Moses, 1967 (14), Valley Stream Apartments, Q-203, Lansdale, Pennsylvania 19446

Lloyd, David Pierce Cradoc, 1953 (9), New Cottage, Greatham, Pulborough RH20 2ES, Sussex, England

Long, Esmond Ray, 1946 (17), 220 Locust Street, Apt. 23-B, Philadelphia, Pennsylvania 19106

Longsworth, Lewis Gibson, 1947 (5), 144-60 29th Avenue, Flushing, New York 11354

Longwell, Chester Ray, 1935 (6), 1820 Mark Twain Street, Palo Alto, California 94303

Redfield, Alfred Clarence, 1958 (13), P.O. Box 106, Woods Hole, Massachusetts 02543

Schultz, Adolph Hans, 1939 (11), Anthropologisches Institut, Künstlergasse 15, Zurich, Switzerland 8001

Wetmore, Ralph Hartley, 1954 (7), 12 Francis Avenue, Cambridge, Massachusetts 02138

Woodring, Wendell Phillips, 1946 (6), National Museum of Natural History, Washington, D.C. 20560

Number of Members Emeriti July 1, 1974: 22

FOREIGN ASSOCIATES

The number in parentheses following the year of election indicates association within the Sections of the National Academy of Sciences.

Adrian, of Cambridge, Edgar Douglas, Baron, 1941 (9), Trinity College, Cambridge, England

Aigrain, Pierre Raoul, 1974 (16), 8 Square Henry Paté, Paris, 75016, France

Alexandroff, Paul S., 1947 (1), Mathematical Institute of the Academy of Sciences of the U.S.S.R., Bolshaya Kalushskaya 19, Moscow, U.S.S.R.

Alfvén, Hannes O. G., 1966 (13), Division of Plasma Physics, Royal Institute of Technology, Stockholm 70, Sweden

Amaldi, Edoardo, 1962 (3), University of Rome, Piazzale delle Scienze, 5, Rome, Italy

Ambartsumian, Victor Amazaspovich, 1959 (2), Burakan Astronomical Observatory, Erevan, Armenia, U.S.S.R.

Andrewes, Sir Christopher Howard, 1964 (17), Overchalke, Coombe Bissett, Salisbury, Wiltshire, England

Auerbach, Charlotte, 1970 (18), Department of Genetics, Institute of Animal Genetics, West Mains Road, Edinburgh, EH9 3JN, Scotland

Baltzer, Fritz, 1967 (8), Zoological Institute, University of Berne, Berne, Switzerland

Barton, Derek Harold Richard, 1970 (5), Department of Chemistry, Imperial College of Science and Technology, South Kensington, London SW7, England

Bell, Ronald Percy, 1972 (5), Stirling University, Stirling, Scotland

Bergström, Sune, 1973 (14), Karolinska Institutet, S10Y01, Stockholm, Sweden

Best, Charles Herbert, 1950 (9), The C. H. Best Institute, 112 College Street, Toronto, Ontario, M5G 1L6, Canada

Blackett, Patrick Maynard Stuart, Baron, 1966 (3), The Royal Society, 6 Carlton House Terrace, London S.W. 1, England

Bogolubov, Nikolai Nikolaevich, 1969 (3), Joint Institute for Nuclear Research, Dubna, Main Post Office, P.O. Box 79, Moscow, U.S.S.R.

Bohr, Aage Niels, 1971 (3), Department of Physics, Niels Bohr Institute, Blegdamsvej 17, Copenhagen, Denmark

Brachet, Jean, 1965 (8), Laboratoire de Morphologie Animale, Université Libre de Bruxelles, 67, rue des Chevaux, Rhode-St-Genese, Belgium

Braunstein, Aleksandr E., 1974 (14), Institute of Molecular Biology, U.S.S.R. Academy of Sciences, Vavilova ul. 32, 117312 Moscow, U.S.S.R.

Broadbent, Donald E., 1970 (12), Applied Psychology Unit, Medical Research Council, 15 Chaucer Road, Cambridge, England

FOREIGN ASSOCIATES

de Broglie, Prince Louis, 1948 (3), 94 Rue Perronet, Neuilly-sur-Seine, France

Brun, Edmond Antoine, 1960 (4), University of Paris, 8-10, place du Commerce, Paris XV, France

Bullard, Sir Edward Crisp, 1959 (13), Madingley Rise, Madingley Road, Cambridge, England

Bullen, Keith Edward, 1961 (13), Department of Applied Mathematics, University of Sydney, Sydney, Australia

Bünning, Erwin, 1968 (7), Institut für Biologie, 74 Tübingen, Auf der Morgenstelle, Germany-W

Burnet, Sir Macfarlane, 1954 (10), c/o Department of Microbiology, University of Melbourne, Parkville, 3052, Victoria, Australia

Cartan, Henri Paul, 1972 (1), 95, boulevard Jourdan, 75014-Paris, France

Casimir, Hendrik Brugt Gerhard, 1970 (16), N. V. Philips' Gloeilampenfabrieken, Eindhoven, The Netherlands

Catcheside, David Guthrie, 1974 (18), Research School of Biological Sciences, Australian National University, P.O. Box 475, Canberra, A.C.T. 2601, Australia

Clark, John Grahme Douglas, 1974 (11), The Master's Lodge, Peterhouse, Cambridge, CB2 1QY, England

Cottrell, Sir Alan Howard, 1972 (4), The Master's Lodge, Jesus College, Cambridge, England

Cousteau, Jacques Yves, 1968 (4), Oceanographic Museum, Monaco

Crick, Francis Harry Compton, 1969 (14), Medical Research Council, Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, England

Dirac, Paul Adrien Maurice, 1949 (1), Department of Mathematics, St. John's College, Cambridge, England

Dubinin, Nikolai Petrovich, 1969 (18), Institute of General Genetics, Academy of Sciences of the U.S.S.R., Moscow, B-I33, Moscow, U.S.S.R.

Eccles, Sir John Carew, 1966 (9), Department of Physiology, Laboratory of Neurobiology, State University of New York, 4234 Ridge Lea Road, Amherst, New York 14226 U.S.A.

Eigen, Manfred, 1966 (5), Max-Planck-Institut für Physikalische Chemie, Bunsenstrasse 10, 3400 Göttingen, Germany

Engelhardt, Wladimir Aleksandrovitch, 1973 (14), Institute of Molecular Biology, Academy of Sciences of the U.S.S.R., Vavilov str. 32, Moscow B-312, U.S.S.R.

Ephrussi, Boris, 1961 (18), Laboratoire de Génétique Physiologique, 91, Gif-sur-Yvette, France

Eschenmoser, Albert Jakob, 1973 (5), Eidgenössische Technische Hochschule Zürich, Laboratorium für Organische Chemie, Universitatstrasse 6/8, CH-8006 Zürich, Switzerland

von Euler, Ulf Svante, 1972 (9), Fysiologiska Institutionen 1, Karolinska Institutet, S-104 01 Stockholm 60, Sweden

Frey-Wyssling, Albert Friedrich, 1970 (7), Institut für Allgemeine Botanik, Eidgenössische Technische Hochschule, Universitätstrasse 2, Zurich, Switzerland

von Frisch, Karl, 1951 (8), Uber der Klause 10, 8000 Munchen 90, Germany

Frumkin, Alexander N., 1969 (5), Institute of Electrochemistry, Academy of Sciences of the U.S.S.R., Leninsky Prospekt 31, Moscow, V-71, U.S.S.R.

Gabor, Dennis, 1973 (4), CBS Laboratories, 227 High Ridge Road, Stamford, Connecticut 06905 U.S.A.

Gansser, Augusto, 1971 (6), Geologisches Institut, Eidgenössische Technische Hochschule, Sonneggstrasse 5, Zurich, Switzerland

Geijer, Per, 1958 (6), Agnevaegen 5, Djursholm I, Sweden

Gelfand, Israel M., 1970 (1), Laboratory of Mathematical Methods in Biology, Moscow State University, Moscow, 117234, U.S.S.R.

Glass, David V., 1973 (19), The London School of Economics and Political Science, Houghton Street, Aldwych, London, WC2A 2AE, England

Glen, Robert, 1967 (15), 4523 Juniper Place, Victoria, British Columbia, V8N 3K1, Canada

Goguel, Jean, 1973 (6), Ecole Nationale Supérieure des Mines, 100, Rue du Bac, Paris VIIe, France

Gorter, Cornelis Jacobus, 1967 (3), Kamerlingh Onnes Laboratory, State University of Leiden, Nieuwsteeg 18, Leiden, The Netherlands

Granit, Ragnar, 1968 (9), The Nobel Institute for Neurophysiology, Karolinska Institutet, Stockholm 60, Sweden

Gustafsson, Carl Åke Torsten, 1967 (7), Institute of Genetics, Lund University, Sölvegaten 29, S-223, 62 Lund, Sweden

Hadorn, Ernst, 1969 (8), Zoologisch-Verlg. Anatomisches Institut der Universität Zurich, Kunstlergasse 16, 8006 Zurich, Switzerland

Harrison, James Merritt, 1965 (6), UNESCO, Place de Fontenoy, Paris 7, France

Hawthorne, William Rede, 1965 (4), University Engineering Laboratory, University of Cambridge, Trumpington Street, Cambridge, England

Hayaishi, Osamu, 1972 (14), Department of Medical Chemistry, Kyoto University Faculty of Medicine, Sakyo-ku, Kyoto 606, Japan

Heisenberg, Werner, 1961 (3), Max Planck Institut für Physik und Astrophysik, Aumeisterstrasse 6, Munich 23, Germany

Herzberg, Gerhard, 1968 (3), Division of Physics, National Research Council of Canada, Ottawa, Ontario, K1A OR6, Canada

Hill, Archibald Vivian, 1941 (9), 11A Chaucer Road, Cambridge, England

Hodge, Sir William Vallance Douglas, 1959 (1), 16 Amhurst Court, Grange Road, Cambridge CB3 9BH, England

Hodgkin, Sir Alan Lloyd, 1974 (9), The Royal Society, 6 Carlton House Terrace, London, SW1Y 5AG, England

Hodgkin, Dorothy Crowfoot, 1971 (5), Chemical Crystallography Laboratory, South Parks Road, Oxford, England

Hoyle, Sir Fred, 1969 (2), Cockley Moor, Dockray, Penrith, Cumberland CA 11 OLG, England

Jacob, François, 1969 (10), Institut Pasteur, 25, Rue du Docteur Roux, Paris XV, France

Jeffreys, Sir Harold, 1945 (13), St. John's College, Cambridge, England

FOREIGN ASSOCIATES

Kapitza, Peter Leonidovich, 1946 (3), S. I. Vavilov Institute of Physical Problems, Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R.

Katchalski, Ephraim, 1966 (14), Residence of the President of the State of Israel, Jerusalem, Israel

Keilis-Borok, Vladimir Isackovich, 1971 (13), Institute of the Physics of the Earth, Academy of Sciences, Moscow, U.S.S.R.

Kendrew, John Cowdery, 1972 (14), Medical Research Council, Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, England

Kihara, Hitoshi, 1958 (18), National Institute of Genetics, Misima, Japan

Kimura, Motoo, 1973 (18), National Institute of Genetics, Mishima, 411 Japan

Klein, George, 1973 (17), Institutet för Tumörbiologi, Karolinska Institutet, 104 01 Stockholm 60, Sweden

von Koenigswald, G. H. Ralph, 1972 (11), Forschungsinstitut Senckenberg, Senckenberganlage 25, 6 Frankfurt-M 1, Germany

Kolmogorov, Andrej N., 1967 (1), Moscow State University, Moscow, U.S.S.R.

Krebs, Sir Hans Adolf, 1964 (14), Metabolic Research Laboratory, Nuffield Department of Clinical Medicine, Radcliffe Infirmary, Oxford, England

Kubo, Ryogo, 1974 (3), Department of Physics, University of Tokyo, Hongo Bunkyoku Tokyo, Japan

Leloir, Luis F., 1960 (14), Instituto de Investigaciones Bioquimicas, Obligado 2490, Buenos Aires, Argentina

Leray, Jean, 1965 (1), Collège de France, 11 Place Marcelin-Berthelot, Paris V, France

Lévi-Strauss, Claude, 1967 (11), Laboratoire d'Anthropologie Sociale, Collège de France, 11 Place Marcelin-Berthelot, Paris V, France

Longuet-Higgins, Hugh Christopher, 1968 (5), Centre for Research on Perception and Cognition, Laboratory of Experimental Psychology, University of Sussex, Falmer, Brighton BN1 9QY, England

Lorenz, Konrad, 1966 (8), Max-Planck-Institut für Verhaltensphysiologie, 8131 Seewiesen, Seewiesen über Starnberg (Obb.), Germany

Luria, Alexander **R.,** 1968 (12), Psychology Faculty, University of Moscow, 13 Frunze Street, Moscow G.19, U.S.S.R.

Lwoff, André, 1955 (17), Institut Pasteur, 28 Rue du Docteur Roux, 75 Paris-XVe, France

Lynen, Feodor, 1962 (14), Max-Planck-Institut für Biochemie, 8033 Martinsried b., Munchen, Germany

McMichael, Sir John, 1974 (17), 2 North Square, London, NW11 7AA, England

Medawar, Sir Peter Brian, 1965 (17), Clinical Research Centre, Watford Road, Harrow, Middlesex HA 1 3 UJ, England

Mizushima, Sanichiro, 1970 (5), 2-10-6, Tamagawa-Denenchofu, Setagayaku, Tokyo, Japan

Monod, Jacques, 1968 (14), Department of Cellular Biochemistry, Institut Pasteur, 25, Rue du Docteur Roux, Paris XV, France

Mott, Sir Nevill Francis, 1957 (3), University of Cambridge, Cavendish Laboratory, Madingley Road, Cambridge CB3 OHE, England

Mottelson, Ben Roy, 1973 (3), Nordisk Institut for Teoretisk Atomfysik, Copenhagen Ø, Denmark

Nagata, Takesi, 1969 (13), Office of Geophysics Research Laboratory, c/o Geophysical Institute, University of Tokyo, Tokyo, Japan

Ne'eman, Yuval, 1972 (3), Tel-Aviv University, Tel-Aviv, Israel

Nicolet, Marcel, 1972 (13), Institut d'Aeronomie Spatiale, Avenue Circulaire 3, B-1180 Brussels, Belgium

Oort, Jan Hendrik, 1953 (2), Observatory of Leiden, Leiden, The Netherlands

Oudin, Jacques, 1974 (10), Institut Pasteur, 28, rue du Docteur Roux, Paris XVe, France

Peierls, Sir Rudolf, 1970 (3), Department of Theoretical Physics, University of Oxford, 12 Parks Road, Oxford OX1 3PQ, England

Penfield, Wilder, 1953 (10), Montreal Neurological Institute, 3801 University Street, Montreal 112, H3A 2B4, Canada

Penney, William George, Baron, 1962 (16), Wantage, Oxfordshire, England

Perutz, Max Ferdinand, 1970 (14), Laboratory of Molecular Biology, University Postgraduate Medical School, Hills Road, Cambridge CB2 2QH, England

Piaget, Jean, 1966 (12), Institut des Sciences de l'Éducation, Université de Genève, Palais Wilson, Geneva, Switzerland

Pickering, Sir George, 1970 (17), Pembroke College, Oxford OX1 1DW, England

Porter, Sir George, 1974 (5), The Royal Institution, 21 Albemarle Street, London W1X 4BS, England

Porter, Rodney Robert, 1972 (10), Department of Biochemistry, University of Oxford, South Parks Road, Oxford OX1 3QU, England

Prelog, Vladimir, 1961 (5), Laboratorium für organische Chemie, Eidgenössische Technische Hochschule, Zurich, Switzerland

Prigogine, Ilya, 1967 (5), Université Libre de Bruxelles, Avenue F-D. Roosevelt, 50, Brussels 5, Belgium

Ramalingaswami, Vulimiri, 1973 (15), All India Institute of Medical Sciences, Ansari Nagar, New Delhi—110016, India

Reichstein, Tadeus, 1952 (5), Organisch-chemische Anstalt, St. Johanns-Ring 19, Basel, Switzerland

Robertson, Sir Rutherford Ness, 1962 (7), Research School of Biological Sciences, Australian National University, Box 4, P.O. Canberra, A.C.T., Australia 2600

Robinson, Sir Robert, 1934 (5), Shell Research Ltd., Shell Centre, Downstream Building, London, S.E. 1, England

Rosenblueth, Emilio, 1970 (4), Instituto de Ingenieria, Ciudad Universitaria, Mexico, D.F.

Roy, Maurice, 1964 (4), 86, Avenue Niel, Paris XVII, France

Ruzicka, Leopold, 1944 (5), Department of Organic Chemistry, Institute of Technology, Zurich, Switzerland

Sakharov, Andrei, 1973 (3), P.N. Lebedev, Institute of Physics, Academy of Sciences of the U.S.S.R., 14 Leninsky, Prospekt, Moscow, U.S.S.R.

FOREIGN ASSOCIATES

Sander, Bruno Hermann Max, 1966 (6), Mineralogisches Institut, Alte Universität, Universitätstrasse 4, 6020 Innsbruck, Austria

Sanger, Frederick, 1967 (14), Medical Research Council, Laboratory of Molecular Biology, University Postgraduate Medical School, Hills Road, Cambridge, England

Semenov, Nikolai Nikolaevich, 1963 (5), Institute of Chemical Physics, Vorobyevskoye chaussee 2, Moscow, V-133, U.S.S.R.

Shafarevich, Igor R., 1974 (1), Mathematical Institute of the U.S.S.R. Academy of Sciences, Ul. Vavilova 42, Moscow II7333, U.S.S.R.

Shklovsky, I. S., 1973 (2), Astrophysical Department, Institute of Space Research, Academy of Sciences of the U.S.S.R., 14 Leninsky, Prospekt, Moscow, U.S.S.R.

Siegel, Carl Ludwig, 1968 (1), Mathematics Institute, University of Göttingen, 34 Göttingen, Germany

Šorm, František, 1971 (5), Institute of Organic Chemistry and Biochemistry, Czechoslovak Academy of Science, Prague 6, Czechoslovakia

Strömgren, Bengt, 1971 (2), Department of Astronomy, University of Copenhagen, Copenhagen, Denmark

Swings, Pol, 1966 (2), Institut d'Astrophysique, Université de Liège, Cointe-Sclessin, Belgium

Szentágothai, János, 1972 (8), 1st Department of Anatomy, Semmelweis University Medical School, Tüzoltó utca 58, Budapest IX, Hungary

Takhtajan, Armen Leonovich, 1971 (7), Komarov Botanical Institute, 2 Popov Street, Leningrad 17202, U.S.S.R.

Tamiya, Hiroshi, 1966 (7), Shinjuku-ku, Shimo-ochiai, Tokyo, Japan 3-9-10, (161)

Taylor, Sir Geoffrey Ingram, 1945 (1), Trinity College, Cambridge, England

Theorell, Axel **Hugo,** 1957 (14), Nobel Institute of Medicine, Solnavagen 1, Stockholm 60, Sweden

Tinbergen, Jan, 1974 (19), Erasmus University, Rotterdam 3016, The Netherlands

Tinbergen, Nikolaas, 1974 (8), Department of Zoology, Animal Behaviour Research Group, South Parks Road, Oxford OX1 3PS, England

Todd, of **Trumpington,** Alexander Robertus, Baron, 1955 (5), University of Cambridge, University Chemical Laboratory, Lensfield Road, Cambridge, England

Tomonaga, Sin-itiro, 1965 (3), 3-17-12 Kyonan-cho, Musashino-city, Tokyo 180, Japan

Wagner, Carl, 1967 (4), Max-Planck-Institut für Physikalische Chemie, Bunsenstrasse 10, 34 Göttingen, Germany

Waldenström, Jan Gosta, 1969 (17), Department of Medicine, General Hospital, Malmö, Sweden

Westergaard, Mogens Christian Wanning, 1972 (18), 91 Abildgaardsvej, 2830 Virum, Denmark

Wigglesworth, Sir Vincent Brian, 1971 (8), Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, England

Wilson, John Tuzo, 1968 (6), Department of Geophysics, Erindale College, University of Toronto 5, Canada

Yukawa, Hideki, 1949 (3), Yukawa Hall, Kyoto University, Kyoto, Japan

Number of Foreign Associates July 1, 1974: 138

SECTIONS

1—*Mathematics* (C1.I)—59 members

Jacobson, Nathan
Chairman (1976)
Ahlfors, L. V.
Bers, Lipman
Bing, R. H.
Birkhoff, Garrett
Blackwell, David
Bochner, S.
Bott, Raoul
Brauer, Richard
Browder, Felix
Calderón, A. P.
Chern, S. S.
Cohen, Paul J.
Doob, J. L.
Eilenberg, S.
Friedrichs, K. O.
Gleason, A. M.
Gödel, Kurt
Hille, Einar
Kac, Mark
Kaplansky, Irving
Kleene, Stephen C.
Lax, Peter D.
Levinson, Norman
Lewy, Hans
Mackey, George W.
Mac Lane, Saunders
McShane, E. J.
Milnor, J. W.
Montgomery, Deane
Moore, R. L.
Morrey, C. B., Jr.
Morse, Marston
Moser, J. K.
Mostow, G. D.
Murnaghan, F. D.
Neyman, Jerzy
Nirenberg, Louis
Robbins, Herbert
Schiffer, M. M.
Segal, Irving E.
Shannon, C. E.
Singer, I. M.
Smale, S.
Smith, Paul A.
Spencer, D. C.
Stein, Elias M.
Stone, M. H.
Tarski, Alfred
Tate, John T.
Thomas, T. Y.
Thompson, J. G.
Ulam, S. M.
Whitehead, G. W.
Whitney, Hassler
Wilder, R. L.
Wolfowitz, J.
Zariski, O.
Zygmund, Antoni

Foreign Associates

Alexandroff, P.
Cartan, Henri
Dirac, P. A. M.
Gelfand, I. M.
Hodge, Sir William
Kolmogorov, A.
Leray, Jean
Shafarevich, Igor R.
Siegel, C. L.
Taylor, Sir Geoffrey

2—*Astronomy* (C1.I)—43 members

Spitzer, Lyman, Jr.
Chairman (1977)
Aller, L. H.
Babcock, H. W.
Baker, J. G.
Bok, Bart J.
Burke, B. F.
Chandrasekhar, S.
Clemence, G. M.
Code, A. D.
Drake, F. D.
Friedman, Herbert
Giacconi, R.
Goldberg, Leo
Greenstein, J. L.
Heeschen, D. S.
Herbig, George H.
Herget, Paul
Johnson, H. L.
Kraft, R. P.
Kraushaar, W. L.
Leighton, R. B.
Low, Frank J.
Luyten, W. J.
Lynds, Roger
Mayall, N. U.
Menzel, D. H.
Minkowski, R. L.
Morgan, W. W.
Münch, Guido
Neugebauer, G.
Osterbrock, D. E.
Ostriker, J. P.
Parker, E. N.
Salpeter, E. E.
Sandage, A. R.
Schwarzschild, M.
Shane, C. D.
Shapiro, I. I.
Thorne, Kip S.
Tousey, Richard
Whipple, F. L.
Whitford, A. E.
Wilson, Olin C.

Foreign Associates

Ambartsumian, V.
Hoyle, Sir Fred
Oort, Jan Hendrik
Shklovsky, I. S.
Strömgren, B.
Swings, P.

3—*Physics* (C1.I)—123 members

Slichter, C. P.
Chairman (1977)
Alvarez, L. W.
Anderson, C. D.
Anderson, H. L.
Anderson, P. W.
Bacher, R. F.
Bainbridge, K. T.
Bardeen, John
Barschall, H. H.
Beams, J. W.
Bethe, H. A.
Birge, R. T.
Bjorken, James D.
Bloch, Felix
Bloembergen, N.
Bradbury, N. E.
Brattain, W. H.
Breit, Gregory
Brode, R. B.
Brueckner, K. A.
Chamberlain, Owen
Chew, Geoffrey F.
Christy, R. F.
Cool, R. L.
Crane, H. R.
Crewe, A. V.
Cronin, J. W.
Dennison, D. M.
Deutsch, M.
Dicke, R. H.
Drell, Sidney D.
DuBridge, L. A.
DuMond, J. W. M.
Dunning, J. R.
Dyson, Freeeman J.
Fairbank, W. M.
Feshbach, Herman
Fitch, V. L.
Fowler, W. A.
Garwin, R. L.
Gell-Mann, Murray
Glaser, Donald A.
Goldberger, M. L.
Goldhaber, G. S.
Goldhaber, M.
Gordy, Walter
Goudsmit, S. A.
Greisen, K. I.
Hahn, E. L.
Haworth, L. J.
Herb, R. G.
Herring, Conyers
Herzfeld, K. F.
Hofstadter, R.
Hopfield, J. J.
Hughes, Vernon W.
Inghram, Mark G.
Javan, Ali
Kemble, E. C.
Kerst, D. W.
Kittel, C.
Kohn, Walter
Kroll, Norman M.
Kusch, P.
Lamb, W. E., Jr.
Land, E. H.
Lederman, L. M.
Lee, Tsung-Dao
Livingston, M. S.
Loomis, F. W.
Low, Francis E.
Marshak, R. E.
Matthias, Bernd
McMillan, E. M.
Morrison, P.
Morse, P. M.
Nambu, Yoichiro
Nier, A. O. C.
O'Brien, Brian
Pais, A.
Panofsky, W. K. H.
Pines, David
Pound, R. V.
Primakoff, Henry
Purcell, E. M.
Rabi, I. I.
Rainwater, James
Ramsey, N. F.
Rossi, Bruno
Ruderman, M. A.
Sachs, R. G.
Schawlow, A. L.
Schrieffer, J. R.
Schwinger, Julian
Segrè, E.
Seitz, Frederick
Serber, R.
Simpson, J. A.
Slater, J. C.
Steinberger, J.
Street, J. C.
Telegdi, V. L.
Teller, Edward
Tinkham, M.
Townes, C. H.
Treiman, Sam
Tuve, M. A.
Uhlenbeck, G. E.
Van Vleck, J. H.
Watson, K. M.
Webster, D. L.
Weinberg, Steven
Weisskopf, V. F.
Wentzel, Gregor
Wheeler, J. A.
Wick, Gian-Carlo
Wightman, A. S.
Wigner, E. P.
Wilson, Robert R.
Wu, C. S.
Yang, Chen Ning
Zacharias, J. R.
Zachariasen, W. H.

Foreign Associates

Amaldi, Edoardo
Lord Blackett
Bogolubov, N. N.
Bohr, Aage
de Broglie, Prince Louis
Gorter, C. J.
Heisenberg, Werner
Herzberg, Gerhard
Kapitza, P. L.

Kubo, Ryogo
Mott, Sir Nevill
Mottelson, Ben R.
Ne'eman, Yuval
Peierls, Sir Rudolf
Sakharov, Andrei
Tomonaga, Sin-itiro
Yukawa, Hideki

4—*Engineering* (C1.III)—71 members

Bisplinghoff, R. L.
Chairman (1975)
Barrett, C. S.
Benedict, Manson
Bryson, A. E., Jr.
Buchsbaum, S. J.
Bueche, A. M.
Chodorow, M.
Cohen, Morris
Collins, Samuel C.
Curme, G. O., Jr.
David, E. E., Jr.
Deere, D. U.
Den Hartog, J. P.
Draper, C. S.
Duwez, Pol
Edgerton, H. E.
Emmons, H. W.
Fisk, J. B.
Fletcher, Harvey
Gilruth, R. R.
Ginzton, E. L.
Goldmark, P. C.
Gould, Roy W.
Greenewalt, C. H.
Haensel, V.
Hottel, H. C.
Housner, G. W.
Hunsaker, J. C.
Isaacs, John D.
Johnson, C. L.
Kinzel, A. B.
Kompfner, Rudolf
Lewis, W. K.
Licklider, J. C. R.
Loomis, A. L.
McLean, W. B.
Mehl, R. F.
Newmark, N. M.
Nierenberg, W. A.
Oliver, B. M.
Olson, Harry F.
Orowan, Egon
Patel, C. Kumar N.
Pearson, G. L.
Pfann, W. G.
Pickering, W. H.
Pierce, J. R.
Pigford, R. L.
Piore, E. R.
Puckett, Allen E.
Ramo, Simon
Raymond, A. E.
Schairer, G. S.
Sears, W. R.
Shapiro, A. H.
Sherwood, T. K.
Shockley, W.
Soderberg, C. R.
Sporn, Philip
Stever, H. G.
Stratton, J. A.
Suits, C. G.
Terman, F. E.
Thomas, C. A.
Weber, Ernst
Whinnery, J. R.
Wiesner, J. B.
Wolman, Abel
Wooldridge, Dean E.
Zinn, W. H.
Zworykin, V. K.

Foreign Associates

Brun, Edmond A.
Cottrell, Sir Alan
Cousteau, Jacques
Gabor, Dennis
Hawthorne, W. R.
Rosenblueth, E.
Roy, Maurice
Wagner, Carl

5—*Chemistry* (C1.I)—135 members

Breslow, Ronald
Chairman (1977)
Alberty, R. A.
Alder, B. J.
Badger, R. M.
Baker, W. O.
Baldeschwieler, J.
Bartlett, P. D.
Bender, M. L.
Bernstein, R. B.
Berson, J. A.
Bigeleisen, Jacob
Boekelheide, V.
Brewer, Leo
Brode, W. R.
Brown, H. C.
Bruice, T. C.
Büchi, George
Cairns, T. L.
Calvin, Melvin
Chapman, O. L.
Closs, G. L.
Conant, J. B.
Connick, R. E.
Corey, E. J.
Cotton, F. A.
Cram, Donald J.
Crawford, Bryce, Jr.
Cristol, S. J.
Curtin, David Y.
Dauben, W. G.
Djerassi, Carl
Doering, William

Drickamer, H. G.
Elderfield, R. C.
Eliel, E. L.
Emmett, P. H.
Eyring, Henry
Ferry, John D.
Fieser, L. F.
Fixman, Marshall
Flory, P. J.
Flygare, W. H.
Folkers, Karl
Fried, J.
Friedlander, G.
Fuoss, R. M.
Fuson, R. C.
Gates, M.
Giauque, E. F.
Gilman, Henry
Gray, H. B.
Grunwald, E.
Gutowsky, H. S.
Haagen-Smit, A. J.
Hackerman, N.
Hammes, G. G.
Hammond, G. S.
Hawthorne, M. F.
Herschbach, Dudley
Hildebrand, J. H.
Hirschfelder, J. O.
Hoard, J. L.
Hoffmann, Roald
Hornig, D. F.
Hutchison, C. A., Jr.
Johnson, W. S.
Johnston, H. S.
Julian, Percy L.
Karplus, Martin
Kasha, M.
Katz, J. J.
Kauzmann, Walter
Kistiakowsky, G. B.
Klemperer, William
Kolthoff, I. M.
Leonard, N. J.
Libby, W. F.
Lipscomb, W. N.
Long, Franklin A.
Marcus, R. A.
Margrave, J. L.
Mark, H. F.
Marvel, C. S.
Mayer, J. E.
McConnell, H. M.
Meinwald, Jerrold
Mislow, Kurt
Muetterties, E. L.
Mulliken, R. S.
Newman, M. S.
Noyes, W. A., Jr.
Onsager, Lars
Parr, Robert G.
Pauling, Linus
Pearson, R. G.
Perlman, Isadore
Pettit, R.
Pimentel, G. C.
Pitzer, K. S.
Rice, Oscar K.
Rice, Stuart A.
Roberts, J. D.
Rossini, F. D.
Scheraga, H. A.
Seaborg, G. T.
Shedlovsky, Theodore
Sheehan, J. C.
Shull, Harrison
Smyth, C. P.
Spedding, F. H.
Stockmayer, W. H.
Stork, Gilbert
Streitwieser, Andrew, Jr.
Tarbell, D. S.
Taube, Henry
Tishler, Max
Turkevich, A. L.
Urey, H. C.
van Tamelen, E. E.
Wall, Frederick T.
Walling, Cheves
Warner, J. C.
Waugh, J. S.
Weissman, S. I.
Westheimer, F. H.
Wiberg, K. B.
Widom, Benjamin
Williams, J. W.
Wilson, E. Bright
Witkop, Bernhard
Woodward, R. B.
Wyckoff, R. W. G.
Yost, D. M.
Young, W. G.
Zimm, B. H.

Foreign Associates

Barton, D. H. R.
Bell, Ronald P.
Eigen, Manfred
Eschenmoser, Albert
Frumkin, Alexander N.
Hodgkin, D.
Longuet-Higgins, H. C.
Mizushima, S.
Porter, Sir George
Prelog, Vladimir
Prigogine, I.
Reichstein, Tadeus
Robinson, Sir Robert
Ruzicka, Leopold
Semenov, Nikolai N.
Šorm, F.
Lord Todd

6—*Geology* (C1.I)—37 members

Yoder, H. S.
Chairman (1976)
Abelson, P. H.
Anderson, C. A.
Billings, M. P.
Birch, Francis
Boyd, F. R., Jr.
Brace, W. F.
Buerger, M. J.

SECTIONS

Cloud, Preston
Doell, Richard R.
Dunbar, C. O.
Emery, K. O.
Engel, A. E. J.
Eugster, H. P.
Garrels, R. M.
Hedberg, H. D.
Hubbert, M. King
James, Harold L.
Krauskopf, K. B.
Langbein, W. B.
Leopold, L. B.
Lovering. T. S.
Menard, H. W.
Nolan, T. B.
Patterson, Bryan
Pettijohn, F. J.
Rodgers, John
Sharp, Robert P.
Silver, L. T.
Simpson, G. G.
Thompson, J. B., Jr.
Turner, F. J.
Tuttle, O. F.
Waters, Aaron C.
Wells, John W.
White, Donald E.
Williams, Howel

Foreign Associates

Gansser, A.
Geijer, Per
Goguel, Jean
Harrison, J. M.
Sander, Bruno
Wilson, J. T.

7—*Botany* (C1.II)—40 members

Bogorad, Lawrence
Chairman (1977)
Arnold, William A.
Barghoorn, E. S.
Beevers, Harry
Benson, A. A.
Blinks, L. R.
Bold, Harold C.
Bonner, James
Bonner, J. T.
Braun, A. C.
Briggs, W. R.
Burris, R. H.
Couch, J. N.
Emerson, Ralph
Esau, Katherine
Evans, Harold J.
Fred, E. B.
French, C. S.
Gibbs, Martin
Goddard, D. R.
Granick, Sam
Grant, Verne
Hendricks, S. B.
Kok, Bessel
Kramer, Paul J.
Lang, Anton
Leopold, E. B.
Patrick, Ruth
Raper, K. B.
Riker, A. J.
Robbins, W. J.
Rollins, R. C.
Skoog, Folke
Smith, A. C.
Srb, Adrian M.
Stebbins, G. L.
Thimann, K. V.
Van Niel, C. B.
Went, F. W.
Wilson, P. W.

Foreign Associates

Bünning, Erwin
Frey-Wyssling, A.
Gustafsson, Åke
Robertson, Sir R.N.
Takhtajan, A.
Tamiya, H.

8—*Zoology* (C1.II)—56 members

Bullock, T. H.
Chairman (1976)
Alexander, R. D.
Bern, Howard A.
Bodenstein, D. H.
Bodian, David
Briggs, Robert
Brown, Donald D.
Burns, R. K.
Colbert, E. H.
Darlington, P. J., Jr.
Dethier, V. G.
Dobzhansky, Th.
Ebert, James D.
Edmondson, W. T.
Eisner, Thomas
Emerson, A. E.
Fawcett, D. W.
Flexner, Louis B.
Fraenkel, G. S.
Friedmann, Herbert
Gall, J. G.
Griffin, D. R.
Grobstein, Clifford
Hamburger, Viktor
Hasler, Arthur D.
Holtfreter, J.

Hubbs, C. L.
Hutchinson, G. E.
Kennedy, Donald
Lerner, I. M.
Levi-Montalcini, R.
Markert, C. L.
Marler, Peter
Mayr, Ernst
Mazia, Daniel
Michener, C. D.
Moore, J. A.
Palade, G. E.
Pittendrigh, C. S.
Porter, Keith R.
Prescott, D. M.
Prosser, C. L.
Ripley, S. D.
Ris, Hans
Roeder, Kenneth D.
Scharrer, Berta
Schmidt-Nielsen, K.
Schmitt, F. O.
Scholander, P. F.
Straus, W. L., Jr.
Swift, H. H.
Weiss, Paul
Wetmore, Alexander
Williams, C. M.
Wilson, Edward O.
Zirkle, R. E.

Foreign Associates

Baltzer, Fritz
Brachet, Jean
von Frisch, Karl
Hadorn, Ernst
Lorenz, Konrad
Szentágothai, János
Tinbergen, J.
Wigglesworth, Sir Vincent

9—*Physiology* (C1.II)—33 members

Rahn, Hermann
Chairman (1977)
Bard, Philip
Beidler, Lloyd M.
Berliner, R. W.
Brink, Frank, Jr.
Brodie, B. B.
Bronk, Detlev W.
Cole, K. S.
Comroe, Julius H., Jr.
Davenport, H. W.
Davis, Hallowell
Forster, Robert E.
Gilman, Alfred
Goodman, L. S.
Hardy, J. D.
Hartline, H. K.
Hubel, D. H.
Ingle, D. J.
Kandel, E. R.
Kety, S. S.
Koelle, G. B.
Krayer, Otto
Kuffler, S. W.
Landis, E. M.
Larrabee, Martin G.
Lorente de Nó, R.
Magoun, H. W.
Mountcastle, V. B.
Pappenheimer, J. R.
Pitts, R. F.
Rose, J. E.
Visscher, M. B.
Woolsey, C. N.

Foreign Associates

Lord Adrian
Best, C. H.
Eccles, Sir John
von Euler, U.S.
Granit, Ragnar
Hill, A. V.
Hodgkin, Sir Alan

10—*Microbiology* (C1.II)—25 members

Davis, Bernard D.
Chairman (1975)
Adelberg, E. A.
Benacerraf, B.
Coons, Albert H.
Darnell, J. E., Jr.
Dulbecco, Renato
Eagle, Harry
Eisen, Herman N.
Enders, J. F.
Gajdusek, D. C.
Geiduschek, E. P.
Goebel, W. F.
Habel, Karl
Heidelberger, Michael
Hirst, George K.
Hotchkiss, R. D.
Lancefeld, R.
Levinthal, C.
Luria, S. E.
Magasanik, Boris
Pappenheimer, A. M., Jr.
Temin, Howard M.
Trager, William
Whipple, G. H.
Zinder, Norton D.

Foreign Associates

Burnet, Sir Macfarlane
Jacob, François
Oudin, Jacques
Penfield, Wilder
Porter, Rodney R.

11—*Anthropology* (C1.V)—29 members

Stewart, T. D.
Chairman (1975)
Adams, R. M.
Braidwood, Robert J.
Chomsky, Noam
Coon, C. S.
Eggan, Fred
Geertz, Clifford
Goodenough, W. H.
Greenberg, J. H.
Griffin, J. B.
Hallowell, A. Irving
Haury, E. W.
Heizer, R. F.
Hockett, Charles F.
Howell, F. C.
Howells, W. W.
Hulse, F. S.
Krogman, W. M.
Lounsbury, Floyd G.
MacNeish, Richard S.
Movius, H. L., Jr.
Murdock, G. P.
Rouse, Irving
Shapiro, H. L.
Spoehr, Alexander
Wallace, A. F. C.
Washburn, S. L.
Wedel, W. R.
Willey, G. R.

Foreign Associates

Clark, J. G. D.
von Koenigswald, G.H.R.
Lévi-Strauss, Claude

12—*Psychology* (C1.V)—39 members

Underwood, B. J.
Chairman (1977)
Atkinson, R. C.
Beach, F. A.
Bower, Gordon H.
Brown, Roger
Estes, W. K.
Festinger, Leon
Galambos, R.
Garner, W. R.
Gibson, E. J.
Gibson, J. J.
Guilford, J. P.
Harlow, H. F.
Held, R. M.
Hilgard, E. R.
Klüver, Heinrich
Lindsley, D. B.
Luce, R. D.
Melton, Arthur W.
Miles, W. R.
Miller, George A.
Miller, N. E.
Nauta, Walle J. H.
Neff, William D.
Newell, Allen
Olds, James
Pfaffmann, C.
Postman, Leo J.
Ratliff, Floyd
Richter, C. P.
Riggs, Lorrin A.
Roberts, R. B.
Skinner, B. F.
Solomon, R. L.
Sperry, R. W.
Stellar, Eliot
Teitelbaum, Philip
Teuber, H. L.
Wever, E. G.

Foreign Associates

Broadbent, D. E.
Luria, A. R.
Piaget, J.

13—*Geophysics* (C1.I)—40 members

Chamberlain, J. W.
Chairman (1975)
Anders, Edward
Arnold, James R.
Bjerknes, J.
Booker, H. G.
Brown, Harrison
Byerly, Perry
Byers, H. R.

Charney, Jule G.
Cox, Allan
Elsasser, W. M.
Forbush, Scott E.
Gilbert, Freeman
Gold, Thomas
Goldreich, Peter
Goody, R.
Griggs, D. T.
Haurwitz, B.
Helliwell, R. A.
Knopoff, Leon
MacDonald, G. J. F.
Malkus, Willem
Malone, T. F.
Munk, W. H.
Ney, E. P.
Pekeris, C. L.
Press, Frank
Reichelderfer, F. W.
Revelle, Roger
Reynolds, J. H.
Slichter, L. B.
Stommel, Henry
Suess, H. E.
Van Allen, J. A.
Verhoogen, John
Villard, O. G., Jr.
Walker, Robert M.
Wasserburg, G. J.
Wetherill, G. W.
Wulf, O. R.

Foreign Associates

Alfvén, Hannes
Bullard, Sir Edward
Bullen, K. E.
Jeffreys, Sir Harold
Keilis-Borok, V. I.
Nagata, Takesi
Nicolet, Marcel

14—*Biochemistry*—(C1.II)—107 members

Smith, Emil L.
Chairman (1975)
Ames, B. N.
Anfinsen, C. B.
Arnon, D. I.
Axelrod, J.
Ball, E. G.
Barker, H. A.
Berg, Paul
Bloch, K. E.
Blout, E. R.
Boyer, P. D.
Buchanan, John M.
Carter, H. E.
Chance, Britton
Chargaff, Erwin
Cohen, P. P.
Cohen, S. S.
Cohn, M.
Colowick, S. P.
Cori, Carl F.
Craig, L. C.
Davidson, N.
Doisy, E. A.
Doty, Paul
Doudoroff, Michael
du Vigneaud, V.
Edelman, Gerald M.
Edsall, J. T.
Fischer, E. H.
Fraenkel-Conrat, H.
Fruton, J. S.
Green, David E.
Gunsalus, I. C.
Handler, Philip
Heppel, L. A.
Hill, T. L.
Hofmann, Klaus
Holley, R. W.
Horecker, B. L.
Hurwitz, J.
Jencks, W. P.
Kabat, E. A.
Kalckar, H. M.
Kamen, Martin D.
Kaplan, Nathan
Kennedy, E. P.
Khorana, H. G.
King, C. G.
Klotz, Irving
Kornberg, A.
Koshland, D. E., Jr.
Krebs, E. G.
Lardy, Henry
Lehninger, A. L.
Li, Choh Hao
Link, K. P.
Lipmann, Fritz
Lowry, Oliver H.
McElroy, W. D.
Meister, Alton
Merrifield, Bruce
Meselson, M. S.
Meyer, Karl
Miller, S. L.
Moore, Stanford
Nachmansohn, David
Neurath, Hans
Nirenberg, M. W.
Northrop, J. H.
Ochoa, Severo
Oncley, J. L.
Pardee, A. B.
Phillips, W. D.
Racker, Efraim
Ratner, Sarah
Reed, Lester J.
Rich, Alexander
Richards, F. M.
Rose, W. C.
Roseman, Saul
Schachman, H. K.
Shemin, David
Shulman, Robert G.
Singer, S. J.
Sinsheimer, R. L.
Snell, E. E.

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Stadtman, E. R.
Stein, W. H.
Strominger, J. L.
Sturtevant, J. M.
Szent-Györgyi, A.
Tanford, Charles
Tatum, E. L.
Udenfriend, S.
Utter, M. F.
Vagelos, P. Roy
Vallee, Bert L.
Vickery, H. B.
Vinograd, J.
Wald, George
Watson, J. D.
White, Abraham
Willliams, R. C.
Williams, R. J.
Wood, H. G.
Wyman, Jeffries
Zamecnik, P. C.

Foreign Associates

Bergström, Sune
Braunstein, A. E.
Crick, Francis
Englehardt, W. A.
Hayaishi, Osamu
Katchalski, Ephraim
Kendrew, John C.
Krebs, Sir Hans A.
Leloir, Luis F.
Lynen, Feodor
Monod, Jacques
Perutz, M. F.
Sanger, F.
Theorell, Hugo

15—*Applied Biology* (C1.III)—30 members

Sprague, G. F.
Chairman (1975)
Borlaug, Norman E.
Bormann, F. H.
Brakke, Myron K.
Cain, Stanley
Cockerham, C. C.
Cowling, E. B.
Darby, W. J.
Harlan, J. R.
Harrar, J. G.
Hegsted, D. M.
Hepting, George H.
Horsfall, J. G.
Knipling, E. F.
Leopold, A. S.
Lush, Jay L.
Mangelsdorf, P. C.
Metcalf, R. L.
Munro, H. N.
Nelson, O. E., Jr.
Odum, Eugene P.
Rick, Charles M.
Salisbury, G. W.
Schultes, R. E.
Scrimshaw, N. S.
Sears, Ernest R.
Stakman, E. C.
Stephens, S. G.
Wadleigh, C. H.
Walker, J. C.

Foreign Associates

Glen, Robert
Ramalingaswami, V.

16—*Applied Physical and Mathematical Sciences* (C1.III)—47 members

Carrier, G. F.
Chairman (1976)
Astin, A. V.
Backus, G. E.
Backus, John
Bode, Hendrik W.
Branscomb, L. M.
Brooks, Harvey
Budiansky, B.
Cahn, John W.
Chipman, John
Clogston, A. M.
Cochran, W. G.
Dantzig, G. B.
Darken, L. S.
Duffin, R. J.
Geballe, T. H.
Giaever, Ivar
Goldstine, H. H.
Gomory, R. E.
Gordon, W. E.
Grad, Harold
Harris, Zellig S.
John, Fritz
Kantrowitz, A.
Kaplan, Joseph
Karlin, Samuel
Keller, J. B.
Lax, Benjamin
Liepmann, H. W.
Lin, C. C.
Macdonald, J. Ross
Mindlin, R. D.
Minsky, Marvin
Montroll, Elliott W.
Mosteller, Frederick
Prager, W.
Prausnitz, J. M.
Rosenbluth, M. N.

Smith, C. S.
Stoker, J. J.
Thomas, L. H.
Tukey, John W.
Turnbull, David
Weaver, Warren
Weinberg, A. M.
Zener, Clarence
Zwanzig, Robert

Foreign Associates

Aigrain, Pierre R.
Casimir, H. B. G.
Lord Penney

17—*Medical Sciences* (C1.IV)—71 members

Jacobson, Leon O.
Chairman (1977)
Ahrens, E. H., Jr.
Astwood, E. B.
Austen, K. Frank
Baltimore, David
Bearn, A. G.
Beeson, Paul B.
Braunwald, Eugene
Brinkhous, K. M.
Cannon, P. R.
Castle, W. B.
Chanock, R. M.
Clements, John A.
Conn, J. W.
Cotzias, G. C.
Cournand, André
Dalldorf, Gilbert
Dixon, F. J.
Dole, V. P.
Dorfman, Albert
Dragstedt, L. R.
Edelman, Isidore S.
Finch, Clement A.
Finland, Maxwell
Fredrickson, D. S.
Furth, Jacob
Goldblatt, Harry
Good, Robert A.
Gross, Jerome
Gross, Ludwik
Guillemin, Roger
Hastings, A. Baird
Hertz, Roy
Hirsch, J. G.
Huebner, R. J.
Huggins, C. B.
Isselbacher, K. J.
Jensen, Elwood V.
Kaplan, H. S.
Kunkel, H. G.
Lawrence, H. S.
Leaf, Alexander
Lerner, Aaron B.
Levine, Philip
London, I. M.
Marks, Paul A.
McCarty, Maclyn
McDermott, Walsh
McKusick, V. A.
Miller, C. P.
Müller-Eberhard, H. J.
Novikoff, Alex B.
Page, I. H.
Rammelkamp, C. H.
Ranney, Helen M.
Robbins, F. C.
Sabin, A. B.
Schmid, Rudi
Schmidt, C. F.
Seegmiller, J. E.
Shannon, J. A.
Spiegelman, Sol
Stetten, DeWitt, Jr.
Taussig, Helen B.
Thomas, Lewis
Wangensteen, O. H.
Warren, Shields
Watson, C. J.
Weller, Thomas H.
Wintrobe, M. M.
Wyngaarden, James B.

Foreign Associates

Andrewes, Sir Christopher
Klein, George
Lwoff, André
McMichael, Sir John
Medawar, Sir Peter
Pickering, Sir George
Waldenström, Jan G.

18—*Genetics* (C1.II)—42 members

Roman, H. L.
Chairman (1977)
Allard, R. W.
Anderson, T. F.
Beadle, G. W.
Benzer, Seymour
Brink, R. A.
Britten, R. J.
Campbell, A. M.
Crow, James F.
Delbrück, Max
Emerson, Sterling
Garen, A.
Giles, N. H.
Glass, H. Bentley
Gorini, L.
Haskins, C. P.
Hershey, A. D.

SECTIONS

Hollaender, A.
Horowitz, Norman H.
Irwin, M. R.
Kaiser, A. D.
Kaufmann, B. P.
Lederberg, Joshua
Levinthal, Cyrus
Lewis, Edward B.
Lindsley, D. L.
McClintock, Barbara
Metz, C. W.
Mintz, Beatrice
Neel, J. V.
Owen, R. D.
Puck, Theodore T.
Rhoades, M. M.
Russell, E. S.
Russell, W. L.
Setlow, Richard B.
Smithies, O.
Snell, George D.
Sonneborn, T. M.
Stern, Curt
Wood, W. B.
Wright, Sewall
Yanofsky, Charles

Foreign Associates

Auerbach, Charlotte
Catcheside, D. G.
Dubinin, N. P.
Ephrussi, Boris
Kihara, Hitoshi
Kimura, Motoo
Westergaard, Mogens

19—*Social, Economic, and Political Sciences* (C1.V)—38 members

Samuelson, P. A.
Chairman (1976)
Arrow, K. J.
Aydelotte, W. O.
Campbell, D. T.
Coale, Ansley J.
Coleman, J. S.
Converse, P. E.
Cronbach, Lee J.
Dahl, R. A.
Davis, Kingsley
Duncan, O. D.
Fogel, R. W.
Freedman, Ronald
Friedman, Milton
Goodman, Leo A.
Homans, G. C.
Houthakker, H. S.
Hurwicz, Leonid
Klein, L. R.
Koopmans, T. C.
Kuznets, Simon
Lasswell, H. D.
Lazarsfeld, P. F.
Leontief, W.
Lerner, Abba P.
Lipset, S. M.
March, J. G.
Marschak, Jacob
Merton, R. K.
Modigliani, Franco
Newcomb, T. M.
Osgood, C. E.
Riker, W. H.
Schultz, T. W.
Simon, H. A.
Solow, R. M.
Tobin, James
White, Gilbert F.

Foreign Associates

Glass, David V.
Tinbergen, Jan

STANDING COMMITTEES OF THE ACADEMY (JULY 1, 1972)

Auditing

Sterling B. Hendricks, chairman; S. Dillon Ripley, Frederick T. Wall.

Biographical Memoirs

Allen V. Astin, chairman, ex officio, home secretary of the Academy, and the chairmen of sections of the Academy.

Finance

E. R. Piore, chairman, ex officio, treasurer of the Academy.
Philip Handler, ex officio, president of the Academy.
W. O. Baker (1976), Detlev W. Bronk (1974), Crawford H. Greenewalt (1976), Roger Revelle (1972), J. C. Warner (1974).

Editorial Board of the Proceedings

John T. Edsall, chairman.
James V. Neel, vice chairman.
Walter Kauzmann, vice chairman.
Harrison Brown, foreign secretary of the Academy, ex officio.
Allen V. Astin, home secretary of the Academy, ex officio.
E.R. Piore, treasurer of the Academy, ex officio.
C. B. Anfinsen, Frank Brink, Jr., Bernard D. Davis, Kingsley Davis, Louis B. Flexner, Robert A. Good, Mark Kac, Gordon J. F. MacDonald, Elliott W. Montroll, Arthur B. Pardee, Theodore T. Puck, Richard B. Roberts, Paul A. Samuelson, Emil L. Smith.

Retirement Annuity Program

Pension Committee: Philip Handler, president of the Academy; E. R. Piore, treasurer of the Academy; Allen V. Astin, home secretary of the Academy.
Trustees: Philip Handler, B. L. Kropp.

STANDING COMMITTEES OF THE ACADEMY(JULY 1, 1973)

Auditing

Caryl P. Haskins, chairman (1974); Wallace R. Brode (1975), Hatten S. Yoder, Jr. (1976).

Biographical Memoirs

Allen V. Astin, chairman, ex officio, home secretary of the Academy, and the chairmen of the sections of the Academy.

Finance

E. R. Piore, chairman, ex officio, treasurer of the Academy.
Philip Handler, ex officio, president of the Academy.
Philip H. Abelson (1978), William O. Baker (1976), Maclyn McCarty (1980). Franco Modigliani (1976), Philip Sporn (1978), Julius Stratton (1980).

Editorial Board of the Proceedings

Robert L. Sinsheimer, chairman.
Robert M. Solow, vice chairman.
Michael Kasha, vice chairman.
C. B. Anfinsen, Alexander G. Bearn, Bernard D. Davis, Kingsley Davis, Herman Eisen, Louis B. Flexner, Robert A. Good, Mark Kac, Martin D. Kamen, Seymour S. Kety, Maclyn McCarty, Eugene P. Odum, Arthur B. Pardee, Alexander Rich, Paul A. Samuelson, Emil L. Smith.

Retirement Annuity Program

Pension Committee: Philip Handler, president of the Academy; E. R. Piore, treasurer of the Academy; Allen V. Astin, home secretary of the Academy.
Trustees: Philip Handler, B. L. Kropp.

STANDING COMMITTEES OF THE ACADEMY (JULY 1, 1974)

Auditing

Caryl P. Haskins, chairman (1974), Wallace R. Brode (1975), Hatten S. Yoder, Jr. (1976).

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Allen V. Astin, chairman, ex officio, home secretary of the Academy, and the chairmen of the sections of the Academy.

Finance

E. R. Piore, chairman, ex officio, treasurer of the Academy.
Philip Handler, ex officio, president of the Academy.
Philip H. Abelson (1978), William O. Baker (1976), Maclyn McCarty (1980), Franco Modigliani (1976), Philip Sporn (1978), J. A. Stratton (1980).

Editorial Board of the Proceedings

Robert L. Sinsheimer, chairman.
Robert M. Solow, vice chairman.
Michael Kasha, vice chairman.
Allen V. Astin, home secretary of the Academy, ex officio.
George S. Hammond, foreign secretary of the Academy, ex officio.
E. R. Piore, treasurer of the Academy, ex officio.
C. B. Anfinsen, Alexander G. Bearn, Bernard D. Davis, Kingsley Davis, Harry Eagle, Herman Eisen, Mark Kac, Martin D. Kamen, Henry S. Kaplan, Seymour S. Kety, Maclyn McCarty, Eugene P. Odum, Alexander Rich, Paul A. Samuelson.

Retirement Annuity Program

Pension Committee: Philip Handler, president of the Academy; E. R. Piore, treasurer of the Academy; Allen V. Astin, home secretary of the Academy.
Trustees: Philip Handler, B. L. Kropp.

TRUST FUND AND AWARD COMMITTEES

(As of July 1, 1973 and July 1, 1974)

Henryk Arctowski Fund

Gold medal and honorarium, for the promotion of the study of solar activity changes of short or long duration and their effects upon the ionosphere and terrestrial atmosphere

1973 Committee: Eugene N. Parker, *Chairman* (1975); James G. Baker (1976), Robert A. Helliwell (1974).

1974 Committee: Eugene N. Parker, *Chairman* (1975); James G. Baker (1976), William L. Kraushaar (1978), Edward P. Ney (1978).

ARCTOWSKI MEDALISTS

Parker, Eugene Norman, 1969
Wild, J. Paul, 1969
Johnson, Francis Severin, 1972

Alexander Dalles Bache Fund

Grants for researches in physical and natural science

Board of Directors: Donald R. Griffin, *Chairman;* J. T. Bonner, Joseph L. Doob, Konrad B. Krauskopf.

John J. Carty Fund

Gold medal and honorarium, awarded not oftener than every two years, for noteworthy and distinguished accomplishment in any field of science coming within the scope of the charter of the Academy

1973 Committee: Luis W. Alvarez, *Chairman* (1974); William A. Nierenberg (1977), J. D. Watson (1975).

1974 Committee: William A. Nierenberg, *Chairman* (1977); Sterling Hendricks (1977), J. D. Watson (1975), Bernhard Witkop (1978).

JOHN J. CARTY MEDALISTS

Carty, John J., 1932
Wilson, Edmund Beecher, 1936
Bragg, Sir William, 1939
Conklin, Edwin Grant, 1943
Durand, William Frederick, 1945
Harrison, Ross Granville, 1947
Langmuir, Irving, 1950
Bush, Vannevar, 1953
Townes, Charles Hard, 1961
Ewing, Maurice, 1963
Sturtevant, Alfred Henry, 1965
Gell-Mann, Murray, 1968
Watson, James Dewey, 1971

Thomas Lincoln Casey Endowment Fund

To be used in the advancement of engineering in all of its applications

Committee: to be appointed.

Cyrus B. Comstock Fund

Prize awarded every five years for most important discovery or investigation in electricity, magnetism, or radiant energy, or to aid worthy investigation in those subjects.

Committee: since no presentation of this award is planned until 1978 the membership of the Award Committee is not being brought up to date at this time. A Chairman and additional members will be named well in advance of the next scheduled award.

COMSTOCK PRIZE AWARDEES

Millikan, Robert A., 1913
Barnett, Samuel J., 1918
Duane, William, 1923
Davisson, C. J., 1928
Bridgman, Percy W., 1933
Lawrence, Ernest O., 1938
Kerst, Donald W., 1943
Tuve, Merle A., 1948
Shockley, William, 1953
Townes, Charles Hard, 1958
Wu, Chien-Shiung, 1963
*Cooper, Leon N., 1968
*Schrieffer, J. Robert, 1968
Dicke, Robert H., 1973

ARTHUR L. DAY FUND

To advance studies of the physics of the earth

1973 Trust Fund Committee: Merle A. Tuve, *Chairman* (1977); Herbert Friedman (1976), John H. Reynolds (1976), J. A. Van Allen (1977).

1974 Trust Fund Committee: Merle A. Tuve, *Chairman* (1977); Herbert Friedman (1976), John H. Reynolds (1976), J. A. Van Allen (1977).

1973 Selection Committee: George E. Backus, *Chairman* (1975); Bruce A. Bolt (1976), Horace R. Byers (1976), Julie G. Charney (1974), O. G. Villard (1975).

1974 Selection Committee: George E. Backus, *Chairman* (1975); Bruce A. Bolt (1976), Horace R. Byers (1976), O. G. Villard (1975), George W. Wetherill (1977).

ARTHUR L. DAY PRIZE AWARDEE

Yoder, Hatten S., 1972

HENRY DRAPER FUND

Gold medal, awarded not more often than once every two years, for notable investigation in astronomical physics

1973 Committee: Leo Goldberg, *Chairman* (1974); David S. Heeschen (1974), Richard Tousey (1975) .

1974 Committee: Richard Tousey (1975). Since no presentation of this award is planned for 1975, the membership of the Award Committee is not being brought up to date at this time. A Chairman and additional members will be named well in advance of the next scheduled award.

HENRY DRAPER MEDALISTS

Langley, Samuel P., 1886
Pickering, E. C., 1888
Rowland, H. A., 1890
Vogel, H. K., 1893
Keeler, J. E., 1899
Huggins, Sir William, 1901
Hale, George E., 1904
Campbell, W. W., 1906
Abbot, C. G., 1910
Deslandres, H., 1913
Stebbins, Joel, 1915
Michelson, A. A., 1916
Adams, W. S., 1918
Fabry, Charles, 1919
Fowler, Alfred, 1920
Zeeman, Pieter, 1921
Russell, Henry Norris, 1922
Eddington, Sir Arthur Stanley, 1924
Shapley, Harlow, 1926
Wright, William Hammond, 1928
Cannon, Annie Jump, 1931
Slipher, V. M., 1932
Plaskett, John Stanley, 1934
Mees, C. E. Kenneth, 1936
Wood, Robert Williams, 1940
Bowen, Ira Sprague, 1942
Merrill, Paul W., 1945
Bethe, Hans Albrecht, 1947
Struve, Otto, 1949
Lyot, Bernard, 1951
van de Hulst, Hendrik C., 1955
Babcock, Horace W., 1957
Schwarzschild, Martin, 1960
Tousey, Richard, 1963
Ryle, Martin, 1965
Edlén, Bengt, 1968
Chandresekhar, Subrahmanyan, 1971
Spitzer, Lyman, Jr., 1974

*Joint Award.

DANIEL GIRAUD ELLIOT FUND

Gold medal and honorarium, for the most meritorious work in zoology or paleontology published each year

1973 Committee: S. Dillon Ripley, *Chairman* (1975); Richard D. Alexander (1977), Vincent G. Dethier (1975).

1974 Committee: S. Dillon Ripley, *Chairman* (1975); Richard D. Alexander (1977), Vincent G. Dethier (1975), John W. Wells (1977).

DANIEL GIRAUD ELLIOT MEDALISTS

Chapman, F. M., 1917
Beebe, William, 1918
Ridgway, Robert, 1919
Abel, Othenio, 1920
Dean, Bashford, 1921
Wheeler, William Morton, 1922
Canu, Ferdinand, 1923
Breuil, Henri, 1924
Wilson, Edmund B., 1925
Stensiö, Erik A.: Son, 1927
Seton, Ernest Thompson, 1928
Osborn, Henry Fairfield, 1929
Coghill, George Ellett, 1930
Black, Davidson, 1931
Chapin, James P., 1932
Lull, Richard Swann, 1933
Painter, Theophilus Shickel, 1934
Colbert, Edwin H., 1935
Murphy, Robert Cushman, 1936
Parker, George Howard, 1937
Irwin, Malcolm Robert, 1938
Northrop, John Howard, 1939
Scott, William Berryman, 1940
Dobzhansky, Theodosius, 1941
Thompson, Sir D'Arcy W., 1942
Lashley, Karl Spencer, 1943
Simpson, George Gaylord, 1944
Wright, Sewall Green, 1945
Broom, Robert, 1946
Patterson, John Thomas, 1947
Bigelow, Henry B., 1948
Bent, Arthur Cleveland, 1949
Osburn, Raymond Carrol, 1950
Hyman, Libbie Henrietta, 1951
Carr, Archie Fairly, 1952
Ekman, Sven P., 1953
Friedmann, Herbert, 1955
Rober, Alfred Sherwood, 1956
Darlington, Philip J., Jr., 1957
Griffin, Donald Redfield, 1958
Simpson, George Gaylord, 1965
Mayr, Ernst, 1967
Alexander, Richard, 1971

GIBBS BROTHERS FUND

Gold medal and honorarium awarded not more often than once every two years, for outstanding contribution in the field of naval architecture and marine engineering

1973 *Committee:* Philip Sporn, *Chairman* (1974); N. M. Newmark (1977), Henry A. Schade (1974).

1974 *Committee:* N. M. Newmark (1977). Since no presentation of this award is planned for 1975, the membership of the Award Committee is not being brought up to date at this time. A Chairman and additional members will be named well in advance of the next scheduled award.

GIBBS BROTHERS MEDALISTS

Todd, Frederick Henry, 1965
Kiel, Alfred Adolf Heinrich, 1967
Schade, Henry A., 1971
Eisenberg, Phillip, 1974

WOLCOTT GIBBS FUND

Grants for chemical research

Board of Directors: Bryce Crawford, Jr., *Chairman;* James S. Coles, George S. Hammond, W. H. Stockmayer.

BENJAMIN APTHORP GOULD FUND

Honorarium awarded for outstanding contribution in astronomy, the mechanics of orbits of asteroids or comets or problems of local galactic structure

Board of Directors: Bart J. Bok, *Chairman;* William A. Fowler, Herbert Friedman, Fred L. Whipple.

GOULD PRIZE AWARDEES

Roemer, Elizabeth, 1971
Kellermann, Kenneth I., 1973

JOSEPH HENRY FUND

Grants to assist meritorious investigators, especially in the direction of original research

1973 *Committee:* Murray Gell-Mann, *Chairman* (1975); Ernest M. Grunwald (1974), Waldo R. Wedel (1975).

1974 *Committee:* Murray Gell-Mann, *Chairman* (1975); Jerrold Meinwald (1978), Arthur R. Pardee (1978), Waldo R. Wedel (1975).

HUNSAKER FUND

The National Academy of Sciences Award in Aeronautical Engineering consists of an honorarium awarded every five years; established by a gift of Mr. and Mrs. J. C. Hunsaker

Committee: Raymond L. Bisplinghoff (1978). Since no presentation of the award is planned for 1975, the membership of the Award Committee is not being brought up to date at this time. Additional members will be named well in advance of the next scheduled award.

NAS AWARD IN AERONAUTICAL ENGINEERING

Grumman, Leroy Randle, 1968
Douglas, Donald Wills, Sr., 1973

KIMBER GENETICS AWARD (Inactive since 1967)

Gold Medal and honorarium awarded from time to time for achievement in the science of genetics; established as an international award by Johon Kimber

KIMBER GENETICS MEDALISTS

Castle, William Ernest, 1955
Muller, Hermann Joseph, 1955
Wright, Sewall Green, 1956
Sturtevant, A. H., 1957
Dobzhansky, Theodosius, 1958
Sonneborn, Tracy Morton, 1959
Beadle, George W., 1960
Haldane, John Burdon Sanderson, 1961
Demerec, Milislav, 1962
Stern, Curt, 1963
Delbrück, Max, 1964
Hershey, Alfred Day, 1965
Timofeeff-Ressovsky, Nikolai V., 1966
McClintock, Barbara, 1967

JESSIE STEVENSON KOVALENKO FUND

Gold medal and honorarium for meritorious research in medical science

1973 Committee: Irvine H. Page, *Chairman* (1976); Seymour S. Kety (1976), Frederick C. Robbins (1975).

1974 Committee: Irvine H. Page, *Chairman* (1976); Seymour S. Kety (1976), Frederick C. Robbins (1975).

KOVALENKO MEDALISTS

Richard, Alfred Newton, 1952
Rous, Peyton, 1955
Goodpasture, Ernest W., 1958
Opie, Eugene Lindsay, 1959
Meyer, Karl Fredrich, 1961
Whipple, George Hoyt, 1962
Cole, Rufus, 1966
Link, Karl Paul, 1967
Francis, Thomas, Jr., 1970 (p.h.)
Kety, Seymour Solomon, 1973

MARSH FUND

Grants for original research in the natural sciences

1973 Committee: John D. Baldeschwieler, *Chairman* (1976); James D. Hardy (1975), Michael Kasha (1974).

1974 Committee: John D. Baldeschwieler, *Chairman* (1976); Clifford Grobstein (1977), James D. Hardy (1975), Konrad B. Krauskopf (1977).

GEORGE P. MERRILL FUND

Grants for studies of meteors, meteorites, and space

1973 Committee: J. A. Van Allen, *Chairman* (1974); W. F. Brace (1975), F. D. Drake (1976).

1974 Committee: F. D. Drake, *Chairman* (1976); W. F. Brace (1975), Joseph W. Chamberlain (1977), Riccardo Giacconi (1978).

MURRAY FUND

Agassiz gold medal for original contribution in the science of oceanography

1973 Committee: Frank Press, *Chairman* (1975); Maurice Ewing (1974), Roger Revelle (1975).

1974 Committee: Frank Press, *Chairman* (1975); Roger Revelle (1975).

AGASSIZ MEDALISTS

Hjort, Johan, 1913
Albert I, Prince of Monaco, 1918
Sigsbee, Charles Dwight, 1920
Pettersson, Otto Sven, 1924
Bjerknes, Wilhelm, 1926
Weber, Max, 1927
Ekman, Vagn Walfrid, 1928
Gardiner, J. Stanley, 1929
Schmidt, Johannes, 1930
Bigelow, Henry Bryant, 1931
Defant, Albert, 1932
Helland-Hansen, Björn, 1933
Gran, Haakon Hasberg, 1934
Vaughan, T. Wayland, 1935
Knudsen, Martin, 1936
Allen, Edgar Johnson, 1937
Sverdrup, Harald Ulrik, 1938
Lillie, Frank Rattray, 1939
Iselin II, Columbus, 1942
Proudman, Joseph, 1946
Vening Meinesz, Felix Andries, 1947
Thompson, Thomas Gordon, 1948
Marmer, Harry A., 1951
Harvey, H. W., 1952
Ewing, Maurice, 1954
Redfield, Alfred Clarence, 1955
Johnson, Martin Wiggo, 1959
Bruun, Anton Frederik, 1960
Deacon, George Edward Raven, 1962
Revelle, Roger R. 1963
Bullard, Sir Edward, 1965
Eckart, Carl, 1966
Fuglister, Frederick C., 1969
Uyeda, Seiya, 1972
Steele, John H., 1973

NATIONAL ACADEMY OF SCIENCES AWARD IN APPLIED MATHEMATICS AND NUMERICAL ANALYSIS

Honorarium, awarded once every three years through funds provided by the International Business Machines Corporation

1973 Committee: Fritz John, *Chairman* (1974); Elliott Montroll (1976), Warren Weaver (1974).

1974 Committee: Elliott Montroll (1976). Since no presentation of this award is planned for 1975, the membership of the Award Committee is not being brought up to date at this time. A Chairman and additional members will be named well in advance of the next scheduled award.

NAS AWARD IN APPLIED MATHEMATICS AND NUMERICAL ANALYSIS

Friedrichs, Kurt Otto, 1972
Karlin, Samuel, 1973

NATIONAL ACADEMY OF SCIENCES AWARD IN ENVIRONMENTAL QUALITY

Honorarium awarded in recognition of significant contributions to environmental quality presented annually through funds provided by Research Corporation in honor of Frederick Gardner Cottrell

1973 Committee: Franklin A. Long, *Chairman* (1976); W. T. Edmondson (1976), Arie J. Haagen-Smit (1977), Cyrus Levinthal (1975), Gordon J. F. MacDonald (1976).

1974 Committee: Franklin A. Long, *Chairman* (1976); W. T. Edmondson (1976), Arie J. Haagen-Smit (1977), Cyrus Levinthal (1975), Gordon J. F. MacDonald (1976).

NAS AWARD IN ENVIRONMENTAL QUALITY

Haagen-Smit, Arie Jan, 1972
Edmondson, W. Thomas, 1973
Hutchinson, G. Evelyn, 1974

PUBLIC WELFARE MEDAL

Gold medal and honorarium, for eminence in the application of science to the public welfare, established by the Marcellus Hartley Fund now depleted

1973 Committee: Frederick Seitz, *Chairman* (1975); James A. Shannon (1976), Alvin M. Weinberg (1976).

1974 Committee: Frederick Seitz, *Chairman* (1975); H. E. Carter (1977), E. E. David, Jr. (1977), James A. Shannon (1976), Alvin M. Weinberg (1976)

PUBLIC WELFARE MEDALISTS

Goethals, G. W., 1914
Gorgas, W. C., 1914
Abbe, Cleveland, 1916
Pinchot, Gifford, 1916
Stratton, S. W., 1917
Hoover, Herbert, 1920
Stiles, C. W., 1921
Chapin, Charles V., 1928
Mather. Stephen Tyng, 1930
Rose, Wickliffe, 1931
Park, William Hallock, 1932
Fairchild, David, 1933
Vollmer. August, 1934
Russel, F. F., 1935
Cumming, Hugh S., 1935
Whitney, Willis Rodney, 1937
Hoover, John Edgar, 1939
Rockefeller, John D., Jr., 1943
Bush, Vannevar, 1945
Compton, Karl Taylor, 1947
Shull, George Harrison, 1948
Lilienthal, David E., 1951
Killian, James R., Jr., 1956
Weaver, Warren, 1957
Moe, Henry Allen, 1958
Doolittle, James H., 1959
Waterman, Alan T., 1960
Shannon, James A., 1962
Harrar, J. George, 1963
Bronk, Detlev Wulf, 1964
Gardner, John W., 1966
Hill, Lister, 1969
Carmichael, Leonard, 1972

H. P. ROBERTSON MEMORIAL LECTURESHIP FUND

To provide an honorarium for a lecture once every three years by a distinguished scientist from any part of the world

1973 Committee: Harrison Brown, *Chairman* (1975); Bentley Glass (1974), Kip S. Thorne (1976).

1974 Committee: Harrison Brown, *Chairman* (1975); Bentley Glass (1975), George S. Hammond (1978), Kip S. Thorne.

H. P. ROBERTSON LECTURERS

Wheeler, John A., 1967
Doty, Paul, 1971

J. LAWRENCE SMITH FUND

Gold medal, awarded not more often than once every two years, and grants for investigations of meteoric bodies

1973 Committee: G. J. Wasserburg, *Chairman* (1976); Thomas Gold (1974), John H. Reynolds (1975).

1974 Committee: G. J. Wasserburg, *Chairman* (1976); John H. Reynolds (1975).

J. LAWRENCE SMITH MEDALISTS

Newton, H. A., 1888
Merrill, George P., 1922
Perry, Stuart Hoffman, 1945
Whipple, Fred Lawrence, 1949
Millman, Peter Mackenzie, 1954
Inghram, Mark G., 1957
Öpik, Ernst J., 1960
Urey, Harold Clayton, 1962
Reynolds, John Hamilton, 1967
Henderson, Edward Porter, 1970
Anders, Edward, 1971
Patterson, Clair Cameron, 1973

MARY CLARK THOMPSON FUND

Gold medal for most important service to geology and paleontology

1973 Committee: Marland P. Billings, *Chairman* (1974); Walter B. Langbein (1974), Thomas B. Nolan (1974).

1974 Committee: Since no presentation of this award is planned for 1975, the membership of the Award Committee is not being brought up to date at this time. Members will be named well in advance of the next scheduled award.

MARY CLARK THOMPSON MEDALISTS

Walcott, Charles Doolittle, 1921
Margerie, Emmanuel de, 1923
Clarke, John Mason, 1925
Smith, James Perrin, 1928
Scott, William Berryman, 1930
Ulrich, Edward Oscar, 1930
White, David, 1931
Bather, Francis Arthur, 1932
Schuchert, Charles, 1934
Grabua, Amadeus William, 1936
Watson, David Meredith Seares, 1941
Woodward, Sir Arthur Smith, 1942
Berry, Edward Wilber, 1942
Simpson, George Gaylord, 1943
Arkell, William Joscelyn, 1944
Vaughan, T. Wayland, 1945
Reeside, John Bernard, Jr., 1946
McLearn, Frank, 1948
Koch, Lauge, 1949
Stephenson, Lloyd William, 1952
Romer, Alfred Sherwood, 1954
Cooper, Gustav Arthur, 1957
Kozlowski, Roman, 1958
Newell, Norman Dennis, 1961
Bramlette, Milton Nunn, 1964
Woodring, Wendell Phillips, 1967
Moore, Raymond Cecil, 1970
Hedberg, Hollis Dow, 1973

U.S. STEEL FOUNDATION AWARD IN MOLECULAR BIOLOGY

Honorarium, may be presented annually, for recent notable discovery in this field by a young scientist

1973 Committee: Matthew S. Meselson, *Chairman* (1975); Donald D. Brown (1976), Norton D. Zinder (1974).

1974 Committee: Donald D. Brown, *Chairman* (1976); M. S. Meselson (1975), Marshall Warren Nirenberg (1978), Charles Yanofsky (1977).

AWARDS IN MOLECULAR BIOLOGY

Nirenberg, Marshall W., 1962
Meselson, Matthew S., 1963
Yanofsky, Charles, 1964
Edgar, Robert Stuart, 1965
Zinder, Norton D., 1966
Holley, Robert W., 1967
Gilbert, Walter, 1968
Wood III, William Barry, 1969
Kaiser, Armin Dale, 1970
Nomura, Masayasu, 1971
Temin, Howard Martin, 1972
Brown, Donald David, 1973
Baltimore, David, 1974

SELMAN A. WAKSMAN AWARD IN MICROBIOLOGY

Honorarium awarded annually or biennially in honor of Selman A. Waksman the award is made available by the Foundation for Microbiology

1973 Committee: Bernard D. Davis, *Chairman* (1974); Rollin D. Hotchkiss (1976), Charles Yanofsky (1975).

1974 Committee: Rollin D. Hotchkiss (1976), Charles Yanofsky (1975).

WAKSMAN AWARDEES

Strominger, Jack L., 1968
Stadtman, Earl Reece, 1970
Yanofsky, Charles, 1972
Dulbecco, Renato, 1974

CHARLES DOOLITTLE WALCOTT FUND

For stimulation of research in pre-Cambrian or Cambrian life by award of a gold medal and honorarium every five years

1973 Board of trustees: Ernst Mayr, *Chairman* (1976); Albert E. J. Engel (1977), Kenneth V. Thimann (1978).

1974 Board of trustees: Ernst Mayr, *Chairman* (1976); Albert E. Engel (1977), Kenneth V. Thimann (1978), Alwyn Williams, representing the Royal Society of London (1977).

CHARLES DOOLITTLE WALCOTT MEDALISTS

White, David, 1934
Westergaard, A. H., 1939
Vologdin, Alexander G., 1947
Rasetti, Franco, 1952
Hupé, Pierre, 1957
Öpik, Armin Alexander, 1962
Palmer, Allison Ralph, 1967
Barghoorn, Elso Sterrenberg, 1972

G. K. WARREN PRIZE FUND

In support of an award to be known as the G. K. Warren Prize, in any field of science.

1973 Committee: Hollis D. Hedberg, *Chairman* (1976); William W. Rubey (1975), Abel Wolman (1976).

1974 Committee: Hollis D. Hedberg, *Chairman* (1976); Abel Wolman (1976).

G. K. WARREN PRIZE AWARDEES

Bagnold, R. A., 1969
Leopold, Luna Bergere, 1973

JAMES CRAIG WATSON FUND

Gold medal and honorarium awarded for contributions to the science of astronomy and also support for astronomical research

1973 Board of trustees: Paul Herget, *Chairman;* Lawrence Aller, Martin Schwarzschild.

1974 Board of trustees: Paul Herget, *Chairman;* Lawrence Aller, Donald E. Osterbrock, Martin Schwarzschild.

JAMES CRAIG WATSON MEDALISTS

Gould, Benjamin A., 1887
Schoenfeld, Ed., 1889
Auwers, Arthur, 1891
Chandler, S. C., 1894
Gill, Sir David, 1899
Kapteyn, J. C., 1913
Leuschner, A. O., 1916
Charlier, C.V.L., 1924
de Sitter, Willem, 1929
Brown, Ernest William, 1936
Mitchell, Samuel A., 1948
Morgan, Herbert R., 1951
Watts, Chester B., 1955
Van Biesbroeck, George, 1957
Hagihara, Yusuke, 1960
Heckmann, Otto, 1961
Luyten, Willem Jacob, 1964
Herget, Paul, 1965
Eckert, Wallace J., 1966
Moser, Jürgen Kurt, 1969
Deprit, André, 1972

PRESIDENTS OF THE NATIONAL ACADEMY OF SCIENCES

Name	Year
Alexander Dallas Bache	1863–67
Joseph Henry	1868–78
William Barton Rogers	1879–82
Othniel Charles Marsh	1883–95
Wolcott Gibbs	1895–1900
Alexander Agassiz	1901–07
Ira Remsen	1907–13
William Henry Welch	1913–17
Charles Doolittle Walcott	1917–23
Albert Abraham Michelson	1923–27
Thomas Hunt Morgan	1927–31
William Wallace Campbell	1931–35
Frank Rattray Lillie	1935–39
Frank Baldwin Jewett	1939–47
Alfred Newton Richards	1947–50
Detlev Wulf Bronk	1950–62
Frederick Seitz	1962–69
Philip Handler	1969–

MEDALISTS OF THE NATIONAL ACADEMY OF SCIENCES

Awardee	Medal	Year
Abbe, Cleveland	Welfare	1916
Abbot, Charles Greeley	Draper	1910
Abel, Othenio	Elliot	1920
Adams, Walter Sydney	Draper	1918
Albert I, Prince of Monaco	Agassiz	1918
Alexander, Richard Dale	Elliot	1971
Allen, Edgar Johnson	Agassiz	1937
Anders, Edward	Smith	1971
Arkell, William Joscelyn	Thompson	1944
Auwers, G. F. J. Arthur	Watson	1891
Babcock, Horace W.	Draper	1957
Barghoorn, Eleo Sterrenberg	Walcott	1972
Bather, Francis Arthur	Thompson	1932
Beadle, George W.	Kimber	1960
Beebe, William	Elliot	1918
Bent, Arthur Cleveland	Elliot	1949
Berry, Edward Wilber	Thompson	1942
Bethe, Hans Albrecht	Draper	1947
Bigelow, Henry Bryant	Agassiz	1931
Bigelow, Henry Bryant	Elliot	1948
Bjerknes, Vilhelm	Agassiz	1926
Black, Davidson	Elliot	1931
Bowen, Ira Sprague	Draper	1942
Bragg, Sir William Henry	Carty	1939
Bramlette, Milton Nunn	Thompson	1964
Breuil, Henri	Elliot	1924
Bronk, Detlev Wulf	Welfare	1964
Broom, Robert	Elliot	1946
Brown, Ernest William	Watson	1936
Bruun, Anton Frederik	Agassiz	1960
Bullard, Sir Edward	Agassiz	1965
Bush, Vannevar	Welfare	1945
Bush, Vannevar	Carty	1953
Campbell, William Wallace	Draper	1906
Cannon, Annie Jump	Draper	1931
Canu, Ferdinand	Elliot	1923
Carmichael, Leonard	Welfare	1972
Carr, Archie Fairly	Elliot	1952
Carty, John J.	Carty	1932
Castle, William Ernest	Kimber	1955
Chandler, Seth Carlo	Watson	1894
Chandrasekhar, S.	Draper	1971
Chapin, Charles V.	Welfare	1928
Chapin, James P.	Elliot	1932
Chapman, Frank Mickler	Elliot	1917
Charlier, C. V. L.	Watson	1924
Clarke, John Mason	Thompson	1925
Coghill, George Ellett	Elliot	1930
Colbert, Edwin H.	Elliot	1935
Cole, Rufus	Kovalenko	1966
Compton, Karl Taylor	Welfare	1947
Conklin, Edwin Grant	Carty	1943
Cooper, Gustav Arthur	Thompson	1957
Cumming, Hugh S.	Welfare	1935
Darlington, Philip J., Jr.	Elliot	1957
Deacon, George Edward Raven	Agassiz	1962
Dean, Bashford	Elliot	1921
Defant, Albert	Agassiz	1932
Delbrück, Max	Kimber	1964
Demerec, Milislav	Kimber	1962
Deprit, André	Watson	1972
de Sitter, Willem	Watson	1929
Deslandres, Henri	Draper	1913
Dobshansky, Theodosius	Elliot	1941
Dobshansky, Theodosius	Kimber	1958
Doolittle, James H.	Welfare	1959
Durand, William Frederick	Carty	1945
Eckart, Carl	Agassiz	1966
Eckert, Wallace J.	Watson	1966
Eddington, Sir Arthur Stanley	Draper	1924
Edlén, Bengt	Draper	1968
Eisenberg, Phillip	Gibbs Bros.	1974
Ekman, Sven P.	Elliot	1953
Ekman, V. Walfrid	Agassiz	1928
Ewing, Maurice	Agassiz	1954
Ewing, Maurice	Carty	1963
Fabry, Charles	Draper	1919
Fairchild, David	Welfare	1933
Fowler, Alfred	Draper	1920
Francis, Thomas, Jr.	Kovalenko	1970
Friedmann, Herbert	Elliot	1955
Fuglister, Frederick C.	Agassiz	1969
Gardiner, J. Stanley	Agassiz	1929
Gardner, John W.	Welfare	1966
Gell-Mann, Murray	Carty	1968
Gill, Sir David	Watson	1899
Goethals, George Washington	Welfare	1914
Goodpasture, Ernest W.	Kovalenko	1958
Gorgas, William Crawford	Welfare	1914
Gould, Benjamin Apthorp	Watson	1887
Grabau, Amadeus William	Thompson	1936
Gran, Haakan Hasberg	Agassiz	1934
Griffin, Donald Redfield	Elliot	1958
Hagihara, Yusuke	Watson	1960
Haldane, John Burdon Sanderson	Kimber	1961
Hale, George Ellery	Draper	1904
Harrar, J. George	Welfare	1963
Harrison, Ross Granville	Carty	1947
Harvey, H. W.	Agassiz	1952
Heckmann, Otto	Watson	1961
Hedberg, Hollis Dow	Thompson	1973
Helland-Hansen, Björn	Agassiz	1933
Henderson, Edward Porter	Smith	1970
Herget, Paul	Watson	1965
Hershey, Alfred Day	Kimber	1965
Hill, Lister	Welfare	1969
Hjort, Johan	Agassiz	1913
Hoover, Herbert Clark	Welfare	1920
Hoover, John Edgar	Welfare	1939
Huggins, Sir William	Draper	1901
Hupé, Pierre	Walcott	1957
Hyman, Libbie Henrietta	Elliot	1951
Ingham, Mark G.	Smith	1957
Irwin, Malcolm Robert	Elliot	1938
Iselin II, Columbus	Agassiz	1942
Johnson, Francis Severin	Arctowski	1972
Johnson, Martin Wiggo	Agassiz	1959
Kapteyn, J. C.	Watson	1913
Keeler, James Edward	Draper	1899
Keil, Klaus	Merrill	1970
Kety, Seymour Solomon	Kovalenko	1973
Kiel, Alfred Adolf Heinrich	Gibbs Bros.	1967
Killian, James R., Jr.	Welfare	1956
Knudsen, Martin	Agassiz	1936
Koch, Lauge	Thompson	1949
Koslowski, Roman	Thompson	1958
Langley, Samuel Pierpont	Draper	1886
Langmuir, Irving	Carty	1950
Lashley, Karl Spencer	Elliot	1943
Leuschner, Armin Otto	Watson	1916
Lilienthal, David E.	Welfare	1961
Lillie, Frank Rattray	Agassiz	1939

MEDALISTS OF THE NATIONAL ACADEMY OF SCIENCES—Continued

Awardee	Medal	Year
Link, Karl Paul	Kovalenko	1967
Lull, Richard Swann	Elliot	1933
Luyten, Willem Jacob	Watson	1964
Lyot, Bernard	Draper	1951
Margerie, Emmanuel de	Thompson	1923
Marmer, Harry A.	Agassiz	1951
Mather, Stephen Tyng	Welfare	1930
Mayr, Ernst	Elliot	1967
McClintock, Barbara	Kimber	1967
McLearn, Frank	Thompson	1948
Mees, C. E. Kenneth	Draper	1936
Merrill, George Perkins	Smith	1922
Merrill, Paul Willard	Draper	1945
Meyer, Karl Friedrich	Kovalenko	1961
Michelson, Albert Abraham	Draper	1916
Millman, Peter Mackenzie	Smith	1954
Mitchell, Samuel A.	Watson	1948
Moe, Henry Allen	Welfare	1958
Moore, Raymond Cecil	Thompson	1970
Morgan, Herbert R.	Watson	1951
Moser, Jürgen Kurt	Watson	1969
Muller, Hermann Joseph	Kimber	1955
Murphy, Robert Cushman	Elliot	1936
Newell, Norman Dennis	Thompson	1961
Newton, Hubert Anson	Smith	1888
Northrop, John Howard	Elliot	1939
Opie, Eugene Lindsay	Kovalenko	1959
Opik, Armin Alexander	Walcott	1962
Opik, Ernst J.	Smith	1960
Osborn, Henry Fairfield	Elliot	1929
Osburn, Raymond Carroll	Elliot	1950
Painter, Theophilus Shickel	Elliot	1934
Palmer, Allison Ralph	Walcott	1967
Park, William Hallock	Welfare	1932
Parker, Eugene Norman	Arctowski	1969
Parker, George Howard	Elliot	1937
Patteron, Clair Cameron	Smith	1973
Patterson, John Thomas	Elliot	1947
Perry, Stuart Hoffman	Smith	1945
Pettersson, Otto Sven	Agassiz	1924
Pickering, Edward Charles	Draper	1888
Pinchot, Gifford	Welfare	1916
Plaskett, John Stanley	Draper	1934
Proudman, Joseph	Agassiz	1946
Rasetti, Franco	Walcott	1952
Redfield, Alfred Clarence	Agassiz	1955
Reeside, John B., Jr.	Thompson	1946
Revelle, Roger R.	Agassiz	1963
Reynolds, John Hamilton	Smith	1967
Richards, Alfred Newton	Kovalenko	1952
Ridgway, Robert	Elliot	1919
Rockefeller, John Davison, Jr.	Welfare	1943
Romer, Alfred Sherwood	Thompson	1954
Romer, Alfred Sherwood	Elliot	1956
Rose, Wickliffe	Welfare	1931
Rous, Peyton	Kovalenko	1955
Rowland, Henry Augustus	Draper	1890
Russell, F. F.	Welfare	1935
Russell, Henry Norris	Draper	1922
Ryle, Martin	Draper	1965
Schade, Henry Adrian	Gibbs Bros.	1971
Schmidt, Johannes	Agassiz	1930
Schmitt, Roman A.	Merrill	1972
Schoenfeld, Ed.	Watson	1889
Schuchert, Charles	Thompson	1934
Schwarzschild, Martin	Draper	1960
Scott, William Berryman	Thompson	1930
Scott, William Berryman	Elliot	1940
Seton, Ernest Thompson	Elliot	1928
Shannon, James A.	Welfare	1962
Shapley, Harlow	Draper	1926
Shull, George Harrison	Welfare	1948
Sigsbee, Charles Dwight	Agassiz	1920
Simpson, George Gaylord	Thompson	1943
Simpson, George Gaylord	Elliot	1944
Simpson, George Gaylord	Elliot	1965
Slipher, V. M.	Draper	1932
Smith, James Perrin	Thompson	1928
Sonneborn, Tracy Morton	Kimber	1959
Spitzer, Lyman, Jr.	Draper	1974
Stebbins, Joel	Draper	1915
Steele, John H.	Agassiz	1973
Stensiö, Erik A.: Son	Elliot	1927
Stephenson, Lloyd William	Thompson	1952
Stern, Curt	Kimber	1963
Stiles, Charles Wardell	Welfare	1921
Stratton, Samuel Wesley	Welfare	1917
Struve, Otto	Draper	1949
Sturtevant, A. H.	Kimber	1957
Sturtevant, A. H.	Carty	1965
Sverdrup, Harald Ulrik	Agassiz	1938
Thompson, Sir D'Arcy Wentworth	Elliot	1942
Thompson, Thomas Gordon	Agassiz	1948
Timofeeff-Ressovsky, Nikolai V.	Kimber	1966
Todd, Frederick H.	Gibbs Bros.	1965
Tousey, Richard	Draper	1963
Townes, Charles Hard	Carty	1961
Ulrich, Edward Oscar	Thompson	1930
Urey, Harold Clayton	Smith	1962
Uyeda, Seiya	Agassiz	1972
Van Biesbroeck, George	Watson	1957
van de Hulst, H. C.	Draper	1955
Vaughan, T. Wayland	Agassiz	1935
Vaughan, T. Wayland	Thompson	1945
Vening Meiness, Felix Andries	Agassiz	1947
Vogel, Herman Karl	Draper	1893
Vollmer, August	Welfare	1934
Vologdin, Alexander G.	Walcott	1947
Walcott, Charles Doolittle	Thompson	1921
Waterman, Alan T.	Welfare	1960
Watson, David Meredith Seares	Thompson	1941
Watson, James Dewey	Carty	1971
Watts, Chester B.	Watson	1955
Weaver, Warren	Welfare	1957
Weber, Max	Agassiz	1927
Westergaard, A. H.	Walcott	1939
Wheeler, William Morton	Elliot	1922
Whipple, Fred Lawrence	Smith	1949
Whipple, George Hoyt	Kovalenko	1962
White, David	Thompson	1931
White, David	Walcott	1934
Whitney, Willis Rodney	Welfare	1937
Wild, J. Paul	Arctowski	1969
Wilson, Edmund Beecher	Elliot	1925
Wilson, Edmund Beecher	Carty	1936
Wood, Robert Williams	Draper	1940
Woodring, Wendell Phillips	Thompson	1967
Woodward, Sir Arthur Smith	Thompson	1942
Wright, Sewall	Elliot	1945
Wright, Sewall	Kimber	1956
Wright, William Hammond	Draper	1928
Zeeman, Pieter	Draper	1921

RECIPIENTS OF PRIZES AND OTHER AWARDS

Awardee	Prize or Award	Date
Bagnold, R. A.	Warren Prize	1969
Baltimore, David	Molecular Biology	1974
Barnett, Samuel J.	Comstock Prize	1918
Bridgman, Percy W.	Comstock Prize	1933
Brown, Donald David	Molecular Biology	1973
*Cooper, Leon N.	Comstock Prize	1968
Davisson, C. J.	Comstock Prize	1928
Dicke, Robert H.	Comstock Prize	1973
Douglas, Donald Wills, Sr.	Aeronautical Engineering	1973
Duane, William	Comstock Prize	1923
Dulbecco, Renato	Waksman Award	1974

See footnotes at end of table.

RECIPIENTS OF PRIZES AND OTHER AWARDS—Continued

Awardee	Prize or Award	Date
Edgar, Robert Stuart	Molecular Biology	1965
Edmondson, W. Thomas	Environmental Quality	1973
Friedrichs, Kurt Otto	Appl. Mathematics & Numerical Analysis	1972
Gilbert, Walter	Molecular Biology	1968
Grumman, Leroy Randle	Aeronautical Engineering	1968
Haagen-Smit, Arie Jan	Environmental Quality	1972
Hutchinson, G. Evelyn	Environmental Quality	1974
Holley, Robert W.	Molecular Biology	1967
Kaiser, Armin Dale	Molecular Biology	1970
Karlin, Samuel	Appl. Mathematics & Numerical Analysis	1973
Kellermann, Kenneth I.	Gould Prize	1973
Kerst, Donald W.	Comstock Prize	1943
Lawrence, Ernest O.	Comstock Prize	1938
Leopold, Luna Bergere	Warren Prise	1973
Meselson, Matthew S.	Molecular Biology	1963
Millikan, Robert A.	Comstock Prise	1913
Nirenberg, Marshall W.	Molecular Biology	1962
Nomura, Masayasu	Molecular Biology	1971
Roemer, Elizabeth	Gould Prize	1971
*Schrieffer, J. Robert	Comstock Prize	1968
Shockley, William	Comstock Prize	1953
Stadtman, Earl Reece	Microbiology	1970
Strominger, Jack L.	Microbiology	1968
Temin, Howard	Molecular Biology	1972
Townes, Charles Hard	Comstock Prize	1958
Tuve, Merle A.	Comstock Prize	1948
Wood, III, William Barry	Molecular Biology	1969
Wu, Chien-Shiung	Comstock Prise	1963
Yanofsky, Charles	Molecular Biology	1964
Yanofsky, Charles	Microbiology	1972
Yoder, Hatten Schuyler, Jr.	Day Prise and Lectureship	1972
Zinder, Norton D.	Molecular Biology	1966

*Joint award.

DECEASED MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES

March 1863 through June 1974

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Abbe, Cleveland	Dec. 3, 1838	1879	Oct. 28, 1916	8
Abbot, Charles Greeley	May 31, 1872	1915	Dec. 17, 1973	--
Abbot, Henry Larcom	Aug. 13, 1831	1872	Oct. 1, 1927	13
Abel, John Jacob	May 19, 1857	1912	May 26, 1938	24
Adams, Comfort Avery	Nov. 1, 1868	1930	Feb. 21, 1958	38
Adams, Leason H.	Jan. 16, 1887	1943	Aug. 20, 1969	--
Adams, Roger	Jan. 2, 1889	1929	July 6, 1971	--
Adams, Walter Sydney	Dec. 20, 1876	1917	May 11, 1956	31
Addis, Thomas	July 27, 1881	1944	June 4, 1949	--
Adkins, Homer	Jan. 16, 1892	1942	Aug. 10, 1949	22
Agassiz, Alexander	Dec. 17, 1835	1866	Mar. 27, 1910	2
Agassiz, Louis	May 28, 1807	(1)	Dec. 14, 1873	1
Aitken, Robert Grant	Dec. 31, 1864	1918	Oct. 29, 1951	32
Albert, Abraham Adrian	Nov. 9, 1905	1943	June 6, 1972	--
Albright, Fuller	Jan. 12, 1900	1952	Dec. 8, 1969	--
Albright, William Foxwell	May 24, 1891	1955	Sept. 19, 1971	--
Alexander, James Waddell	Sept. 19, 1888	1930	Sept. 23, 1971	--
Alexander, John H.	June 26, 1812	(1)	Mar. 2, 1867	2
Alexander, Stephen	Sept. 1, 1806	(1)	June 25, 1883	1
Allee, Warder Clyde	June 5, 1885	1951	Mar. 18, 1955	30
Allen, Charles Elmer	Oct. 4, 1872	1924	June 25, 1954	29
Allen, Eugene Thomas	Apr. 2, 1864	1930	July 17, 1964	40
Allen, Joel Asaph	July 19, 1838	1876	Aug. 29, 1921	[2] 21
Allison, Samuel King	Nov. 13, 1900	1946	Sept. 15, 1965	--
Ames, Joseph Sweetman	July 3, 1864	1909	June 24, 1943	23
Anderson, Edgar	Nov. 9, 1897	1954	June 18, 1969	--
Anderson, John August	Aug. 7, 1876	1928	Dec. 2, 1959	36
Anderson, Rudolph John	Sept. 13, 1879	1946	Apr. 6, 1961	36
Angell, James Roland	May 8, 1869	1920	Mar. 4, 1949	26
Armsby, Henry Prentiss	Sept. 21, 1853	1920	Oct. 19, 1921	19
Armstrong, Charles	Sept. 25, 1886	1944	June 22, 1967	--
Atkinson, George Francis	Jan. 25, 1854	1918	Nov. 14, 1918	29
Aub, Joseph Charles	May 30, 1890	1957	Dec. 30, 1973	--
Avery, Oswald Theodore	Oct. 21, 1877	1933	Feb. 20, 1955	32
Babcock, Ernest Brown	July 10, 1877	1946	Dec. 8, 1954	32
Babcock, Harold Delos	Jan. 24, 1882	1933	Apr. 8, 1968	--
Bache, Alexander Dallas	July 19, 1806	(1)	Feb. 17, 1867	1
Bachmann, Werner Emmanuel	Nov. 13, 1901	1941	Mar. 22, 1951	34
Baekeland, Leo Hendrik	Nov. 14, 1863	1936	Feb. 23, 1944	24
Bailey, Irving Widmer	Aug. 15, 1884	1929	May 16, 1967	--
Bailey, Liberty Hyde	Mar. 15, 1858	1917	Dec. 25, 1954	--
Bailey, Percival	May 9, 1892	1953	Aug. 10, 1973	--

See footnotes at end of table.

*Except as noted otherwise in the list of numbered footnotes at the end of the table, the numbers in this column refer to the volumes in the series of "Biographical Memoirs" of deceased members published by the National Academy of Sciences.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Bailey, Solon Irving	Dec. 29, 1854	1923	June 5, 1931	15
Bain, Edgar Collins	Sept. 14, 1891	1954	Nov. 27, 1971	--
Baird, Spencer F.	Feb. 3, 1823	1864	Aug. 19, 1887	3
Balls, Arnold Kent	Apr. 2, 1891	1954	May 25, 1966	41
Bancroft, Wilder Dwight	Oct. 1, 1867	1920	Feb. 7, 1953	--
Barbour, Thomas	Aug. 19, 1884	1933	Jan. 8, 1946	27
Barker, George F.	July 14, 1835	1876	May 24, 1910	--
Barnard, Edward Emerson	Dec. 16, 1857	1911	Feb. 6, 1923	[2] 21
Barnard, F. A. P.	May 5, 1809	([1])	Apr. 27, 1889	20
Barnard, John Gross	May 19, 1815	([1])	May 14, 1882	5
Barrell, Joseph	Dec. 15, 1869	1919	May 4, 1919	12
Bartlett, W. H. C.	Sept. 1804	([1])	Feb. 11, 1893	7
Bartelmez, George William	Mar. 23, 1885	1949	Sept. 2, 1967	43
Barus, Carl	Feb. 19, 1856	1892	Sept. 20, 1935	22
Bateman, Harry	May 29, 1882	1930	Jan. 21, 1946	25
Baxter, Gregory Paul	Mar. 3, 1876	1916	Feb. 10, 1953	--
Becker, George Ferdinand	Jan. 5, 1847	1901	Apr. 20, 1919	[2] 21
Beecher, Charles Emerson	Oct. 9, 1856	1899	Feb. 14, 1904	6
Bell, Alexander Graham	Mar. 3, 1847	1883	Aug. 2, 1922	23
Bell, Eric Temple	Feb. 7, 1883	1927	Dec. 21, 1960	--
Benedict, Francis Gano	Oct. 13, 1870	1914	May 14, 1957	32
Benedict, Stanley Rossiter	Mar. 17, 1884	1924	Dec. 21, 1936	27
Benioff, Victor Hugo	Sept. 14, 1899	1953	Feb. 29, 1968	43
Berkey, Charles Peter	Mar. 25, 1867	1927	Aug. 22, 1955	30
Berkner, Lloyd Viel	Feb. 1, 1905	1948	June 4, 1967	--
Berry, Edward Wilber	Feb. 10, 1875	1922	Sept. 20, 1945	--
Berson, Solomon Aaron	Apr. 22, 1918	1972	Apr. 11, 1972	--
Bigelow, Henry Bryant	Oct. 3, 1879	1931	Dec. 11, 1967	--
Billings, John Shaw	Apr. 12, 1838	1883	Mar. 11, 1913	8
Birkhoff, George David	Mar. 21, 1884	1918	Nov. 12, 1944	--
Bishop, George Holman	June 27, 1889	1967	Oct. 11, 1973	--
Blackwelder, Eliot	June 4, 1880	1936	Jan. 14, 1969	--
Blake, Francis Gilman	Feb. 22, 1887	1947	Feb. 1, 1952	26
Blakeslee, Albert Francis	Nov. 9, 1874	1929	Nov. 16, 1954	33
Blalock, Alfred	Apr. 5, 1899	1945	Sept. 15, 1964	--
Blichfeldt, Hans Frederik	Jan. 9, 1873	1920	Nov. 16, 1945	26
Bliss, Gilbert Ames	May 9, 1876	1916	May 8, 1951	31
Bloom, William	Sept. 15, 1899	1954	May 11, 1972	--
Boas, Franz	July 9, 1858	1900	Dec. 21, 1942	24
Bocher, Maxime	Aug. 28, 1867	1909	Sept. 12, 1918	--
Bodine, Joseph Hall	Sept. 19, 1895	1953	July 23, 1954	--
Bogert, Marston Taylor	Apr. 18, 1868	1916	Mar. 21, 1954	--
Bolton, Elmer K.	June 23, 1896	1946	July 30, 1968	--
Boltwood, Bertram Borden	July 27, 1870	1911	Aug. 14, 1927	14
Bonner, David Mahlon	May 15, 1916	1959	May 2, 1964	--
Bonner, Tom Wilkerson	Oct. 19, 1910	1959	Dec. 6, 1961	38
Boring, Edwin Garrigues	Oct. 23, 1886	1932	July 1, 1968	43
Borthwick, Harry Alfred	Jan. 7, 1898	1961	May 21, 1974	--
Boss, Lewis	Oct. 26, 1846	1889	Oct. 5, 1912	9
Bowditch, Henry Pickering	Apr. 4, 1840	1887	Mar. 13, 1911	17
Bowen, Ira Sprague	Dec. 21, 1898	1936	Feb. 6, 1973	--
Bowen, Norman Levi	June 21, 1887	1935	Sept. 11, 1956	--
Bowie, William	May 6, 1872	1927	Aug. 28, 1940	26
Bowman, Isaiah	Dec. 26, 1878	1930	Jan. 6, 1950	33
Branner, John Casper	July 4, 1850	1905	Mar. 1, 1922	[2] 21
Bray, William Crowell	Sept. 2, 1879	1924	Feb. 24, 1946	26
Breasted, James Henry	Aug. 27, 1865	1923	Dec. 2, 1935	18
Brewer, William Henry	Sept. 14, 1828	1880	Nov. 2, 1910	12
Bridges, Calvin Blackman	Jan 11, 1889	1937	Dec. 27, 1938	22
Bridgman, Percy Williams	Apr. 21, 1882	1918	Aug. 20, 1961	41
Briggs, Lyman, Jr.	May 7, 1874	1942	Mar. 25, 1963	--
Brillouin, Leon	Aug. 7, 1889	1953	Oct. 4, 1969	--
Britton, Nathaniel Lord	Jan. 15, 1859	1914	June 25, 1934	19
Brooks, William Keith	Mar. 25, 1848	1884	Nov. 12, 1908	7
Brouwer, Dirk	Sept. 1, 1902	1951	Jan. 31, 1966	41
Brown, Ernest William	Nov. 29, 1866	1923	July 22, 1938	21
Brown-Sequard, Charles E.	Apr. 8, 1817	1868	Apr. 2, 1894	4
Brush, George Jarvis	Dec. 15, 1831	1868	Feb. 6, 1912	17
Bucher, Walter Hermann	May 12, 1888	1938	Feb. 17, 1965	40
Buckley, Oliver Ellsworth	Aug. 8, 1887	1937	Dec. 14, 1959	37
Burkholder, Paul Rufus	Feb. 1, 1903	1949	Aug. 11, 1972	--
Bumstead, Henry Andrews	Mar. 12, 1870	1913	Dec. 31, 1920	13
Burgess, George Kimball	Jan. 4, 1874	1922	July 2, 1932	30
Bush, Vannevar	Mar. 11, 1890	1934	June 28, 1974	--
Calkins, Gary Nathan	Jan. 18, 1869	1919	Jan. 4, 1943	--
Campbell, Douglas Houghton	Dec. 16, 1859	1910	Feb. 23, 1953	29
Campbell, William Wallace	Apr. 11, 1862	1902	June 14, 1938	25
Cannan, Robert Keith	Apr. 18, 1894	1969	June 18, 1971	--
Cannon, Walter Bradford	Oct. 19, 1871	1914	Oct. 1, 1945	--
Carlson, Anton Julius	Jan. 29, 1875	1920	Sept. 2, 1956	35
Carmichael, Leonard	Nov. 9, 1898	1943	Sept. 16, 1973	--
Carothers, Wallace Hume	Apr. 27, 1896	1936	Apr. 29, 1937	20

See footnotes at end of table.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Carty, John Joseph	Apr. 14, 1861	1917	Dec. 27, 1932	18
Casey, Thomas Lincoln	May 10, 1831	1890	Mar. 25, 1896	4
Castle, William Ernest	Oct. 25, 1867	1915	June 3, 1962	38
Caswell, Alexis	Jan. 29, 1799	(1)	Jan. 8, 1877	6
Cattell, James McKeen	May 25, 1860	1901	Jan. 20, 1944	25
Chamberlin, Rollin Thomas	Oct. 20, 1881	1940	Mar. 6, 1948	41
Chamberlin, Thomas Chrowder	Sept. 25, 1843	1903	Nov. 15, 1928	15
Chandler, Charles Frederick	Dec. 6, 1836	1874	Aug. 25, 1925	14
Chandler, Seth Carlo	Sept. 17, 1846	1888	Dec. 31, 1913	--
Chandler, William Henry	July 1, 1878	1943	Oct. 29, 1970	--
Chaney, Ralph Works	Aug. 24, 1890	1947	Mar. 3, 1971	--
Chapman, Frank Michler	June 12, 1864	1921	Nov. 15, 1945	25
Chauvenet, William	May 24, 1820	(1)	Dec. 13, 1870	1
Child, Charles Manning	Feb. 2, 1869	1935	Dec. 19, 1954	30
Chittenden, Russell Henry	Feb. 18, 1856	1890	Dec. 26, 1943	24
Clark, Henry James	June 22, 1826	1872	July 1, 1873	1
Clark, William Bullock	Dec. 15, 1860	1908	July 27, 1917	9
Clark, William Mansfield	Aug. 17, 1884	1928	Jan. 19, 1964	39
Clarke, Frank Wigglesworth	Mar. 19, 1847	1909	May 23, 1931	15
Clarke, Hans Thacher	Dec. 27, 1887	1942	Oct. 21, 1972	--
Clarke, John Mason	Apr. 15, 1857	1909	May 29, 1925	12
Clausen, Jens Christian	Mar. 11, 1891	1959	Nov. 22, 1969	--
Clausen, Roy Elwood	Aug. 21, 1891	1951	Aug. 21, 1956	39
Cleland, Ralph Erskine	Oct. 20, 1892	1942	June 11, 1971	--
Cleveland, Lemuel Roscow	Nov. 14, 1892	1952	Feb. 12, 1969	--
Clinton, George Perkins	May 7, 1867	1930	Aug. 13, 1937	20
Cloos, Ernst	May 17, 1898	1950	May 28, 1974	--
Coble, Arthur Byron	Nov. 3, 1878	1924	Dec. 8, 1966	--
Coblentz, William Weber	Nov. 20, 1873	1930	Sept. 15, 1962	39
Cochrane, Edward Lull	Mar. 18, 1892	1945	Nov. 14, 1959	35
Coffin, James H.	Sept. 6, 1806	1869	Feb. 6, 1873	1
Coffin, J. H. C.	Sept. 14, 1815	(1)	Jan. 8, 1890	8
Coghill, George Ellett	Mar. 17, 1872	1935	July 23, 1941	22
Cohn, Edwin Joseph	Dec. 17, 1892	1943	Oct. 1, 1953	35
Cole, Rufus	Apr. 30, 1872	1922	Apr. 20, 1966	--
Compton, Arthur Holly	Sept. 10, 1892	1927	Mar. 15, 1962	38
Compton, Karl Taylor	Sept. 14, 1887	1924	June 22, 1954	--
Comstock, Cyrus B.	Feb. 3, 1831	1884	May 29, 1910	7
Comstock, George Cary	Feb. 12, 1855	1899	May 11, 1934	20
Condon, Edward Uhler	Mar. 2, 1902	1944	Mar. 25, 1974	--
Conklin, Edwin Grant	Nov. 24, 1863	1908	Nov. 20, 1952	31
Cook, George Hammell	Jan. 5, 1818	1887	Sept. 22, 1889	4
Cooke, Josiah Parsons	Oct. 12, 1827	1872	Sept. 3, 1894	4
Cope, Arthur Clay	June 27, 1909	1947	June 4, 1965	--
Cope, Edward Drinker	July 28, 1840	1872	Apr. 12, 1897	13
Corey, Robert Brainard	Aug. 19, 1897	1970	Apr. 23, 1971	--
Cori, Gerty Theresa	Aug. 15, 1896	1948	Oct. 26, 1957	--
Cottrell, Frederick Gardner	Jan. 10, 1877	1939	Nov. 16, 1948	27
Coues, Elliott	Sept. 9, 1842	1877	Dec. 25, 1899	6
Courant, Richard	Jan. 8, 1888	1955	Jan. 27, 1972	--
Coulter, John Merle	Nov. 20, 1851	1909	Dec. 23, 1928	14
Councilman, William Thomas	Jan. 1, 1854	1904	May 27, 1933	18
Crafts, James Mason	Mar. 8, 1839	1872	June 20, 1917	9
Crew, Henry	June 4, 1859	1909	Feb. 17, 1953	37
Cross, (Charles) Whitman	Sept. 1, 1854	1908	Apr. 20, 1949	32
Curtis, Heber Doust	June 27, 1872	1919	Jan. 9, 1942	22
Cushing, Harvey (Williams)	Apr. 8, 1869	1917	Oct. 7, 1939	22
Dall, William Healey	Aug. 21, 1845	1897	Mar. 27, 1927	31
Dalton, John Call	Feb. 2, 1825	1864	Feb. 2, 1889	3
Daly, Reginald Aldworth	May 19, 1871	1925	Sept. 19, 1957	34
Dana, Edward Salisbury	Nov. 16, 1849	1884	June 16, 1935	18
Dana, James Dwight	Feb. 12, 1813	(1)	Apr. 4, 1895	9
Danforth, Charles Haskell	Nov. 30, 1883	1952	Jan. 10, 1969	44
Daniels, Farrington	Mar. 9, 1889	1947	June 23, 1972	--
Davenport, Charles Benedict	June 1, 1866	1912	Feb. 18, 1944	25
Davidson, George	May 9, 1825	1874	Dec. 2, 1911	18
Davis, Bergen	Mar. 31, 1869	1929	June 30, 1958	34
Davis, Charles Henry	Jan. 16, 1807	(1)	Feb. 18, 1877	4
Davis, William Morris	Feb. 12, 1850	1904	Feb. 5, 1934	23
Davisson, Clinton Joseph	Oct. 22, 1881	1929	Feb. 1, 1958	36
Day, Arthur Louis	Oct. 30, 1869	1911	Mar. 2, 1960	--
Debye, Peter [8]	Mar. 24, 1884	1947	Nov. 2, 1966	--
DeGolyer, Everette Lee	Oct. 9, 1886	1951	Dec. 14, 1956	33
Demerec, Milislav	Jan. 11, 1895	1946	Apr. 12, 1966	42
Dempster, Arthur Jeffrey	Aug. 14, 1886	1937	Mar. 11, 1950	27
Detwiler, Samuel Randall	Feb. 17, 1890	1932	May 2, 1957	35
Dewey, John	Oct. 20, 1859	1910	June 1, 1952	30
Dickson, Leonard Eugene	Jan. 22, 1874	1913	Jan. 17, 1954	--
Dingle, John Holmes	Nov. 24, 1908	1958	Aug. 15, 1973	--
Dochez, Alphonse Raymond	Apr. 21, 1882	1933	June 30, 1964	42
Dodge, Bernard Ogilvie	Apr. 18, 1872	1933	Aug. 9, 1960	36
Dodge, Raymond	Feb. 20, 1871	1924	Apr. 8, 1942	29

See footnotes at end of table.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Donaldson, Henry Herbert	May 12, 1857	1914	Jan. 23, 1938	20
Douglas, Jesse	July 3, 1897	1946	Oct. 7, 1965	--
Draper, Henry	Mar. 7, 1837	1877	Nov. 20, 1882	3
Draper, John William	May 5, 1811	1877	Jan. 4, 1882	2
Dryden, Hugh Latimer	July 2, 1898	1944	Dec. 2, 1965	40
Duane, William	Feb. 17, 1872	1920	Mar. 7, 1935	18
DuBois, Eugene Floyd	June 4, 1882	1933	Feb. 12, 1959	36
Duggar, Benjamin Minge	Sept. 1, 1872	1927	Sept. 10, 1956	32
Dunn, Gano	Oct. 18, 1870	1919	Apr. 18, 1953	28
Dunn, Leslie Clarence	Nov. 2, 1893	1943	Mar. 19, 1974	--
Durand, William Frederick	Mar. 5, 1859	1917	Aug. 9, 1958	--
Dutton, Clarence Edward	May 15, 1841	1884	Jan. 4, 1912	32
Eads, James Buchanan	May 23, 1820	1872	Mar. 8, 1887	3
East, Edward Murray	Oct. 4, 1879	1925	Nov. 9, 1938	23
Eckart, Carl Henry	May 4, 1902	1953	Oct. 23, 1973	--
Edison, Thomas Alva	Feb. 11, 1847	1927	Oct. 18, 1931	15
Eigenmann, Carl H.	Mar. 9, 1863	1923	Apr. 24, 1927	18
Einstein, Albert[4]	Mar. 14, 1879	1942	Apr. 18, 1955	--
Eisenhart, Luther Pfahler	Jan. 13, 1876	1922	Oct. 28, 1965	40
Elkin, William Lewis	Apr. 29, 1855	1895	May 30, 1933	18
Elvehjem, Conrad Arnold	May 27, 1901	1942	July 27, 1962	--
Emerson, Robert	Nov. 4, 1903	1953	Feb. 3, 1959	35
Emerson, Rollins Adams	May 5, 1873	1927	Dec. 8, 1947	25
Emmet, William LeRoy	July 10, 1859	1921	Sept. 26, 1941	22
Emmons, Samuel Franklin	Mar. 29, 1841	1892	Mar. 28, 1911	7
Engelmann, George	Feb. 2, 1809	(1)	Feb. 4, 1884	4
Epstein, Paul Sophus	Mar. 20, 1883	1930	Feb. 8, 1966	--
Erlanger, Joseph	Jan. 5, 1874	1922	Dec. 5, 1965	41
Evans, Griffith Conrad	May 11, 1887	1933	Dec. 8, 1973	--
Evans, Herbert McLean	Sept. 23, 1882	1927	Mar. 6, 1971	--
Ewing, James	Dec. 25, 1866	1935	May 16, 1943	26
Ewing, William Maurice	May 12, 1906	1948	May 4, 1974	--
Farlow, William Gilson	Dec. 17, 1844	1879	June 3, 1919	[2] 21
Feller, William	July 7, 1906	1960	Jan. 14, 1970	--
Fenn, Wallace Osgood	Apr. 27, 1883	1943	Sept. 20, 1971	--
Fermi, Enrico	Sept. 29, 1901	1945	Nov. 28, 1954	30
Fernald, Merritt Lyndon	Oct. 5, 1873	1935	Sept. 22, 1950	28
Ferrel, William	Jan. 29, 1817	1868	Sept. 18, 1891	13
Fewkes, Jesse Walter	Nov. 14, 1850	1914	May 31, 1930	5
Fischer, Hermann Otto Laurenz	Dec. 16, 1888	1954	Mar. 9, 1960	40
Fleming, John Adam	Jan. 28, 1877	1938	July 29, 1956	39
Flexner, Simon	Mar. 25, 1863	1908	May 2, 1946	--
Folin, Otto	Apr. 4, 1867	1916	Oct. 25, 1934	27
Foote, Paul Darwin	Mar. 27, 1888	1943	Aug. 2, 1971	--
Forbes, Alexander	May 14, 1882	1936	Mar. 27, 1965	40
Forbes, Stephen Alfred	May 29, 1844	1918	Mar. 13, 1930	15
Francis, Thomas, Jr.	July 15, 1900	1948	Oct. 1, 1969	44
Franck, James	Aug. 26, 1882	1944	May 21, 1964	--
Franklin, Edward Curtis	Mar. 1, 1862	1914	Feb. 4, 1937	--
Frazer, John Fries	July 8, 1812	(1)	Oct. 12, 1872	1
Freeman, John Ripley	July 27, 1855	1918	Oct. 6, 1932	17
Frost, Edwin Brant	July 14, 1866	1908	May 14, 1935	19
Gabb, William More	Jan. 20, 1839	1876	May 30, 1878	6
Gamble, James Lawder	July 18, 1883	1945	May 28, 1959	36
Gamow, George	Mar. 4, 1904	1953	Aug. 20, 1968	--
Gasser, Herbert Spencer	July 5, 1888	1934	May 11, 1963	--
Gay, Frederick Parker	July 22, 1874	1939	July 14, 1939	28
Genth, F. A.	May 17, 1820	1872	Feb. 2, 1893	4
Gerard, Ralph Waldo	Oct. 7, 1900	1955	Feb. 17, 1974	--
Gesell, Arnold Lucius	June 21, 1880	1947	May 29, 1961	37
Gherardi, Bancroft	Apr. 6, 1873	1933	Aug. 14, 1941	30
Gibbon, John Heysham, Jr.	Sept. 29, 1903	1972	Feb. 5, 1973	--
Gibbs, Josiah Willard	Feb. 11, 1839	1879	Apr. 28, 1903	6
Gibbs, William Francis	Aug. 24, 1886	1949	Sept. 6, 1967	42
Gibbs, Wolcott	Feb. 21, 1822	(1)	Dec. 9, 1908	7
Gilbert, Grove Karl	May 6, 1843	1883	May 1, 1918	[2] 21
Gill, Theodore Nicholas	Mar. 21, 1837	1873	Sept. 25, 1914	8
Gilliland, Edwin Richard	July 10, 1909	1948	Mar. 10, 1973	--
Gilliss, James Melville	Sept. 4, 1811	(1)	Feb. 9, 1865	1
Goldschmidt, Richard Benedikt	Apr. 12, 1878	1947	Apr. 24, 1958	39
Gomberg, Moses	Feb. 8, 1866	1914	Feb. 12, 1947	41
Gooch, Frank Austin	May 2, 1852	1897	Aug. 12, 1929	15
Goodale, George Lincoln	Aug. 3, 1839	1890	Apr. 15, 1923	[2] 21
Goode, G. Brown	Feb. 13, 1851	1888	Sept. 6, 1896	4
Goodpasture, Ernest William	Oct. 17, 1886	1937	Sept. 20, 1960	38
Gortner, Ross Aiken	Mar. 20, 1885	1935	Sept. 30, 1942	23
Gould, Augustus A.	Apr. 23, 1805	(1)	Sept. 15, 1866	5
Gould, Benjamin A.	Sept. 27, 1824	(1)	Nov. 26, 1896	[2] 17
Graham, Clarence Henry	Jan. 6, 1906	1946	July 25, 1971	--
Graham, Evarts Ambrose	Mar. 19, 1883	1941	Mar. 4, 1957	--
Gray, Asa	Nov. 18, 1810	(1)	Jan. 30, 1888	3
Gregory, William King	May 19, 1876	1927	Dec. 29, 1970	--

See footnotes at end of table.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Gunn, Ross	May 12, 1897	1931	Nov. 24, 1966	--
Gutenberg, Beno	June 4, 1889	1945	Jan. 25, 1960	--
Guyot, Arnold	Sept. 28, 1807	(1)	Feb. 8, 1884	5
Hadley, James	Mar. 30, 1821	1872	Nov. 14, 1872	5
Hague, Arnold	Dec. 3, 1840	1885	May 14, 1917	9
Haldeman, S. S.	Aug. 12, 1812	1876	Sept. 20, 1880	2
Hale, George Ellery	June 29, 1868	1902	Feb. 21, 1938	21
Hall, Asaph	Oct. 15, 1829	1875	Nov. 22, 1907	6
Hall, Edwin Herbert	Nov. 7, 1855	1911	Nov. 20, 1938	21
Hall, G. Stanley	Feb. 1, 1846	1915	Apr. 24, 1924	12
Hall, James	Sept. 12, 1811	(1)	Aug. 7, 1898	(1)
Halsted, W. S.	Sept. 23, 1852	1917	Sept. 7, 1922	17
Hansen, William Webster	May 27, 1909	1949	May 23, 1949	27
Harkins, William Draper	Dec. 28, 1873	1921	Mar. 7, 1951	--
Harned, Herbert Spencer	Dec. 2, 1888	1950	July 29, 1969	--
Harper, Robert Almer	Jan. 21, 1862	1911	May 12, 1946	25
Harrison, Ross Granville	Jan. 13, 1870	1913	Sept. 30, 1959	35
Hart, Edwin Bret	Dec. 25, 1874	1944	Mar. 12, 1953	28
Hartman, Carl Gottfried	June 3, 1879	1937	Mar. 1, 1968	--
Harvey, Edmund Newton	Nov. 25, 1887	1934	July 21, 1959	39
Hassid, William Zev	Oct. 1, 1897	1958	Apr. 28, 1974	--
Hastings, Charles Sheldon	Nov. 27, 1848	1889	Jan. 29, 1932	20
Hauser, Charles Roy	Mar. 8, 1900	1958	Jan. 6, 1970	--
Hayden, F. V.	Sept. 7, 1829	1873	Dec. 22, 1887	3
Hayford, John Fillmore	May 19, 1868	1911	Mar. 10, 1925	16
Hecht, Selig	Feb. 8, 1892	1944	Sept. 18, 1947	--
Hektoen, Ludvig	July 2, 1863	1918	July 5, 1951	28
Henderson, Lawrence Joseph	June 3, 1878	1919	Feb. 10, 1942	23
Henderson, Yandell	Apr. 23, 1873	1923	Feb. 18, 1944	--
Henry, Joseph [6]	Dec. 17, 1797	(1)	May 13, 1878	5
Henyey, Louis George	Feb. 3, 1910	1968	Feb. 18, 1970	--
Herrick, Charles Judson	Oct. 6, 1868	1918	Jan. 29, 1960	43
Herskovits, Melville Jean	Sept. 10, 1895	1959	Feb. 25, 1963	42
Herty, Charles Holmes, Jr.	Oct. 6, 1896	1947	Jan. 17, 1953	31
Hess, Harry Hammond	May 24, 1906	1952	Aug. 26, 1969	43
Hewett, Donnel Foster	June 24, 1881	1937	Feb. 5, 1971	44
Hibbert, Harold	Aug. 27, 1877	1945	May 13, 1945	32
Hilgard, Eugene W.	Jan. 5, 1833	1872	Jan. 8, 1916	9
Hilgard, Julius Erasmus	Jan. 7, 1825	(1)	May 8, 1891	3
Hill, George William	Mar. 3, 1838	1874	Apr. 16, 1914	8
Hill, Henry B.	Apr. 27, 1849	1883	Apr. 6, 1903	5
Hillebrand, William F.	Dec. 12, 1853	1908	Feb. 7, 1925	12
Hisaw, Frederick Lee	Aug. 23, 1891	1947	Dec. 3, 1972	--
Hitchcock, Edward	May 24, 1793	(1)	Feb. 27, 1864	1
Hoagland, Dennis Robert	Apr. 2, 1884	1934	Sept. 5, 1949	29
Holbrook, J. E.	Dec. 30, 1794	1868	Sept. 8, 1871	5
Holden, Edward Singleton	Nov. 5, 1846	1885	Mar. 16, 1914	8
Holmes, William Henry	Dec. 1, 1846	1905	Apr. 20, 1933	17
Hooton, Earnest Albert	Nov. 20, 1887	1935	May 3, 1954	--
Hoover, Herbert	Aug. 10, 1874	1922	Oct. 20, 1964	39
Horsfall, Frank Lappin, Jr.	Dec. 14, 1906	1948	Feb. 19, 1971	--
Hotelling, Harold	Sept. 29, 1895	1970	Dec. 26, 1973	--
Houston, William Vermillion	Jan. 19, 1900	1943	Aug. 20, 1968	44
Hovgaard, William	Nov. 28, 1857	1929	Jan. 5, 1950	36
Hovland, Carl Iver	June 12, 1912	1960	Apr. 16, 1961	--
Howard, Leland Ossian	June 11, 1857	1916	May 1, 1950	33
Howe, H. M.	Mar. 2, 1848	1917	May 14, 1922	[2] 21
Howe, Marshall Avery	June 6, 1867	1923	Dec. 24, 1936	19
Howell, William Henry	Feb. 20, 1860	1905	Feb. 6, 1945	26
Hrdlicka, Ales	Mar. 29, 1869	1921	Sept. 5, 1943	23
Hubbard, J. S.	Sept. 7, 1823	(1)	Aug. 16, 1863	1
Hubble, Edwin Powell	Nov. 20, 1889	1927	Sept. 28, 1953	41
Hudson, Claude Silbert	Jan. 26, 1881	1927	Dec. 27, 1952	32
Hulett, George Augustus	July 15, 1867	1922	Sept. 6, 1955	34
Hull, Albert Wallace	Apr. 10, 1880	1939	Jan. 22, 1966	41
Hull, Clark Leonard	May 24, 1884	1936	May 10, 1952	33
Humphreys, A. A.	Nov. 2, 1810	(1)	Dec. 27, 1883	2
Hunt, Reid	Apr. 20, 1870	1919	Mar. 10, 1948	26
Hunt, T. Sterry	Sept. 5, 1826	1873	Feb. 12, 1892	15
Hunter, Walter Samuel	Mar. 22, 1889	1935	Aug. 4, 1954	31
Huntington, George Sumner	Mar. 21, 1861	1924	Jan. 5, 1927	18
Hyatt, Alpheus	Apr. 5, 1838	1875	Jan. 15, 1902	6
Hyman, Libbie Henrietta	Dec. 6, 1888	1961	Aug. 3, 1969	--
Iddings, Joseph Paxson	Jan. 21, 1857	1907	Sept. 8, 1920	--
Ipatieff, Vladimir Nikolaevich	Nov. 22, 1867	1929	Nov. 29, 1952	--
Iselin, Columbus O'Donnell	Sept. 25, 1904	1951	Jan. 5, 1971	--
Ives, Herbert Eugene	July 31, 1882	1933	Nov. 13, 1953	29
Jackson, Charles Loring	Apr. 4, 1847	1883	Oct. 28, 1935	37
Jackson, Dunham	July 24, 1888	1935	Nov. 6, 1946	33
Jacobs, Merkel Henry	Dec. 6, 1884	1939	June 27, 1970	--
Jacobs, Walter Abraham	Dec. 24, 1883	1932	July 12, 1967	--
James, William [7]	Jan. 11, 1842	1903	Aug. 26, 1910	--

See footnotes at end of table.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Jeffries, Zay	Apr. 22, 1888	1939	May 21, 1965	--
Jennings, Herbert Spencer	Apr. 8, 1868	1914	Apr. 14, 1947	--
Jewett, Frank Baldwin	Sept. 5, 1879	1918	Nov. 18, 1949	27
Johnson, Douglas Wilson	Nov. 30, 1878	1932	Feb. 24, 1944	24
Johnson, S. W.	July 3, 1830	1866	July 21, 1909	7
Johnson, Treat Baldwin	Mar. 29, 1875	1919	July 28, 1947	27
Jones, Donald Forsha	Apr. 16, 1890	1939	June 10, 1963	--
Jones, Lewis Ralph	Dec. 5, 1864	1920	Apr. 1, 1945	31
Jones, Walter	Apr. 28, 1865	1918	Feb. 28, 1935	20
Jordan, Edwin Oakes	July 28, 1866	1936	Sept. 2, 1936	20
Joy, Alfred Harrison	Sept. 23, 1882	1944	Apr. 18, 1973	--
Kasner, Edward	Apr. 2, 1878	1917	Jan. 7, 1955	31
Keeler, J. E.	Sept. 10, 1857	1900	Aug. 12, 1900	5
Keith, Arthur	Sept. 30, 1864	1928	Feb. 7, 1944	29
Kelley, Walter Pearson	Feb. 19, 1878	1943	May 19, 1965	40
Kellogg, Arthur Remington	Apr. 2, 1900	1950	June 20, 1969	--
Kellogg, Vernon Lyman	Dec. 1, 1867	1930	Aug. 8, 1937	20
Kelly, Mervin J.	Feb. 14, 1894	1945	Mar. 18, 1971	--
Kelser, Raymond Alexander	Dec. 2, 1892	1948	Apr. 16, 1952	28
Kemp, James Furman	Aug. 14, 1859	1911	Nov. 17, 1926	16
Kendall, Edward Calvin	Mar. 8, 1886	1950	May 4, 1972	--
Kennelly, Arthur Edwin	Dec. 17, 1861	1921	June 18, 1939	22
Kent, Robert Harrington	July 1, 1876	1951	Feb. 3, 1961	42
Kettering, Charles Franklin	Aug. 29, 1876	1928	Nov. 25, 1958	34
Kharasch, Morris Selig	Aug. 24, 1895	1946	Oct. 9, 1957	34
Kidder, Alfred Vincent	Oct. 29, 1885	1936	June 11, 1963	39
Kimball, George Elbert	July 12, 1906	1954	Dec. 6, 1967	43
King, Arthur Scott	Jan. 18, 1876	1941	Apr. 25, 1957	--
King, Clarence	Jan. 6, 1842	1876	Dec. 24, 1901	6
Kirkwood, John Gamble	May 30, 1907	1942	Aug. 9, 1959	--
Kirtland, Jared P.	Nov. 10, 1793	1865	Dec. 10, 1877	2
Kluckhohn, Clyde Kay Maben	Jan. 11, 1905	1952	July 29, 1960	37
Knopf, Adolph	Dec. 2, 1882	1931	Nov. 24, 1966	41
Kofoid, Charles Atwood	Oct. 11, 1865	1922	May 30, 1947	26
Kohler, Elmer Peter	Nov. 6, 1865	1920	May 24, 1938	27
Köhler, Wolfgang	Jan. 21, 1887	1947	June 11, 1967	--
Kraus, Charles August	Aug. 15, 1875	1925	June 27, 1967	42
Kroeber, Alfred Louis	June 11, 1876	1928	Oct. 5, 1960	36
Kuiper, Gerard Peter	Dec. 7, 1905	1950	Dec. 23, 1973	--
Kunkel, Louis Otto	May 7, 1884	1932	Mar. 20, 1960	38
Lamb, Arthur Becket	Feb. 25, 1880	1924	May 15, 1952	29
Lambert, Walter Davis	Jan. 12, 1879	1949	Oct. 27, 1968	43
La Mer, Victor Kuhn	June 15, 1895	1945	Sept. 26, 1966	--
Landsteiner, Karl	June 14, 1868	1932	June 26, 1943	40
Lane, J. Homer	Aug. 9, 1819	1872	May 3, 1880	3
Langley, Samuel P.	Aug. 22, 1834	1876	Feb. 27, 1906	7
Langmuir, Irving	Jan. 31, 1881	1918	Aug. 16, 1957	--
Larsen, Esper Signius, Jr.	Mar. 14, 1879	1944	Mar. 8, 1961	37
Lashley, Karl Spencer	June 7, 1890	1930	Aug. 7, 1958	35
Latimer, Wendell Mitchell	Apr. 22, 1893	1940	July 6, 1955	32
Laufer, Berthold	Oct. 11, 1874	1930	Sept. 13, 1934	18
Lauritsen, Charles Christian	Apr. 4, 1892	1941	Apr. 13, 1968	--
Lauritsen, Thomas	Nov. 16, 1915	1969	Oct. 16, 1973	--
Lawrence, Ernest Orlando	Aug. 8, 1901	1934	Aug. 27, 1958	41
Lawson, Andrew Cowper	July 25, 1861	1924	June 16, 1952	37
Lea, Matthew Carey	Aug. 18, 1823	1892	Mar. 15, 1897	5
Le Conte, John	Dec. 4, 1818	1878	Apr. 29, 1891	3
Le Conte, John L.	May 13, 1825	(1)	Nov. 15, 1883	2
Le Conte, Joseph	Feb. 26, 1823	1875	July 6, 1901	6
Lefschetz, Solomon	Sept. 3, 1884	1925	Oct. 5, 1972	--
Lehrman, Daniel Sanford	June 1, 1919	1970	Aug. 29, 1972	--
Leidy, Joseph	Sept. 9, 1823	(1)	Apr. 30, 1891	7
Leith, Charles Kenneth	Jan. 20, 1875	1920	Sept. 13, 1956	33
Lesley, J. Peter	Sept. 17, 1819	(1)	June 1, 1903	8
Lesquereux, Leo	Nov. 18, 1806	1864	Oct. 25, 1889	3
Leuschner, Armin Otto	Jan. 16, 1868	1913	Apr. 22, 1953	--
Levene, Phoebus Aaron Theodor	Feb. 25, 1869	1916	Sept. 6, 1940	23
Leverett, Frank	Mar. 10, 1859	1929	Nov. 15, 1943	23
Lewis, George William	Mar. 10, 1882	1945	July 12, 1948	25
Lewis, Gilbert Newton [8]	Oct. 23, 1875	1913	Mar. 23, 1946	21
Lewis, Howard Bishop	Nov. 8, 1887	1949	Mar. 7, 1954	44
Lewis, Warren Harmon	June 17, 1870	1936	July 3, 1964	39
Lillie, Frank Rattray	July 27, 1870	1915	Nov. 5, 1947	30
Lim, Robert Kho-Seng [9]	Oct. 15, 1897	1965	July 8, 1969	--
Lind, Samuel Colville	June 15, 1879	1930	Feb. 12, 1965	--
Lindgren, Waldemar	Feb. 14, 1860	1909	Nov. 3, 1939	--
Linton, Ralph	Feb. 27, 1893	1945	Dec. 24, 1953	31
Little, Clarence Cook	Oct. 6, 1888	1945	Dec. 22, 1971	--
Loeb, Jacques	Apr. 7, 1859	1910	Feb. 11, 1924	13
Loeb, Leo	Sept. 21, 1869	1937	Dec. 28, 1959	35
Loeb, Robert Frederick	Mar. 14, 1895	1946	Oct. 21, 1973	--
Long, Cyril Norman Hugh	June 19, 1901	1948	July 6, 1970	--

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DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Longcope, Warfield Theobald	Mar. 29, 1877	1943	Apr. 25, 1953	33
Longstreth, Miers F.	Mar. 15, 1819	(1)	Dec. 27, 1891[7]	8
Loomis, Elias	Aug. 7, 1811	1873	Aug. 15, 1889	3
Lothrop, Samuel Kirkland	July 6, 1892	1951	Jan. 10, 1965	--
Lovering, Joseph	Dec. 25, 1813	1873	Jan. 18, 1892	6
Lowie, Robert Harry	June 12, 1883	1931	Sept. 21, 1957	44
Lucas, Howard Johnson	Mar. 7, 1885	1957	June 22, 1963	43
Lusk, Graham	Feb. 15, 1866	1915	July 8, 1932	21
Lyman, Theodore	Aug. 23, 1833	1872	Sept. 9, 1897	5
Lyman, Theodore	Nov. 23, 1874	1917	Oct. 11, 1954	30
MacArthur, Robert Helmer	Apr. 7, 1930	1969	Nov. 1, 1972	--
MacCallum, William George	Apr. 18, 1874	1921	Feb. 3, 1944	23
MacInnes, Duncan Arthur	Mar. 31, 1885	1937	Sept. 23, 1965	41
Mackin, Joseph Hoover	Nov. 16, 1905	1963	Aug. 12, 1968	--
MacLeod, Colin Munro	Jan. 28, 1909	1955	Feb. 12, 1972	--
MacNider, William de Berniere	June 25, 1881	1938	May 31, 1951	32
Macelwane, James Bernard, S. J.	Sept. 28, 1883	1944	Feb. 15, 1956	31
Mahan, D. H.	Apr. 2, 1802	(1)	Sept. 16, 1871	2
Mall, Franklin P.	Sept. 28, 1862	1907	Nov. 17, 1917	16
Mann, Frank Charles	Sept. 11, 1887	1950	Sept. 30, 1962	38
Mark, Edward Laurens	May 30, 1847	1903	Dec. 16, 1946	--
Marsh, G. P.	Mar. 15, 1801	1866	July 23, 1882	6
Marsh, O. C.	Oct. 29, 1831	1874	Mar. 18, 1899	20
Marshall, Eli Kennerly, Jr.	May 2, 1889	1943	Jan. 10, 1966	--
Mason, Max	Oct. 26, 1877	1923	Mar. 22, 1961	37
Mayer, Alfred M.	Nov. 13, 1836	1872	July 13, 1897	8
Mayer, Maria Goeppert	June 28, 1906	1956	Feb. 20, 1972	--
Maynard, Leonard Amby	Nov. 8, 1887	1944	June 22, 1972	--
Mayor, A. G.	Apr. 16, 1868	1916	June 25, 1922	[2] 21
Mayo-Smith, Richmond	Feb. 9, 1854	1890	Nov. 11, 1901	[2] 17
Maxcy, Kenneth Fuller	July 27, 1889	1950	Dec. 12, 1966	42
McClung, Clarence Erwin	Apr. 5, 1870	1920	Jan. 17, 1946	--
McCollum, Elmer Verner	Mar. 3, 1879	1920	Nov. 15, 1967	--
McElvain, Samuel Marion	Dec. 9, 1897	1949	Apr. 11, 1973	--
McMaster, Philip Duryeé	Sept. 14, 1891	1952	Mar. 20, 1973	--
McMath, Robert Raynolds	May 11, 1891	1958	Jan. 2, 1962	--
Mead, Warren Judson	Aug. 5, 1883	1939	Jan. 16, 1960	35
Meek, F. B.	Dec. 10, 1817	1869	Dec. 21, 1876	4
Meek, Walter Joseph	Aug. 15, 1878	1947	Feb. 15, 1963	--
Mees, Charles Edward Kenneth	May 26, 1882	1950	Aug. 15, 1960	42
Meggers, William Frederick	July 13, 1888	1954	Nov. 19, 1966	41
Meigs, M. C.	May 3, 1816	1865	Jan. 2, 1892	3
Meltzer, Samuel James	Mar. 22, 1851	1912	Nov. 8, 1920	[2] 21
Mendel, Lafayette Benedict	Feb. 5, 1872	1913	Dec. 9, 1935	18
Mendenhall, Charles Elwood	Aug. 1, 1872	1918	Aug. 18, 1935	18
Mendenhall, T. C.	Oct. 4, 1841	1887	Mar. 22, 1924	16
Mendenhall, Walter Curran	Feb. 20, 1871	1932	June 2, 1957	--
Merica, Paul Dyer	Mar. 17, 1889	1942	Oct. 20, 1957	33
Merriam, Clinton Hart	Dec. 5, 1855	1902	Mar. 19, 1942	24
Merriam, John Campbell	Oct. 20, 1869	1918	Oct. 30, 1945	26
Merrill, Elmer Drew	Oct. 15, 1876	1923	Feb. 25, 1956	32
Merrill, George Perkins	May 31, 1854	1922	Aug. 15, 1929	17
Merrill, Paul Willard	Aug. 15, 1887	1929	July 19, 1961	37
Merritt, Ernest George	Apr. 28, 1865	1914	June 5, 1948	--
Meyer, Karl Friedrich	May 19, 1884	1940	Apr. 27, 1974	--
Meyerhof, Otto	Apr. 12, 1884	1949	Oct. 6, 1951	34
Michael, Arthur	Aug. 7, 1853	1889	Feb. 8, 1942	--
Michaelis, Leonor	Jan. 16, 1875	1943	Oct. 8, 1949	31
Michelson, A. A.	Dec. 19, 1852	1888	May 9, 1931	19
Midgley, Thomas, Jr.	May 18, 1889	1942	Nov. 2, 1944	24
Miller, Alden Holmes	Feb. 4, 1906	1957	Oct. 9, 1965	43
Miller, Dayton Clarence	Mar. 13, 1866	1921	Feb. 22, 1941	23
Miller, George Abram	July 31, 1863	1921	Feb. 10, 1951	30
Millikan, Clark Blanchard	Aug. 23, 1903	1964	Jan. 2, 1966	40
Millikan, Robert Andrews	Mar. 22, 1868	1915	Dec. 19, 1953	33
Minot, Charles Sedgwick	Dec. 23, 1852	1897	Nov. 19, 1914	9
Minot, George Richards	Dec. 2, 1885	1937	Feb. 25, 1950	--
Mirsky, Alfred Ezra	Oct. 17, 1900	1954	June 19, 1974	--
Mitchell, Henry	Sept. 16, 1830	1885	Dec. 1, 1902	20
Mitchell, Samuel Alfred	Apr. 29, 1874	1933	Feb. 22, 1960	36
Mitchell, Silas Weir	Feb. 15, 1829	1865	Jan. 4, 1914	32
Modjeski, Ralph	Jan. 27, 1861	1925	June 26, 1940	23
Moore, Carl Richard	Dec. 5, 1892	1944	Oct. 16, 1955	--
Moore, Carl Vernon	Aug. 21, 1908	1970	Aug. 13, 1972	--
Moore, Eliakim Hastings	Jan. 26, 1862	1901	Dec. 30, 1932	17
Moore, Joseph Haines	Sept. 7, 1878	1931	Mar. 16, 1949	29
Morgan, Lewis H.	Nov. 21, 1818	1875	Dec. 17, 1881	6
Morgan, Thomas Hunt	Sept. 25, 1866	1909	Dec. 4, 1945	33
Morley, E. W.	Jan. 29, 1838	1897	Feb. 24, 1923	[2] 21
Morse, Edward Sylvester	June 18, 1838	1876	Dec. 20, 1925	17
Morse, Harmon N.	Oct. 15, 1848	1907	Sept. 8, 1920	[2] 21
Morton, Henry	Dec. 11, 1836	1874	May 9, 1902	8

See footnotes at end of table.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Moulton, Forest Ray	Apr. 29, 1872	1910	Dec. 7, 1952	--
Mueller, John Howard	June 13, 1891	1945	Feb. 16, 1954	41
Muller, Hermann Joseph	Dec. 21, 1890	1931	Apr. 5, 1967	--
Murphree, Eger Vaughan	Nov. 3, 1898	1950	Oct. 29, 1962	40
Murphy, James Bumgardner	Aug. 4, 1884	1940	Aug. 24, 1950	34
Nef, John Ulric	June 14, 1862	1904	Aug. 13, 1915	34
Newberry, J. S.	Dec. 22, 1822	(1)	Dec. 7, 1892	6
Newcomb, Simon	Mar. 12, 1835	1869	July 11, 1909	[2] 17
Newton, H. A.	Mar. 19, 1830	(1)	Aug. 12, 1896	4
Newton, John	Aug. 24, 1823	1876	May 1, 1895	4
Nicholas, John Spangler	Mar. 18, 1895	1949	Sept. 11, 1963	40
Nichols, Edward Leamington	Sept. 14, 1854	1901	Nov. 10, 1937	21
Nichols, Ernest Fox	June 1, 1869	1908	Apr. 29, 1924	12
Nicholson, Seth Barnes	Nov. 12, 1891	1937	July 2, 1963	42
Niemann, Carl George	July 6, 1908	1952	Apr. 29, 1964	40
Nissen, Henry W.	Feb. 5, 1901	1953	Apr. 27, 1958	38
Norris, James Flack	Jan. 20, 1871	1934	Aug. 3, 1940	--
Norton, William A.	Oct. 25, 1810	1873	Sept. 21, 1883	2
Novy, Frederick George	Dec. 9, 1864	1924	Aug. 8, 1957	33
Noyes, Arthur Amos	Sept. 13, 1866	1905	June 3, 1936	31
Noyes, William Albert	Nov. 6, 1857	1910	Oct. 24, 1941	27
Oliver, James E.	July 27, 1829	1872	Mar. 27, 1895	4
Opie, Eugene Lindsay	July 5, 1873	1923	Mar. 12, 1971	--
Oppenheimer, J. Robert	Apr. 22, 1904	1941	Feb. 18, 1967	--
Osborn, Henry Fairfield	Aug. 8, 1857	1900	Nov. 6, 1935	19
Osborne, Thomas Burr	Aug. 5, 1859	1910	Jan. 29, 1929	14
Osgood, William Fogg	Mar. 10, 1864	1904	July 22, 1943	--
Osterhout, Winthrop John Vanleuven	Aug. 2, 1871	1919	Apr. 9, 1964	44
Packard, Alpheus Spring	Feb. 19, 1839	1872	Feb. 14, 1905	9
Painter, Theophilus Shickel	Aug. 22, 1889	1938	Oct. 5, 1969	--
Palache, Charles	July 18, 1869	1934	Dec. 5, 1954	30
Parker, George Howard	Dec. 23, 1864	1913	Mar. 26, 1955	39
Patterson, John Thomas	Nov. 3, 1878	1941	Dec. 4, 1960	38
Paul, John Rodman	Apr. 18, 1893	1945	May 6, 1971	--
Pearl, Raymond	June 3, 1879	1916	Nov. 17, 1940	22
Pecora, William Thomas	Feb. 1, 1913	1965	July 19, 1972	--
Pegram, George Braxton	Oct. 24, 1876	1949	Aug. 12, 1958	14
Peirce, Benjamin [11]	Apr. 4, 1809	(1)	Oct. 6, 1880	--
Peirce, Benjamin Osgood	Feb. 11, 1854	1906	Jan. 14, 1914	8
Peirce, Charles S. S.	Sept. 10, 1839	1877	Apr. 20, 1914	--
Penfield, Samuel L.	Jan. 16, 1856	1900	Aug. 13, 1906	6
Peters, C. H. F.	Sept. 19, 1813	1876	July 18, 1890	--
Peters, John Punnett	Dec. 4, 1887	1947	Dec. 29, 1955	31
Petrunkevitch, Alexander	Dec. 22, 1875	1954	Mar. 9, 1964	--
Pickering, Edward C.	July 19, 1846	1873	Feb. 3, 1919	15
Pierce, George Washington	Jan. 11, 1872	1920	Aug. 25, 1956	33
Piggot, Charles Snowden	June 5, 1892	1946	July 6, 1973	--
Pillsbury, Walter Bowers	July 21, 1872	1925	June 3, 1960	37
Pincus, Gregory Goodwin	Apr. 9, 1903	1965	Aug. 22, 1967	42
Pirsson, Louis V.	Nov. 3, 1860	1913	Dec. 8, 1919	34
Pourtalés, L. F.	Mar. 4, 1824	1873	July 19, 1880	5
Powell, John W.	Mar. 24, 1834	1880	Sept. 23, 1902	8
Power, Frederick Belding	Mar. 4, 1853	1924	Mar. 26, 1927	--
Prudden, T. Mitchell	July 7, 1849	1901	Apr. 10, 1924	12
Pumpelly, Raphael	Sept. 8, 1837	1872	Aug. 10, 1923	16
Pupin, Michael Idvorsky	Oct. 4, 1858	1905	Mar. 12, 1935	19
Putnam, Frederic Ward	Apr. 16, 1839	1885	Aug. 14, 1915	16
Ransome, Frederick Leslie	Dec. 2, 1868	1914	Oct. 6, 1935	22
Ranson, Stephen Walter	Aug. 28, 1880	1940	Aug. 30, 1942	23
Raper, John Robert	Oct. 3, 1911	1964	May 21, 1974	--
Reeside, John Bernard, Jr.	June 24, 1889	1945	July 2, 1958	35
Reid, Harry Fielding	May 18, 1859	1912	June 18, 1944	26
Remsen, Ira	Feb. 10, 1846	1882	Mar. 4, 1927	14
Rich, Arnold Rice	Mar. 28, 1893	1954	Apr. 17, 1968	--
Richards, Alfred Newton	Mar. 22, 1876	1927	Mar. 24, 1966	42
Richards, Dickinson W.	Oct. 30, 1895	1958	Feb. 23, 1973	44
Richards, Theodore William	Jan. 31, 1868	1899	Apr. 2, 1928	--
Richtmyer, Floyd Karker	Oct. 12, 1881	1932	Nov. 7, 1939	22
Riddle, Oscar	Sept. 27, 1877	1939	Nov. 29, 1968	--
Ridgway, Robert	July 2, 1850	1917	Mar. 25, 1929	15
Ritt, Joseph Fels	Aug. 23, 1893	1933	Jan. 5, 1951	29
Rittenberg, David	Nov. 11, 1906	1953	Jan. 24, 1970	--
Rivers, Thomas Milton	Sept. 3, 1888	1934	May 12, 1962	38
Robertson, Howard Percy	Jan. 27, 1903	1951	Aug. 26, 1961	--
Robertson, Oswald Hope	June 2, 1886	1943	Mar. 23, 1966	42
Robinson, Abraham	Oct. 6, 1918	1974	Apr. 11, 1974	--
Robinson, Benjamin Lincoln	Nov. 8, 1864	1921	July 27, 1935	17
Rodebush, Worth Huff	May 24, 1887	1938	Aug. 16, 1959	36
Rodgers, John	Aug. 8, 1812	(1)	May 5, 1882	6
Rogers, Fairman	Nov. 15, 1883	(1)	Aug. 22, 1900	6
Rogers, Robert E.	Mar. 29, 1813	(1)	Sept. 6, 1884	5
Rogers, William A.	Nov. 13, 1832	1885	Mar. 1, 1898	4, 6

See footnotes at end of table.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Rogers, William B.	Dec. 7, 1804	(1)	May 30, 1882	3
Romer, Alfred Sherwood	Dec. 28, 1894	1944	Nov. 5, 1973	--
Rood, Ogden N.	Feb. 3, 1831	1865	Nov. 12, 1902	6
Rosa, E. B.	Oct. 4, 1861	1913	May 17, 1921	16
Ross, Frank Elmore	Apr. 2, 1874	1930	Sept. 21, 1960	39
Rossby, Carl-Gustaf Arvid	Dec. 8, 1898	1943	Aug. 19, 1957	34
Rous, Francis Peyton	Oct. 5, 1879	1927	Feb. 16, 1970	--
Rowland, Henry A.	Nov. 27, 1848	1881	Apr. 16, 1901	5
Royce, Josiah	Nov. 20, 1855	1906	Sept. 14, 1916	33
Rubey, William Walden	Dec. 19, 1898	1945	Apr. 12, 1974	--
Ruedemann, Rudolph	Oct. 16, 1864	1928	June 18, 1956	44
Russell, Henry Norris	Oct. 25, 1877	1918	Feb. 18, 1957	32
Russell, Richard Joel	Nov. 16, 1895	1959	Sept. 17, 1971	--
Rutherfurd, Lewis M.	Nov. 25, 1816	(1)	May 30, 1892	3
Ryan, Harris Joseph	Jan. 8, 1866	1920	July 3, 1934	19
Sabin, Florence Rena	Nov. 9, 1871	1925	Oct. 3, 1953	34
Sabine, Wallace C. W.	June 13, 1868	1917	Jan. 10, 1919	[2] 21
St. John, Charles Edward	Mar. 15, 1857	1924	Apr. 26, 1935	18
Sapir, Edward	Jan. 26, 1884	1934	Feb. 4, 1939	--
Sargent, Charles Sprague	Apr. 24, 1841	1895	Mar. 22, 1927	12
Saunders, Frederick Albert	Aug. 18, 1875	1925	June 9, 1963	39
Sauveur, Albert	June 21, 1863	1927	Jan. 26, 1939	22
Savage, John Lucian	Dec. 25, 1879	1949	Dec. 28, 1967	--
Sax, Karl	Nov. 2, 1892	1941	Oct. 8, 1973	--
Saxton, Joseph	Mar. 22, 1799	(1)	Oct. 26, 1873	1
Scatchard, George	Mar. 19, 1892	1946	Dec. 10, 1973	--
Schairer, John Frank	Apr. 13, 1904	1953	Sept. 26, 1970	--
Schiff, Leonard Isaac	Mar. 29, 1915	1957	Jan. 19, 1971	--
Schlesinger, Frank	May 11, 1871	1916	July 10, 1943	24
Schlesinger, Hermann Irving	Oct. 11, 1882	1948	Oct. 3, 1960	--
Schmidt, Karl Patterson	June 19, 1890	1956	Sept. 26, 1957	--
Schott, Charles A.	Aug. 7, 1826	1872	July 31, 1901	8
Schrader, Franz	Mar. 11, 1891	1951	Mar. 22, 1962	--
Schuchert, Charles	July 3, 1858	1910	Nov. 20, 1942	27
Schultz, Jack	May 7, 1904	1969	Apr. 29, 1971	--
Scott, William Berryman	Feb. 12, 1858	1906	Mar. 29, 1947	25
Scudder, Samuel H.	Apr. 13, 1837	1877	May 17, 1911	[2] 17
Seares, Frederick Hanley	May 17, 1873	1919	July 20, 1964	39
Seashore, Carl Emil	Jan. 28, 1866	1922	Oct. 16, 1949	29
Sellers, William	Sept. 19, 1824	1873	Jan. 24, 1905	--
Setchell, William Albert	Apr. 15, 1864	1919	Apr. 14, 1943	23
Shaffer, Philip Anderson	Sept. 20, 1881	1928	Dec. 4, 1960	40
Shapley, Harlow	Nov. 2, 1885	1924	Oct. 20, 1972	--
Sherman, Henry Clapp	Oct. 16, 1875	1933	Oct. 7, 1955	--
Shope, Richard Edwin	Dec. 25, 1901	1940	Oct. 2, 1967	--
Silliman, Benjamin, Sr.	Aug. 8, 1779	(1)	Nov. 24, 1864	1
Silliman, Benjamin, Jr.	Dec. 4, 1816	(1)	Jan. 14, 1885	7
Sinnott, Edmund Ware	Feb. 5, 1888	1936	Jan. 6, 1968	--
Slepian, Joseph	Feb. 11, 1891	1941	Dec. 19, 1969	--
Slipher, Vesto Melvin	Nov. 11, 1875	1921	Nov. 8, 1969	--
Smadel, Joseph Edwin	Jan. 10, 1907	1957	July 21, 1963	--
Small, Lyndon Frederick	Aug. 16, 1897	1941	June 15, 1947	33
Smith, Alexander	Sept. 11, 1865	1915	Sept. 8, 1922	[2] 21
Smith, Edgar Fahs	May 23, 1856	1899	May 3, 1928	17
Smith, Erwin Frink	Jan. 21, 1854	1913	Apr. 6, 1927	21
Smith, Gilbert Morgan	Jan. 6, 1885	1948	July 11, 1959	36
Smith, Homer William	Jan. 2, 1895	1945	Mar. 25, 1962	39
Smith, J. Lawrence	Dec. 17, 1818	1872	Oct. 12, 1883	2
Smith, James Perrin	Nov. 27, 1864	1925	Jan. 1, 1931	38
Smith, Lee Irvin	July 22, 1891	1944	Mar. 29, 1973	--
Smith, Philip Edward	Jan. 1, 1884	1939	Dec. 8, 1970	--
Smith, Sidney Irving	Feb. 18, 1843	1884	May 6, 1926	14
Smith, Theobald	July 31, 1859	1908	Dec. 10, 1934	17
Spence, Kenneth Wartinbe	May 6, 1907	1955	Jan. 12, 1967	--
Sperry, Elmer Ambrose	Oct. 12, 1860	1925	June 16, 1930	28
Spier, Leslie	Dec. 13, 1893	1946	Dec. 3, 1961	--
Squier, George Owen	Mar. 21, 1865	1919	Mar. 24, 1934	20
Stadie, William Christopher	June 15, 1886	1945	Sept. 11, 1959	--
Stadler, Lewis John	July 6, 1896	1938	May 13, 1954	30
Stanley, William Meredith	Aug. 16, 1904	1941	June 15, 1971	--
Stebbins, Joel	July 30, 1878	1910	Mar. 16, 1966	--
Steenrod, Norman Earl	Apr. 22, 1910	1956	Oct. 14, 1971	--
Steineger, Leonhard	Oct. 30, 1851	1923	Feb. 28, 1943	24
Steinhous, Edward Arthur	Nov. 7, 1914	1968	Oct. 20, 1969	44
Stern, Otto	Feb. 17, 1888	1945	Aug. 17, 1969	43
Stevens, Stanley Smith	Nov. 4, 1906	1946	Jan. 18, 1973	--
Steward, Julian H.	Jan. 31, 1902	1954	Feb. 6, 1972	--
Stewart, George Walter	Feb. 22, 1876	1938	Aug. 16, 1966	32
Stieglitz, Julius	May 26, 1867	1911	Jan. 10, 1937	21
Stillwell, Lewis Buckley	Mar. 12, 1863	1921	June 19, 1941	34
Stimpson, William	Feb. 14, 1832	1868	May 26, 1872	8
Stock, Chester	Jan. 28, 1892	1948	Dec. 6, 1960	27
Stockard, Charles Rupert	Feb. 27, 1879	1922	Apr. 7, 1939	--

*See footnotes at end of table.

DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Stone, Calvin Perry	Feb. 28, 1892	1943	Dec. 28, 1954	--
Stone, Wilson Stuart	Oct. 6, 1907	1960	Feb. 27, 1968	--
Story, William Edward	Apr. 29, 1850	1908	Apr. 11, 1930	--
Stratton, George Malcolm	Sept. 26, 1865	1928	Oct. 9, 1957	35
Stratton, Samuel Wesley	July 18, 1861	1917	Oct. 18, 1931	17
Streeter, George Linius	Jan. 12, 1873	1931	July 27, 1948	28
Strong, Theodore	July 26, 1790	(1)	Feb. 1, 1869	2
Struve, Otto	Aug. 12, 1897	1937	Apr. 6, 1963	--
Sturtevant, Alfred Henry	Nov. 21, 1891	1930	Apr. 6, 1970	--
Sullivant, W. S.	Jan. 15, 1803	1872	Apr. 30, 1873	1
Sumner, Francis Bertody	Aug. 1, 1874	1937	Sept. 6, 1945	25
Sumner, James Batcheller	Nov. 19, 1887	1948	Aug. 12, 1955	31
Sutherland, Earl Wilbur, Jr.	Nov. 19, 1915	1966	Mar. 9, 1974	--
Sverdrup, Harald Ulrik [10]	Nov. 15, 1888	1945	Aug. 20, 1957	--
Swain, George Fillmore	Mar. 2, 1857	1923	July 1, 1931	17
Swanton, John Reed	Feb. 19, 1873	1932	May 2, 1958	34
Swasey, Ambrose	Dec. 19, 1846	1922	June 15, 1937	22
Szilard, Leo	Feb. 11, 1898	1961	May 30, 1964	40
Taliaferro, William Hay	Feb. 10, 1895	1940	Dec. 21, 1973	--
Tate, John Torrance	July 28, 1889	1942	May 27, 1950	--
Taylor, Charles Vincent	Feb. 8, 1885	1943	Feb. 22, 1946	25
Taylor, David Watson	Mar. 4, 1864	1918	July 28, 1940	22
Tennent, David Hilt	May 28, 1873	1929	Jan. 14, 1941	26
Terman, Lewis Madison	Jan. 15, 1877	1928	Dec. 21, 1956	33
Thaxter, Roland	Aug. 28, 1858	1912	Apr. 22, 1932	17
Thom, Charles	Nov. 11, 1872	1937	May 24, 1956	38
Thompson, Thomas Gordon	Nov. 28, 1888	1951	Aug. 10, 1961	43
Thomson, Elihu	Mar. 29, 1853	1907	Mar. 13, 1937	21
Thorndike, Edward Lee	Aug. 31, 1874	1917	Aug. 9, 1949	27
Thurstone, Louis Leon	May 29, 1887	1938	Sept. 29, 1955	30
Tillett, William Smith	July 10, 1892	1951	Apr. 4, 1974	--
Timoshenko, Stephen Prokop	Dec. 23, 1878	1940	May 29, 1972	--
Tolman, Edward Chace	Apr. 14, 1886	1937	Nov. 19, 1959	37
Tolman, Richard Chace	Mar. 4, 1881	1923	Sept. 5, 1948	27
Torrey, John	Aug. 15, 1796	(1)	Mar. 10, 1873	1
Totten, J. G.	Aug. 23, 1788	(1)	Apr. 22, 1864	1
Tozzer, Alfred Marston	July 4, 1877	1942	Oct. 5, 1954	30
Trelease, William	Feb. 22, 1857	1902	Jan. 1, 1945	35
Trowbridge, Augustus	Jan. 2, 1870	1919	Mar. 14, 1934	18
Trowbridge, John	Aug. 5, 1843	1878	Feb. 18, 1923	14
Trowbridge, William P.	May 25, 1828	1872	Aug. 12, 1892	3
Trumbull, James H.	Dec. 20, 1821	1872	Aug. 5, 1897	7
Trumpler, Robert Julius	Oct. 2, 1886	1932	Sept. 10, 1956	--
Tuckerman, Edward	Dec. 7, 1817	1868	Mar. 15, 1886	3
Turner, Richard Baldwin	Oct. 7, 1916	1964	Dec. 22, 1971	--
Twitty, Victor Chandler	Nov. 5, 1901	1940	Mar. 22, 1967	--
Tyzzer, Ernest Edward	Aug. 30, 1875	1942	Apr. 17, 1968	--
Ulrich, Edward Oscar	Feb. 1, 1857	1917	Feb. 22, 1944	24
Vandiver, Harry Schultz	Oct. 21, 1882	1934	Jan. 4, 1973	--
Van Hise, C. R.	May 29, 1857	1902	Nov. 19, 1948	[3] 17
Van Slyke, Donald Dexter	Mar. 29, 1883	1921	May 4, 1971	--
Van Vleck, Edward Burr	June 7, 1863	1911	June 2, 1943	30
Vaughan, Thomas Wayland	Sept. 20, 1870	1921	Jan. 16, 1952	32
Vaughan, Victor Clarence	Oct. 27, 1851	1915	Nov. 21, 1929	--
Veblen, Oswald	June 24, 1880	1919	Aug. 10, 1960	37
Verrill, Addison E.	Feb. 9, 1839	1872	Dec. 10, 1926	14
Vestine, Ernest Harry	May 8, 1906	1954	July 18, 1968	--
von Békésy, George	June 3, 1899	1956	June 13, 1972	--
von Kármán, Theodore	May 11, 1881	1938	May 7, 1963	38
von Neumann, John	Dec. 28, 1903	1937	Feb. 8, 1957	32
Waksman, Selman Abraham	July 2, 1888	1942	Aug. 16, 1973	--
Walcott, Charles Doolittle	Mar. 31, 1850	1896	Feb. 9, 1927	39
Walker, Francis A.	July 2, 1840	1878	Jan. 5, 1897	5
Walsh, Joseph Leonard	Sept. 21, 1895	1936	Dec. 10, 1973	--
Warren, G. K.	Jan. 8, 1830	1876	Aug. 8, 1882	2
Washburn, Edward Wight	May 10, 1881	1932	Feb. 6, 1934	17
Washburn, Margaret Floy	July 25, 1871	1931	Oct. 29, 1939	25
Washington, Henry Stephens	Jan. 15, 1867	1921	Jan. 7, 1934	--
Watson, James C.	Jan. 28, 1838	1868	Nov. 23, 1880	3
Watson, Sereno	Dec. 1, 1826	1889	Mar. 9, 1892	5
Webster, A. G.	Nov. 28, 1863	1903	May 15, 1923	18
Welch, William Henry	Apr. 8, 1850	1895	Apr. 30, 1934	22
Wells, Harry Gideon	July 21, 1875	1925	Apr. 26, 1943	26
Wells, Horace L.	Oct. 5, 1855	1903	Dec. 19, 1924	12
Werkman, Chester Hamlin	June 17, 1893	1946	Sept. 10, 1962	44
Weyl, Claus Hugo Hermann	Nov. 9, 1885	1940	Dec. 8, 1955	--
Wheeler, Henry Lord	Sept. 14, 1867	1909	Oct. 30, 1914	--
Wheeler, William Morton	Mar. 19, 1865	1912	Apr. 19, 1937	19
White, Charles A.	Jan. 26, 1826	1889	June 29, 1910	7
White, David	July 1, 1862	1912	Feb. 7, 1935	17
White, Henry Seely	May 20, 1861	1915	May 20, 1943	25
Whitehead, John Boswell	Aug. 18, 1872	1932	Nov. 16, 1954	37
Whitman, C. O.	Dec. 14, 1842	1895	Dec. 6, 1910	7

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DECEASED MEMBERS—Continued

	Date of birth	Year of election	Date of death	Memoir* (vol. no.)
Whitmore, Frank Clifford	Oct. 1, 1887	1946	June 24, 1947	28
Whitney, Josiah D.[11]	Nov. 23, 1819	(1)	Aug. 19, 1896	--
Whitney, William D.[12]	Feb. 9, 1827	1865	June 29, 1894	--
Whitney, Willis Rodney	Aug. 22, 1868	1917	Jan. 9, 1958	34
Whyburn, Gordon Thomas	Jan. 7, 1904	1951	Sept. 8, 1969	--
Wiener, Norbert[13]	Nov. 26, 1894	1934	Mar. 18, 1964	--
Wiggers, Carl John	May 28, 1883	1951	Apr. 28, 1963	--
Wilczinski, Ernest Julius	Nov. 13, 1876	1919	Sept. 14, 1932	16
Williams, John Harry	July 7, 1908	1961	Apr. 18, 1966	42
Williams, Robert R.	Feb. 16, 1886	1945	Oct. 2, 1965	--
Willier, Benjamin Harrison	Nov. 2, 1890	1945	Dec. 3, 1972	--
Willis, Bailey	May 31, 1857	1920	Feb. 19, 1949	35
Williston, Samuel W.	July 10, 1852	1915	Aug. 30, 1918	17
Wilson, David Wright	Jan. 4, 1889	1955	July 13, 1965	43
Wilson, Edmund Beecher	Oct. 19, 1856	1899	Mar. 3, 1939	21
Wilson, Edwin Bidwell	Apr. 25, 1879	1919	Dec. 28, 1964	43
Wilson, Henry Van Peters	Feb. 16, 1863	1927	Jan. 4, 1939	35
Wilson, Ralph Elmer	Apr. 14, 1886	1950	Mar. 25, 1960	36
Wilson, Robert Erastus	Mar. 19, 1893	1947	Sept. 1, 1964	--
Winlock, Joseph	Feb. 6, 1826	(1)	June 11, 1875	1
Winstein, Saul	Oct. 8, 1912	1955	Nov. 23, 1969	43
Wintersteiner, Oskar	Nov. 15, 1898	1950	Aug. 15, 1971	--
Wislocki, George Bernays	Mar. 25, 1892	1941	Oct. 22, 1956	--
Wissler, Clark	Sept. 18, 1870	1929	Aug. 25, 1947	--
Wolbach, Simeon Burt	July 3, 1880	1938	Mar. 19, 1954	--
Wolfrom, Melville Lawrence	Apr. 2, 1900	1950	June 20, 1969	--
Wood, Horatio C.	Jan. 13, 1841	1879	Jan. 3, 1920	33
Wood, Robert Williams	May 2, 1868	1912	Aug. 11, 1955	--
Wood, William Barry, Jr.	May 4, 1910	1959	Mar. 9, 1971	--
Woodruff, Lorande Loss	July 14, 1879	1924	June 23, 1947	--
Woodward, J. J.	Oct. 30, 1833	1873	Aug. 17, 1884	2
Woodward, Robert S.	July 21, 1849	1896	June 29, 1924	19
Woodworth, Robert Sessions	Oct. 17, 1869	1921	July 4, 1962	29
Woolley, Dilworth Wayne	July 20, 1914	1952	July 23, 1966	--
Worthen, Amos Henry	Oct. 31, 1813	1872	May 6, 1888	3
Wright, Arthur Williams	Sept. 8, 1836	1881	Dec. 19, 1915	15
Wright, Frederick Eugene	Oct. 16, 1877	1923	Aug. 25, 1953	29
Wright, Orville	Aug. 19, 1871	1936	Jan. 30, 1948	25
Wright, William Hammond	Nov. 4, 1871	1922	May 16, 1959	--
Wyman, Jeffries	Aug. 11, 1814	(1)	Sept. 4, 1874	2
Yerkes, Robert Mearns	May 26, 1876	1923	Feb. 3, 1956	38
Young, Charles A.	Dec. 15, 1834	1872	Jan. 3, 1908	7
Zinsser, Hans	Nov. 17, 1879	1924	Sept. 4, 1940	24

[1] Charter member, Mar. 3, 1863.
[2] Scientific Memoir Series.
[3] Elected a foreign associate in 1931; naturalized in 1946.
[4] Elected a foreign associate in 1922; naturalized in 1940.
[5] "Life of James Hall," by John M. Clarke, published in book form.
[6] 1797 or 1799. See "Joseph Henry," by Simon Newcomb, in Biographical Memoirs, vol. 5, no. 1, p. 1 (N.A.S., 1905).
[7] Resigned, 1909.
[8] Resigned, 1934.
[9] Elected a foreign associate in 1942; naturalized in 1955.
[10] Resigned Academy membership on Apr. 2, 1951, when he had maintained residence in Norway for 3 years, thereby losing American citizenship. Elected a foreign associate in 1952.
[11] Resigned, 1874.
[12] Resigned, 1882.
[13] Resigned, 1941.

DECEASED FOREIGN ASSOCIATES OF THE NATIONAL ACADEMY OF SCIENCES

March 1863 through June 1974

	Date of birth	Date of election	Date of death
Adams Frank Dawson	Sept. 17, 1859	1920	Dec. 26, 1942
Adams, John Couch	June 5, 1819	1883	Jan. 22, 1892
Airy, Sir George B.	July 27, 1801	1865	Jan. 4, 1892
Argelander, F. W. A.	Mar. 3, 1799	1864	Feb. 17, 1875
Arrhenius, Svante A.	Feb. 19, 1859	1908	Oct. 2, 1927
Auwers, G. F. J. Arthur	Sept. 12, 1838	1883	Jan. 24, 1915
Backlund, Oskar	Apr. 28, 1846	1903	Aug. 29, 1916
Baer, Karl Ernst von	Feb. 17, 1792	1864	Nov. 28, 1876
Baeyer, Adolf von	Oct. 31, 1835	1898	Aug. 20, 1917
Bailey, Sir Edward	July 1, 1881	1944	Mar. 19, 1965
Baltzer, Fritz	Mar. 12, 1884	1967	Mar. 18, 1974
Barcroft, Sir Joseph	July 26, 1872	1939	Mar. 21, 1947
Barrande, Joachim	Aug. 11, 1799	1867	Oct. 5, 1883
Barrois, Charles	Aug. 21, 1851	1908	Nov. 5, 1939
Bartlett, Sir Frederick Charles	Oct. 20, 1886	1947	Sept. 30, 1969
Bateson, William	Aug. 8, 1861	1921	Feb. 8, 1926
Beaumont, L. Elie de	Sept. 25, 1798	1864	Sept. 21, 1874
Becquerel, Henri	Dec. 15, 1852	1905	Aug. 25, 1908
Berthelot, M. P. E.	Oct. 25, 1827	1883	Mar. 18, 1907
Bertrand, J. L. F.	Mar. 11, 1822	1883	Apr. 3, 1900
Bhabha, Homi Jehangir	Oct. 30, 1909	1963	Jan. 24, 1966
Bjerknes, V. F. K.	Mar. 14, 1862	1934	Apr. 9, 1951
Bjerrum, Niels	Mar. 11, 1879	1952	Sept. 30, 1958
Bohr, Niels	Oct. 7, 1885	1925	Nov. 18, 1962
Boltzmann, Ludwig	Feb. 20, 1844	1904	Sept. 5, 1906
Bordet, Jules	June 13, 1870	1935	Apr. 6, 1961
Born, Max	Dec. 11, 1882	1955	Jan. 5, 1970
Bornet, Edouard	Sept. 2, 1828	1901	Dec. 18, 1911
Boussingault, J. B. J. D.	Feb. 2, 1802	1883	May 11, 1887
Boveri, Theodor	Oct. 12, 1862	1913	Oct. 15, 1915
Bower, Frederick Orpen	Nov. 4, 1855	1929	Apr. 11, 1948
Bragg, Sir William	July 2, 1862	1939	Mar. 12, 1942
Bragg, Sir William Lawrence	Mar. 31, 1890	1945	July 1, 1971
Braun, Alexander	May 10, 1805	1865	Mar. 29, 1877
Brewster, Sir David	Dec. 11, 1781	1864	Feb. 10, 1868
Brogger, Waldemar Christofer	Nov. 10, 1851	1903	Feb. 17, 1940
Bronstead, Johannes Nicolaus	Feb. 22, 1879	1947	Dec. 17, 1947
Bunsen, Robert Wilhelm	Mar. 31, 1811	1864	Aug. 16, 1899
Burmeister, C. H. C.	Jan. 15, 1807	1867	May 2, 1892
Candolle, Alphonse de	Oct. 27, 1806	1883	Apr. 4, 1893
Cartan, Elie	Apr. 9, 1869	1949	May 6, 1951
Caso, Alfonso	Feb. 1, 1896	1943	Nov. 30, 1970
Cayley, Arthur	Aug. 16, 1821	1883	Jan. 26, 1895
Chapman, Sydney	Jan. 29, 1888	1946	June 16, 1970
Chasles, Michel	Nov. 15, 1793	1864	Dec. 18, 1880
Chevreul, Michel Eugène	Aug. 31, 1786	1883	Apr. 9, 1889
Clark, Sir Wilfrid Le Gros	June 5, 1895	1963	June 28, 1971
Clausius, Rudolph	Jan. 2, 1822	1883	Aug. 24, 1888
Cornu, Alfred	Mar. 6, 1841	1901	Apr. 12, 1902
Crookes, Sir William	June 17, 1832	1913	Apr. 1, 1919
Dale, Sir Henry	June 9, 1875	1940	July 22, 1968
Darboux, Gaston	Aug. 13, 1842	1913	Feb. 23, 1917
Darwin, Sir George Howard	July 9, 1845	1904	Dec. 7, 1912
de Sitter, Willem	May 6, 1872	1929	Nov. 21, 1934
Deslandres, Henri	July 24, 1853	1913	Jan. 15, 1948
de Vries, Hugo	Feb. 16, 1848	1904	May 21, 1935
Dewar, Sir James	Sept. 20, 1842	1907	Mar. 27, 1923
Dove, Heinrich Wilhelm	Oct. 6, 1803	1867	Apr. 4, 1879
du Bois-Reymond, Emil	Nov. 7, 1818	1892	Dec. 26, 1896
Dumas, Jean Baptiste	July 15, 1800	1883	Apr. 11, 1884
Dyson, Sir Frank Watson	Jan. 4, 1868	1926	May 25, 1939
Eddington, Sir Arthur Stanley	Dec. 28, 1882	1925	Nov. 21, 1944
Ehrlich, Paul	Mar. 14, 1854	1904	Aug. 20, 1915
Eijkman, Christiaan	Aug. 11, 1858	1921	Nov. 5, 1930
Engler, Adolph	Mar. 25, 1844	1925	Oct. 10, 1930
Eskola, Pentti Eelis	Jan. 8, 1883	1951	Dec. 6, 1964
Faraday, Michael	Sept. 22, 1791	1864	Aug. 25, 1867
Fauré-Fremiet, Emmanual	Dec. 29, 1883	1968	Nov. 6, 1971
Fischer, Emil	Oct. 9, 1852	1904	July 15, 1919
Fisher, Sir Ronald Aylmer	Feb. 17, 1890	1948	July 29, 1962
Florey, Howard Walter (Baron Florey of Adelaide)	Sept. 24, 1898	1963	Feb. 21, 1968
Forsyth, Andrew Russell	June 18, 1858	1907	June 2, 1942
Fowler, Alfred	Mar. 22, 1868	1938	June 24, 1940
Gegenbaur, Karl	Aug. 21, 1826	1891	June 14, 1903
Geikie, Sir Archibald	Dec. 28, 1835	1901	Nov. 10, 1924
Gill, Sir David	June 12, 1843	1898	Jan. 24, 1914
Goebel, Karl E. Ritter von	Mar. 8, 1855	1932	Oct. 10, 1932
Gregory, Frederick Gugenheim	Dec. 22, 1893	1956	Nov. 27, 1961
Groth, Paul von	June 23, 1843	1905	Dec. 2, 1927
Gyldén, Hugo	May 29, 1841	1892	Nov. 9, 1896

DECEASED FOREIGN ASSOCIATES—Continued

	Date of birth	Date of election	Date of death
Haber, Fritz	Dec. 9, 1868	1932	Feb. 1, 1934
Hadamard, Jacques	Dec. 8, 1865	1926	Oct. 17, 1963
Hadfield, Sir Robert A.	Nov. 28, 1858	1928	Sept. 30, 1940
Haldane, John Burdon Sanderson	Nov. 5, 1892	1964	Dec. 1, 1964
Haldane, John Scott	May 2, 1860	1935	Mar. 15, 1936
Hamilton, Sir William Rowan	Aug. 4, 1805	1864	Sept. 2, 1865
Hardy, Godfrey Harold	Feb. 7, 1877	1927	Dec. 1, 1947
Hartmann, Max	July 7, 1876	1959	Oct. 11, 1962
Heim, Albert	Apr. 12, 1849	1913	Aug. 31, 1937
Helland-Hansen, Björn	Oct. 16, 1877	1947	Sept. 7, 1957
Helmholtz, Hermann L. F. von (Baron von Helmholtz)	Aug. 31, 1821	1883	Sept. 8, 1894
Hertwig, Richard	Sept. 23, 1850	1929	Oct. 3, 1937
Hilbert, David	Jan. 23, 1862	1907	Feb. 18, 1943
Hill, James Peter	Feb. 21, 1873	1940	May 24, 1954
Hinshelwood, Sir Cyril Norman	June 19, 1897	1960	Oct. 9, 1967
Hoff, Jacobus Hendricus van't	Aug. 30, 1852	1901	Mar. 1, 1911
Hofmann, August Wilhelm	Apr. 8, 1818	1887	May 5, 1892
Hooker, Sir Joseph Dalton	June 30, 1817	1883	Dec. 10, 1911
Hopf, Heinz	Nov. 19, 1894	1957	June 3, 1971
Hopkins, Sir Frederick Gowland	June 20, 1861	1924	May 16, 1947
Houssay, Bernardo Alberto	Apr. 10, 1887	1940	Sept. 21, 1971
Huggins, Sir William	Feb. 7, 1824	1904	May 10, 1910
Huxley, Thomas Henry	May 4, 1825	1883	June 29, 1895
Ibañez, Carlos	Apr. 14, 1825	1889	Jan. 29, 1891
Janet, Pierre	May 30, 1859	1938	Feb. 24, 1947
Janssen, Pierre Jules Cesar	Feb. 22, 1824	1901	Dec. 23, 1907
Jones, Sir Harold Spencer	Mar. 29, 1890	1943	Nov. 3, 1960
Jordan, Marie Ennemond Camille	Jan. 5, 1838	1920	Jan. 21, 1922
Joule, James Prescott	Dec. 24, 1818	1887	Oct. 11, 1889
Kapteyn, J. C.	Jan. 19, 1851	1907	June 18, 1922
Karrer, Paul	Apr. 21, 1889	1945	June 18, 1971
Katzir-Katchalsky, Aharon	Sept. 1914	1971	May 30, 1972
Keith, Sir Arthur	Feb. 5, 1866	1941	Jan. 7, 1955
Kekulé, August	Sept. 7, 1829	1892	July 13, 1896
Kelvin, William Thomson (Baron Kelvin of Largs)	June 26, 1824	1883	Dec. 17, 1907
Kirchoff, Gustav Robert	Mar. 12, 1824	1883	Oct. 17, 1887
Klein, Felix	Apr. 25, 1849	1898	June 22, 1925
Knorski, Jerzy	Dec. 1, 1903	1963	Sept. 14, 1973
Koch, Robert	Dec. 11, 1843	1903	May 28, 1910
Kohlrausch, Friedrich	Oct. 14, 1840	1901	Jan. 17, 1910
Kölliker, Albert von	July 6, 1817	1883	Nov. 2, 1905
Kossel, Albrecht	Sept. 16, 1853	1913	July 5, 1927
Krishnan, Sir Kariamanikkam Srinivasa	Dec. 4, 1898	1956	June 14, 1961
Krogh, August	Nov. 15, 1874	1937	Sept. 13, 1949
Kronecker, Hugo	Jan. 27, 1839	1901	June 6, 1914
Kuno, Hisashi	Jan. 7, 1910	1963	Aug. 6, 1969
Küstner, Karl Friedrich	Aug. 22, 1856	1913	Oct. 15, 1936
Lacaze-Duthiers, Henri de	May 15, 1821	1898	July 21, 1901
Lacroix, Francois Antoine Alfred	Feb. 4, 1863	1920	Mar. 16, 1948
Landau, Lev Davidovich	Jan. 22, 1908	1960	Apr. 1, 1968
Lankester, Sir E. Ray	May 15, 1847	1903	Aug. 15, 1929
Larmor, Sir Joseph	July 11, 1857	1908	May 19, 1942
Laue, Max von	Oct. 9, 1879	1958	Apr. 24, 1960
Leuckart, Rudolph	Oct. 7, 1822	1895	Feb. 6, 1898
Levi, Giuseppe	Oct. 14, 1872	1940	Feb. 4, 1965
Lie, Sophus	Dec. 17, 1842	1895	Feb. 18, 1899
Liebig, Justus von	May 12, 1803	1867	Apr. 18, 1873
Lindblad, Bertil	Nov. 26, 1895	1955	June 25, 1965
Linderstrom-Lang, Kaj Ulrik	Nov. 29, 1896	1947	May 25, 1959
Lister, Joseph (1st Baron Lister of Lyme Regis)	Apr. 5, 1827	1898	Feb. 10, 1912
Loewy, Maurice	Apr. 15, 1833	1901	Oct. 15, 1907
Lorentz, Hendrik Antoon	July 18, 1853	1906	Feb. 4, 1928
Ludwig, Karl F. W.	Dec. 29, 1816	1893	Apr. 24, 1895
Lundegardh, Henrik Gunnar	Oct. 23, 1888	1964	Nov. 16, 1969
Lyot, Bernard Ferdinand	Feb. 27, 1897	1949	Apr. 1, 1952
Marconi, Marchese Guglielmo	Apr. 25, 1874	1932	July 20, 1937
Marey, Etienne Jules	Mar. 5, 1830	1903	May 15, 1904
Mendeléef, Dimitri I.	Feb. 8, 1834	1903	Feb. 2, 1907
Michotte, Albert Edouard (Baron Michotte van den Berck)	Oct. 13, 1881	1956	June 2, 1965
Milne-Edwards, Henri	Oct. 23, 1800	1864	July 29, 1885
Minnaert, Marcel Gilles Jozef	Feb. 12, 1893	1964	Oct. 26, 1970
Moissan, Henri	Sept. 28, 1852	1898	Feb. 20, 1907
Murchison, Sir Roderick I.	Feb. 19, 1792	1865	Oct. 22, 1871
Murray, Sir John	Mar. 3, 1841	1912	Mar. 16, 1914
Onnes, Heike Kamerlingh	Sept. 21, 1853	1920	Feb. 21, 1926
Oppolzer, Theodor von	Oct. 26, 1841	1883	Dec. 26, 1886
Ostwald, Wilhelm	Sept. 2, 1853	1906	Apr. 4, 1932
Owen, Sir Richard	Jan. 6, 1810	1865	Dec. 18, 1892
Parsons, Sir Charles Algeron	June 13, 1854	1925	Feb. 11, 1931
Pasteur, Louis	Dec. 27, 1822	1883	Sept. 28, 1895
Pavlov, Ivan Petrovic	Sept. 22, 1849	1906	Feb. 27, 1936
Penck, Albrecht	Sept. 25, 1858	1909	Mar. 9, 1945
Pérès, Joseph Jean Camille	Oct. 31, 1890	1956	Feb. 12, 1962
Peters, Christian August Friedrich	Sept. 7, 1806	1867	May 8, 1880

DECEASED FOREIGN ASSOCIATES—Continued

	Date of birth	Date of election	Date of death
Pfeffer, Wilhelm	Mar. 9, 1845	1903	Jan. 31, 1920
Picard, Emile	July 24, 1856	1903	Dec. 12, 1942
Pieron, Henri	July 18, 1881	1949	Nov. 6, 1964
Plana, G. A. A.	Nov. 8, 1781	1864	Jan. 20, 1864
Planck, Max	Apr. 23, 1858	1926	Oct. 4, 1947
Poincaré, Jules Henri	Apr. 29, 1854	1898	July 17, 1912
Portévin, Albert Marcel Germain René	Nov. 1, 1880	1954	Apr. 12, 1962
Prain, Sir David	July 11, 1857	1920	Mar. 16, 1944
Rammelsberg, Karl Friedrich	Apr. 1, 1813	1893	Dec. 28, 1899
Ramon y Cajal, Santiago	May 1, 1852	1920	Oct. 17, 1934
Ramsay, Sir William	Oct. 2, 1852	1904	July 23, 1916
Rayleigh, John Wm. Strutt (3d Baron Rayleigh)	Nov. 12, 1842	1898	June 30, 1919
Regnault, Victor	July 21, 1810	1865	Jan. 19, 1878
Renner, Otto	Apr. 25, 1883	1954	July 8, 1960
Retzius, Gustav	Oct. 17, 1842	1909	July 21, 1919
Richthofen, Ferdinand von	May 5, 1833	1883	Oct. 6, 1905
Rosenbusch, Karl Harry Ferdinand	June 24, 1836	1904	Jan. 20, 1914
Roux, Wilhelm	June 9, 1850	1924	Sept. 15, 1924
Rubner, Max	June 2, 1854	1924	Apr. 27, 1932
Rutherford, Ernest (1st Baron Rutherford of Nelson)	Aug. 30, 1871	1911	Oct. 19, 1937
Sabatier, Paul	Nov. 5, 1854	1927	Aug. 5, 1941
Sachs, Julius von	Oct. 2, 1832	1895	May 29, 1897
Schiaparelli, Giovanni	Mar. 14, 1835	1910	July 4, 1910
Schneider, Charles Eugene	Oct. 29, 1868	1925	Nov. 17, 1942
Schuster, Sir Arthur	Sept. 12, 1851	1913	Oct. 14, 1934
Seeliger, Hugo R. von	Sept. 23, 1849	1908	Dec. 2, 1924
Sherrington, Sir Charles	Nov. 27, 1857	1924	Mar. 4, 1952
Sommerfeld, Arnold	Dec. 5, 1868	1929	Apr. 25, 1951
Sorensen, Soren Peter Lauritiz	Jan. 9, 1868	1938	Feb. 12, 1939
Southwell, Sir Richard Vynne	July 2, 1888	1943	Dec. 9, 1970
Spearman, Charles Edward	Sept. 10, 1863	1943	Sept. 17, 1945
Spemann, Hans	July 27, 1869	1925	Sept. 12, 1941
Stas, Jean Servais	Sept. 20, 1813	1891	Dec. 13, 1891
Steacie, Edgar W. R.	Dec. 25, 1900	1957	Aug. 28, 1962
Stokes, Sir George G.	Aug. 13, 1819	1883	Feb. 1, 1903
Strasburger, Eduard	Feb. 1, 1844	1898	May 19, 1912
Struve, Otto von	Apr. 25, 1819	1883	Apr. 14, 1905
Stumpf, Carl	Apr. 21, 1848	1927	Dec. 29, 1936
Suess, Eduard	Aug. 20, 1831	1898	Apr. 26, 1914
Svedberg, Theodor (The)	Aug. 30, 1884	1945	Feb. 26, 1971
Sverdrup, Harald Ulrik [1]	Nov. 15, 1888	1952	Aug. 20, 1957
Sylvester, James Joseph	Sept. 3, 1814	1883	Mar. 15, 1897
Thompson, Sir D'Arcy	May 2, 1860	1943	June 21, 1948
Thomson, Sir Godfrey	Mar. 21, 1881	1951	Feb. 9, 1955
Thomson, Sir Joseph J.	Dec. 18, 1856	1903	Aug. 30, 1940
Tiselius, Arne W. K.	Aug. 10, 1902	1949	Oct. 29, 1971
Tisserand, François Felix	Jan. 13, 1845	1893	Oct. 30, 1896
Vallée-Poussin, C. de la		1886	1929	1962
van der Bijl, Hendrik Johannes	Nov. 23, 1887	1943	Dec. 2, 1948
Van der Waals, J. D.	Nov. 23, 1837	1913	Mar. 8, 1923
Vening Meinesz, Felix Andries	July 30, 1887	1939	Aug. 10, 1966
Virchow, Rudolph von	Oct. 13, 1821	1883	Sept. 5, 1902
Virtanen, Artturi Ilmari	Jan. 15, 1895	1969	Nov. 11, 1973
Vogel, Hermann Carl	Apr. 3, 1841	1903	Aug. 13, 1907
Volterra, Vito	May 3, 1860	1911	Oct. 11, 1940
Waldeyer, Wilhelm	Oct. 6, 1836	1909	Jan. 23, 1921
Watson, David Meredith Seares	June 18, 1886	1938	July 23, 1973
Weierstrass, Karl	Oct. 31, 1815	1892	Feb. 19, 1897
Weismann, August	Jan. 17, 1834	1913	Nov. 5, 1914
Wieland, Heinrich	June 4, 1877	1932	Aug. 5, 1957
Willstaetter, Richard	Aug. 13, 1872	1926	Aug. 2, 1942
Winge, Ojvind	May 10, 1886	1949	Apr. 5, 1964
Wöhler, Friedrich	July 31, 1800	1865	Sept. 23, 1882
Wolf, Max F. J. C.	June 21, 1863	1913	Oct. 3, 1932
Wundt, Wilhelm	Aug. 16, 1832	1909	Aug. 31, 1920
Würtz, Adolphe	Nov. 26, 1817	1883	May 12, 1884
Zirkel, Ferdinand	May 20, 1838	1903	June 11, 1912
Zittle, K. A. R. von	Sept. 25, 1839	1898	Jan. 5, 1904

[1] Resigned Academy membership on Apr. 2, 1951, when he had maintained residence in Norway for 3 years, thereby losing his American citizenship. Elected a foreign associate in 1952.

APPENDIX II

NATIONAL ACADEMY OF ENGINEERING

AUTUMN MEETING, 1972

The Eighth Autumn Meeting of the NAE was held at the National Academy of Sciences Building in Washington , D.C., on October 12 and 13, 1972. A symposium on Transportation and the Prospects for Improved Efficiency comprised the Technical Session of the meeting. The symposium was organized by the NAE Committee on Transportation with sponsorship by the National Science Foundation, the Department of Housing and Urban Development, and the Department of Transportation. Proceedings were subsequently published. The Business Session was held the afternoon of October 13, following the symposium.

TECHNICAL PROGRAM

The purpose of the symposium was to focus attention on the relationships between urban transportation and the associated modal interface problems, on urban development and renewal as related to transportation, and on institutional barriers to the realization of improved transportation. The one and one-half day meeting also included a review of the efforts by key officials from regional, city, and private enterprise activities to overcome the impediments to urban transportation progress. The main objective was to identify the key factors that have helped improve transportation efficiency.

The Program Committee for the symposium consisted of Messrs. Seymour W. Herwald, J. Erik Jonsson, and John A. Logan. The symposium program was as follows:

Thursday, October 12, 1972

WELCOME:

Clarence H. Linder, President, National Academy of Engineering.

KEYNOTE ADDRESS:

The Need to Develop Innovative Solutions to Transportation Needs

James M. Beggs, Under Secretary of Transportation, Department of Transportation, Washington, D.C.

Symposium Approach to Definition of Problems and to Improvements of Urban Design and Urban Transportation

Seymour W. Herwald, Symposium Chairman; Vice President, Engineering and Development, Westinghouse Electric Corporation, Pittsburgh.

51-371—75——23

Session on the General Transportation Problems and the Modal Interface Problems Related to Urban Transportation

Panelists:

Frank S. Besson, Jr., U.S. Army (Ret.), Board of Directors, Amtrak Corporation, Washington, D.C.

William L. Everett, Dean Emeritus, College of Engineering, University of Illinois, Urbana.

V/STOL Aircraft: The Future Role in Urban Transportation as a Pick Up and Distribution System

Rene Miller, Professor of Flight Transportation and Head, Department of Aeronautics and Astronautics, M.I.T., Cambridge.

Deep Draft Ports: Their Effect on Maritime Freight Movement and Related Interface Problems

Harry Brockel, Center for Great Lakes Studies, University of Wisconsin, Milwaukee.

Planning for Improved Transportation of People and Goods in Urban Areas

Roger H. Gilman, Director of Planning and Development, Port Authority of New York and New Jersey, New York City.

The Relation of Telecommunications to Urban Transportation

Arthur Goldsmith, Chief, Technical Division, Office of Telecommunications, Department of Transportation, Washington, D.C.

New Technological Possibilities in Transportation

Secor D. Browne, Chairman, Civil Aeronautics Board, Washington, D.C.

Session on Urban Development, Design and Renewal and the Relation to Urban Transportation

Panelists:

Harold B. Finger, Assistant Secretary for Research and Technology, Department of Housing and Urban Development, Washington, D.C.

Bernard Gifford, President, New York City-RAND Institute, New York City.

William L. Mertz, Director, Office of Highway Planning, Federal Highway Planning, Federal Highway Administration, Department of Transportation, Washington, D.C.

The Columbia and Hartford Development Processes and the South Richmond Development Project

Morton Hoppenfeld, Vice President, The Rouse Company, Columbia, Maryland.

The New York State Urban Development Corporation

D. David Brandon, Director of Program Development, New York State Urban Development Corporation, New York City.

Transportation and Urban Planning

Harmer E. Davis, Director, Institute of Transportation and Traffic Engineering, University of California, Berkeley.

Urban Development Concepts

Archibald C. Rogers, Chairman of the Board, RTKL, Inc., Baltimore.

Friday, October 13, 1972

Session on Urban Institutional Barriers Including Modal Aspects

Panelists:

Kurt W. Bauer, Executive Director, Southeastern Wisconsin Regional Planning Commission, Waukesha, Wisconsin.

Donald S. Berry, Murphy Professor of Civil Engineering, Northwestern University, Evanston.

Archibald C. Rogers, Chairman of the Board, RTKL, Inc., Baltimore.

The Metropolitan Transportation Commission (San Francisco Bay Area)

Paul C. Watt, Executive Director, Metropolitan Transportation Commission, Berkeley

The Metropolitan Washington Council of Governments

Walter A. Scheiber, Executive Director, The Metropolitan Washington Council of Governments, Washington, D.C.

Chicago Planning and Development

Milton Pikarsky, Commissioner of Public Works, Chicago.

The Dallas Urban Redevelopment Program

Vincent Ponte, City Planning Consultant, Montreal.

Summary Remarks by Symposium Chairman

BUSINESS SESSION

The following 27 members attended the Autumn Business Session on October 13, 1972 in the auditorium of the National Academy of Sciences Building.

Lynn S. Beedle
Donald S. Berry
Benjamin P. Blasingame
James Boyd
Arthur E. Bryson, Jr.
Carl C. Chambers
Paul F. Chenea
Harmer E. Davis
John H. Dessauer
Charles W. Elston
William L. Everitt
Alexander H. Flax
Willis M. Hawkins
J. Erik Jonsson
Rudolf Kompfner
Helmut E. Landsberg
Stephen Lawroski
Humboldt W. Leverenz
Clarence H. Linder
Frederic C. Lindvall
John C. Linvill
John L. McLucas
Eberhardt Rechtin
Paul Rosenberg
Abe Silverstein
Anton Tedesko
Ernst Weber

During the Business Session, President Linder introduced Harmer E. Davis, Chairman of the Committee on Membership, to comment on details of the Tenth Election, then in process, and provide views regarding procedures for subsequent elections. It was noted that the Council of the NAE had authorized the establishment of a Search Subcommittee of the Membership Committee for the systematic identification of candidates for membership to supplement the normal nomination procedure. In the ensuing discussion, the concept of the Search Subcommittee was generally endorsed, and the importance of the personal involvement of a substantial number of members of the Academy in the election process stressed.

President Linder noted that a Joint NAS–NAE Negotiating Team had been appointed early in the summer of 1972 to facilitate progress in reaching an agreement for the joint operation of a restructured NRC. The Team consists of three members each from the Council of the NAS (Allen Astin, E. R. Piore, Harrison Shull) and the Council of the NAE (Robert W. Cairns, John H. Dessauer, Frederic A. L. Holloway). Mr. Dessauer, who had served as the Chairman of the NAE Negotiating Team, presented a report on the Team's activities.

Two motions were passed unanimously, one expressing the appreciation of the members to the Negotiating Team for their efforts and the other expressing member support for the action taken by the Executive Committee of the Council at its meeting on October 12 on the recommendations of the Negotiating Team.

It was further noted at the meeting that difficulties had been experienced in achieving a quorum at the Business Sessions, and the suggestion was made that the Council consider this matter.

It was reported that Academy member Thomas H. Chilton had passed away since the last meeting of the membership.

ANNUAL MEETING, 1973

The Ninth Annual Meeting of the National Academy of Engineering was held May 3–4, 1973, at the National Academy of Sciences Building, Washington, D.C. The Business Session for members took place the afternoon of May 3, and a General Assembly of Members on May 4; the theme, "A Look at the Academy—The Present and the Future", constituted the technical session.

Members and their guests attended the President's Reception and Banquet at the Washington Club, Washington, D.C., the evening of May 3. Presentation of the Academy's Second Vladimir K. Zworykin Award for Electronic Engineering was made during the banquet to Professor Donald K. Bitzer of the University of Illinois at Urbana-Champaign. The award is given for outstanding achievement in the field of electronics applied in the service of mankind. Dr. Bitzer was particularly cited for his invention and development of the computer-based education system known as PLATO

(Programmed Logic of Automatic Teaching Operations). The dinner address entitled, "Science, Engineering, and the Antarctica", was given by Dr. H. Guyford Stever, Director of the National Science Foundation.

The Ladies' Program for members' wives was held on May 4. This included a guided tour of the Museum of the Daughters of the American Revolution.

BUSINESS SESSION

One hundred sixty nine members attended the Business Session of the Ninth Annual Meeting of the NAE, held on May 3, 1973. Present were:

William C. Ackermann
Philip M. Arnold
Stuart L. Bailey
Roy Bainer
Harvey O. Banks
Harry F. Barr
Samuel S. Baxter
Donald S. Berry
Raymond L. Bisplinghoff
Sidney A. Bowhill
James Boyd
Burton P. Brown
Solomon J. Buchsbaum
Stanley W. Burriss
Henri G. Busignies
Robert W. Cairns
Joseph M. Caldwell
Robert H. Cannon, Jr.
John D. Caplan
Jack E. Cermak
Carl C. Chambers
Paul F. Chenea
Harry E. Chesebrough
Frederick J. Clarke
Francis H. Clauser
Morris Cohen
Nathan Cohn
Edward N. Cole
C. Chapin Cutler
W. Kenneth Davis
Richard D. DeLauer
Jacob H. Douma
Charles S. Draper
Rolf Eliassen
Charles W. Elston
William L. Everitt
Phil M. Ferguson
Morris E. Fine
Harold W. Fisher
Richard G. Folsom
John C. Frye
Eugene G. Fubini
Antoine M. Gaudin
Ben C. Gerwick, Jr.
Richard P. Gifford
Charles P. Ginsburg
T. Keith Glennan
Earnest F. Gloyna
Harold B. Gotaas
Lawrence R. Hafstad
Willis M. Hawkins
Alfred Hedefine
Seymour W. Herwald
Walter R. Hibbard, Jr.
Nicholas J. Hoff
Eivind Hognestad
Solomon C. Hollister
Frederic A. L. Holloway
Grace M. Hopper
Donald E. Hudson
Arthur E. Humphrey
J. Donovan Jacobs
Robert I. Jaffee
H. Richard Johnson
James R. Johnson
Woodrow E. Johnson
J. Erik Jonsson
Edward C. Jordan
Donald L. Katz
Thomas C. Kavanagh
Clarence F. Kelly
John F. Kennedy
Fazlur R. Khan
John R. Kiely
Jack S. Kilby
Augustus B. Kinzel
Rudolf Kompfner
John D. Kraus
Ralph Landau
Helmut E. Landsberg
Clarence E. Larson
Allen Latham, Jr.
Stephen Lawroski
Jerome F. Lederer
Frank W. Lehan
Thomas M. Leps
W. Deming Lewis
Clarence H. Linder
John G. Linvill
George M. Low
J. Ross Macdonald
W. D. MacDonnell
Robert W. Mann
W. Robert Marshall
Hans A. Mauch
Gerald T. McCarthy
Kenneth G. McKay
John L. McLucas
Robert C. McMaster
George F. Mechlin, Jr.
Dwight F. Metzler
Stewart E. Miller
George E. Mueller
Eugene F. Murphy
Phillip S. Myers
Joseph H. Newman
Daniel A. Okun
Bruce S. Old
Elburt F. Osborn
Robert J. Parks
William J. Perry
Joseph M. Pettit
Milton Pikarsky
Emanuel R. Piore
David S. Potter
Jan A. Rajchman
William B. W. Rand
Eberhardt Rechtin
Eugene D. Reed
Frank E. Richart, Jr.
Louis H. Roddis, Jr.
Joe B. Rosenbaum
Paul Rosenberg

Walter A. Rosenblith
Hunter Rouse
Rustum Roy
Robert W. Rummel
Karl Schwartzwalder
Robert C. Seamans, Jr.
Milton C. Shaw
Timothy E. Shea
Herman E. Sheets
William E. Shoupp
Anthony E. Siegman
Abe Silverstein
John W. Simpson
Donald B. Sinclair
Ronald Smelt
Louis D. Smullin
Lombard Squires
Chauncey Starr
H. Guyford Stever
Richard H. Tatlow III
Gordon K. Teal
Anton Tedesko
Myron Tribus
Mac E. Van Valkenburg
Oswald G. Villard, Jr.
Harvey A. Wagner
Eric A. Walker
Ernst Weber
Edward Wenk, Jr.
G. O. Wessenauer
Elmer P. Wheaton
Albert D. Wheelon
Lyman D. Wilbur
George Winter
James F. Young
Lotfi A. Zadeh

President's Announcements

President Clarence H. Linder noted the death of three Academy members since the 1972 Autumn Meeting: Edward R. Gilliland, Julius P. Molnar, and Igor I. Sikorsky.

The President announced that the Founders Medal for 1973 had been awarded to Warren K. Lewis, Professor Emeritus of Chemical Engineering at the Massachusetts Institute of Technology. Dr. Lewis, who could not be present for reasons of health, was cited for his development of an improved system for handling heterogeneous reactions between gases and solids and for his contributions to engineering education.

The President also announced the appointment of an Auditing Committee to serve for a one-year term ending with the close of the 1974 Annual Meeting, having the following composition: Thomas O. Paine, Chairman, Chalmer G. Kirkbride, and William G. Shepherd.

Report of the Secretary

Secretary J. H. Mulligan, Jr., noted the resignation of President Linder effective at the close of the 1973 Annual Meeting and announced the election of Robert C. Seamans, Jr., to fill the unexpired term of President Linder through the close of the 1974 Annual Meeting, in accordance with the By-laws. Secretary Mulligan also announced that in the same election five individuals were elected to serve as members of the Council as follows:

To serve three-year terms commencing with the close of the 1973 Annual Meeting and ending with the close of the 1976 Annual Meeting: John H. Dessauer, Frederic A. L. Holloway, Ralph Landau, Joseph M. Pettit;

To fill the unexpired term of Raymond L. Bisplinghoff, for a one-year term beginning with the close of the 1973 Annual Meeting and ending at the close of the 1974 Annual Meeting: Donald N. Frey.

The Secretary also announced the election of 70 new members to the Academy.

Report of the Treasurer

The Treasurer submitted a report for the fiscal year ended June 30, 1972. As of July 1, 1971, the balance in the NAE general fund was $158,259. The balance as of June 30, 1972, was $138,153. The Report of the Treasurer was accepted.

Report of the Auditing Committee

The Auditing Committee for 1972–1973, comprised of Chalmer G. Kirkbride, Chairman, John C. Geyer, and John L. McLucas, reviewed the Report of the Treasurer of the NAS for the fiscal year ended June 30, 1972, including the Auditor's report prepared by Price Waterhouse & Co. for the NAS; and the Report of the Treasurer of the NAE for the same period, including the audit of NAE accounts prepared by Price Waterhouse & Co. The Committee recommended that these reports be accepted by the membership of the NAE. The Committee also noted that the recommendations of the Auditing Committee Report for 1972 have, for the most part, been implemented, and was pleased to observe the continued independent audit of NAE accounts.

Future of the NAE

President Linder described the development of the Academy's activities since the foundation of the NAE. He reviewed the major issues perceived by the Council to be involved in the search for a viable agreement on administrative arrangements for the joint operation of the NRC by the NAS and NAE. Mr. Linder outlined the principal options for action by the NAE at this time, and announced the incorporation, on April 19, 1973, of the National Academy of Engineering Foundation to receive and disburse funds for the activities of the Academy. President-elect Robert C. Seamans, Jr., next presented a resolution of the Council concerning the incorporation of the NAE as a non-profit corporation in the District of Columbia. Discussion of the resolution by the members present and action on amendments resulted in the following modified version of the resolution:

Resolution

Whereas, the National Academy of Engineering was organized in 1964, by action of the Council of the National Academy of Sciences, and has existed since 1964 for purposes stated in the Articles of Organization as a subsidiary organ of the National Academy of Sciences; and

Whereas, the National Academy of Engineering reaffirms the importance of cooperation with the National Academy of Sciences on matters involving both science and technology; and

Whereas, the Council of the National Academy of Engineering has recommended to the members that they authorize the incorporation of the

National Academy of Engineering as a nonprofit corporation, pursuant to the District of Columbia Nonprofit Corporation Act; in the belief that incorporation will provide needed identity and under the present circumstances best enable the National Academy of Engineering to fulfill its objects and purposes of serving the nation, and will provide a basis for responsible partnership with the National Academy of Sciences; it is therefore

Resolved, That the members of the National Academy of Engineering request that the Council prepare a plan and a rationale for the incorporation of the National Academy of Engineering, as a nonprofit corporation, pursuant to the District of Columbia Nonprofit Corporation Act; and

Further Resolved, That the Council of the National Academy of Engineering is authorized to seek approval of the plan for the incorporation of the National Academy of Engineering at the next stated meeting of members; to continue negotiations with the National Academy of Sciences, to draft a Congressional charter, and to propose to the membership at least two options for action prior to the next stated meeting; to give at least 30 days notice to all members that such approval will be sought at the next stated meeting; and to permit voting on such approval by mail ballot so that members unable to be present at the meeting shall have the right to vote on such approval as if they were present at the meeting.

TECHNICAL PROGRAM

A General Assembly of Members, held on May 4, 1973, constituted the Technical Session of the Ninth Annual Meeting of the Academy. The purpose of the Assembly, attended by over 110 persons, was to familiarize the membership with the current work of the Academy. After introductory remarks by Henri Busignies, Chairman of the NAE Project Committee, who served as Chairman of the Assembly, the following presentations on the status and activities of the NAE advisory committees were made by each chairman:

Committee on Telecommunications: William L. Everitt.
Marine Board: William E. Shoupp.
Aeronautics and Space Engineering Board: Willis M. Hawkins.
Space Applications Board: Daniel J. Fink representing Allen E. Puckett, Chairman.
Committee on Public Engineering Policy: Edward Wenk, Jr.
Experimental R&D Incentives Program: Lombard Squires.
Commission on Education: Louis T. Rader representing W. Robert Marshall, Chairman.
Committee on Engineering Manpower Policy: Bob O. Evans.
Committee on Environmental Engineering: William C. Ackermann.
Committee on the Interplay of Engineering with Biology and Medicine: Allen Latham representing W. Robert Marshall, Chairman.
Committee on International Activities: Bruce S. Old.
Integrated Utility Systems Board: G. O. Wessenauer.
Committee on Transportation and BART Impact Program: S. W. Herwald.
Ad Hoc Committee Advisory to the Bureau of Mines: Oscar T. Marzke.

AUTUMN MEETING, 1973

The Ninth Autumn Meeting of the NAE was held at the National Academy of Sciences Building in Washington, D.C., on October 24–26, 1973. The Business Session was held the afternoon of October 24. A joint NAS–NAE meeting on National Materials Policy comprised the Technical Session. The joint meeting was organized by a Steering Committee chiefly drawn from the memberships of the NAS and NAE, with sponsorship by the U.S. Bureau of Mines and the National Science Foundation. Proceedings were subsequently published.

BUSINESS MEETING

The following 76 members attended the Autumn Business Session on October 24, 1973, in the Auditorium of the National Academy of Sciences Building:

Philip M. Arnold
Stuart L. Bailey
Robert F. Bauer
Raymond L. Bisplinghoff
Benjamin P. Blasingame
James Boyd
Arthur E. Bryson, Jr.
Robert W. Cairns
Robert H. Cannon, Jr.
Jack E. Cermak
Carl C. Chambers
Edward J. Cleary
Morris Cohen
Lee L. Davenport
W. Kenneth Davis
Allen F. Donovan
Jacob H. Douma
Daniel C. Drucker
Charles W. Elston
Phil M. Ferguson
Morris E. Fine
Harold W. Fisher
Alexander H. Flax
Richard G. Folsom
Mars G. Fontana
Ivan A. Getting
Charles P. Ginsburg
T. Keith Glennan
Earnest F. Gloyna
Harold B. Gotaas
Jerrier A. Haddad
Willis M. Hawkins
Alfred Hedefine
Edward H. Heinemann
Frederic A. L. Holloway
Grace M. Hopper
Arthur E. Humphrey
Robert I. Jaffee
Wendell E. Johnson
Thomas C. Kavanagh
Helmut E. Landsberg
Clarence E. Larson
Stephen Lawroski
Jerome F. Lederer
Humboldt W. Leverenz
W. Deming Lewis
Hans A. Mauch
William B. McLean
John L. McLucas
George E. Mueller
Eugene F. Murphy
Phillip S. Myers
Kenneth D. Nichols
Bruce S. Old
Samuel C. Phillips
David S. Potter
Eberhardt Rechtin
Denis M. Robinson
Louis H. Roddis, Jr.
Joe B. Rosenbaum
Paul Rosenberg
Walter A. Rosenblith
Rustum Roy
Robert C. Seamans, Jr.
William E. Shoupp
Donald B. Sinclair
Levering Smith
George E. Solomon
Richard H. Tatlow III
Gordon K. Teal
Anton Tedesko
Mac E. Van Valkenburg
Ernst Weber
Edward Wenk, Jr.
G. O. Wessenauer
Vladimir K. Zworykin

President Robert C. Seamans, Jr., commented on NAE program activities and briefly described reports which had been issued since the 1973 Annual Meeting, as follows:

Engineering and Scientific Manpower: Recommendations for the Seventies (Committee on Engineering Manpower Policy)

Federal Agency Development in Medical Engineering (Committee on the Interplay of Engineering with Biology and Medicine)

Issues and Public Policies in Educational Technology—to Realize the Promise (Commission on Education)

Transportation and the Prospects for Improved Efficiency (Committee on Transportation)

Telecommunications Research in the United States and Selected Foreign Countries (Committee on Telecommunications)

U.S. International Firms and R.D. & E. in Developing Countries (*Ad Hoc* Panel of the Board on Science and Technology for International Development, with the collaboration of the NAE)

President Seamans reported on recent technical program initiatives by the NAE relating to energy and minority participation in engineering, and the subsequent formation of an *Ad Hoc* Task Force on Energy Program Planning (chaired by NAE member W. Kenneth Davis); an NAE Committee on Minorities in Engineering (chaired by member Richard J. Grosh) and a National Advisory Council for Minorities in Engineering.

The President remarked on the continuing need to increase the independent funds of the Academy to permit conducting exploratory studies as well as to support activities primarily dealing with the honorific nature of the Academy. He announced that the Academy's Committee on Gifts and Endowments was being reactivated for this purpose, under the chairmanship of Donald N. Frey.

It was reported that an *Ad Hoc* Committee on Membership Procedures had been appointed in February, 1973 (consisting of W. Deming Lewis as Chairman, and Ivan A. Getting and John R. Kiely) to make a study of the qualifications required for election to membership and the detailed procedures to be utilized in the nomination and election of candidates. Mr. Lewis summarized the Committee's findings and the major recommendations contained in this report as approved by the Council. The ensuing discussion indicated consensus that the recommendations of this *Ad Hoc* Committee substantially improved the nomination and election procedures.

Referring to the resolution approved by the members at the Business Session on May 4, 1973, authorizing the Council of the NAE to develop two organizational alternatives for the Academy of operating within the NAS corporate structure and as a separate corporation, President Seamans summarized developments pertaining to NAS/NAE/NRC relationships since the 1973 Annual Meeting. He described the reorganization of the National Research Council and observed that since the Annual Meeting the Council of the NAE had proceeded with the planning and development of two options concerning the organization and operation of the NAE, believed to be responsive to the action by the Academy members.

He reported on a letter he had sent to President Handler suggesting the creation of an Assembly of Engineering within the NRC and an in-depth definition of the role of the President of the NAE as Vice Chairman of the NRC, and on the unanimous acceptance of these principles by the Council of the NAS; that the Council of the NAE had accepted an invitation

from the Council of the NAS to participate in the governance of the NRC on an interim basis by having the Governing Board consist of the Executive Committees of both Councils; and on the development and subsequent approval by the Councils of both Academies of a statement of principles for joint operation of the NRC, which included provision for the organization and operation of an Assembly of Engineering within the NRC and the participation of the President of the NAE, serving as Vice Chairman of the NRC, as Chairman of the Assembly of Engineering.

The President also reported that various aspects of the operation of the NAE as a separate corporation had been investigated. He emphasized that the outlines of these two alternatives for NAE organizational action were being presented at this meeting for the information of the membership. Following extensive discussion the following resolution was unanimously adopted by the members present:

> *Resolved,* That the NAE Council be commended for progress made to date in the development of arrangements for cooperative activity between the NAE and NAS, and be encouraged to continue these efforts.

TECHNICAL SESSION

The main purpose of the joint NAS–NAE Meeting on National Materials Policy, held on October 25–26, 1973, was to explore the future availability and use of the earth's resources. Two major policy studies conducted during 1971–73 provided the focus for discussion: the final report of the National Commission on Materials Policy and the report of the NAS Committee on the Survey of Materials Science Policy.

The Steering Committee for the meeting was comprised of Messrs. Robert I. Jaffee, Chairman, and James Boyd, Arthur M. Bueche, Morris Cohen, Richard R. Doell, Paul J. Flory, and Hans H. Landsberg. The meeting program was as follows:

Thursday, October 25, 1973—Morning

INTRODUCTION:

Robert C. Seamans, Jr., President, National Academy of Engineering.

KEYNOTE ADDRESS:

The Honorable Emilio Q. Daddario, Gulf & Western Engineering Group (former Congressman; Chairman of Subcommittee on Science, Research and Development, House Committee on Science and Astronautics).

Introduction to Policy Studies

James Boyd, Formerly National Commission on Materials Policy.

Morris Cohen, Committee on the Survey of Materials Science and Engineering, National Academy of Sciences.

World Resources, Reserves and U.S. Policy

Vincent E. McKelvey, U.S. Geological Survey, Department of the Interior.

PANELISTS:

Edward P. Cliff, Consultant on Forestry and Land Use (formerly U.S. Forest Service and National Commission on Materials Policy).
Preston Cloud, University of California, Santa Barbara.
Bruce C. Netschert, National Economic Research Associates, Inc.

Afternoon

Elburt F. Osborn, Geophysical Laboratory, Carnegie Institution of Washington (formerly Bureau of Mines, Department of the Interior).

Enlargement of Non-Renewble Reserves Through Technology

David Swan, Kennecott Copper Corporation.

Oil and Gas

Harry Perry, Resources for the Future, Inc.

PANELISTS:

Walter L. Finlay, Copper Range Company.
Menelaos D. Hassialis, Columbia University.
Paul C. Henshaw, Homestake Mining Company.
William E. Shoupp, Westinghouse Electric Corporation.

Options for Exploitation of Unconventional Resources—Ocean, Geothermal, Fusion, Solar, etc.

Harvey Brooks, Harvard University.

Geothermal Resources

Donald H. Stewart, Battelle Pacific Northwest Laboratories.

Solar Resources

Lloyd O. Herwig, Division of Advanced Energy Research and Technology, RANN, National Science Foundation.

Fusion Resources

David Rose, Massachusetts Institute of Technology.

Ocean Resources

Kenneth O. Emery, Woods Hole Oceanographic Institution.

Silica and Silicates

Edwin W. Tooker, U.S. Geological Survey, Department of the Interior.

Options for Technology Policies Involving Production and Utilization of Materials—Conservation, Alternate Materials, Recycling, Creative Re-Use

J. Herbert Hollomon, Massachusetts Institute of Technology.

PANELISTS:

Julius A. Mirabal, General Electric Company.

Richard W. Roberts, National Bureau of Standards.
S. L. Blum, Mitre Corporation.

Evening Program

INTRODUCTION:
Philip Handler, President, National Academy of Sciences.
ADDRESS:
The Honorable Mike McCormack, Chairman, Subcommittee on Energy, U.S. House of Representatives.

Friday, October 26, 1973—Morning

Edward Wenk, Jr., University of Washington, Chairman, NAE Committee on Public Engineering Policy.

MEN, INSTITUTIONS AND PRIORITIES

Education/Manpower

Daniel C. Drucker, University of Illinois.
PANEL DISCUSSION (see below for panelists).

Institutions

Lynton Keith Caldwell, University of Indiana.

Research and Development Priorities

Alan G. Chynoweth, Bell Telephone Laboratories, Inc.
Roland W. Schmitt, Research and Development Center, General Electric Company.
PANELISTS (Single panel for all three talks):
Franklin P. Huddle, Congressional Research Service.
Harold W. Paxton, Carnegie-Mellon University (formerly Director, Division of Materials Research, National Science Foundation).
William A. Vogely, Office of Economic Analysis, Department of the Interior.
Eric A. Walker, Aluminum Company of America.
Nathaniel Wollman, University of New Mexico, Albuquerque.

Afternoon

H. Guyford Stever, National Science Foundation.

MATERIALS POLICY RECOMMENDATIONS—Panel/Audience Discussion.

PANELISTS:

The Honorable J. Caleb Boggs, Bayard, Brill and Handelman Law Firm, Wilmington, Delaware (Author of the National Materials Policy Act 1970).
James Boyd, Formerly National Commission on Materials Policy.

Morris Cohen, Massachusetts Institute of Technology, Chairman, Committee on the Survey of Materials Science and Engineering, National Academy of Sciences.

William Cox, Joint Economic Committee, U.S. Congress.

The Honorable Emilio Q. Daddario, Gulf & Western Engineering Group (former Congressman, Chairman of Subcommittee on Science, Research, and Development, House Committee on Science and Astronautics).

Russell C. Drew, National Science Foundation.

The Honorable Peter H. Dominick, U.S. Senate.

Mary Jane C. Due, Committee on Aeronautical and Space Sciences, U.S. Senate.

The Honorable Pierre S. du Pont, U.S. House of Representatives.

William H. Hogan, Jr., Committee on Armed Services, U.S. House of Representatives.

Tom McGurn, Subcommittee on Computer Services, U.S. Senate.

Jerome L. Klaff, Chairman, Formerly National Commission on Materials Policy.

Elburt F. Osborn, Geophysical Laboratory, Carnegie Institution of Washington (Formerly Bureau of Mines, Department of Interior).

The Honorable Claiborne Pell, U.S. Senate.

Philip B. Yeager, Committee on Science and Astronautics, U.S. House of Representatives.

ANNUAL MEETING, 1974

The Tenth Annual Meeting of the National Academy of Engineering was held May 2–3, 1974, at the National Academy of Sciences Building, Washington, D.C. The Business Session for members took place the afternoon of May 2, with the Technical Session, consisting of presentations concerning the work of the NAE advisory committees, held on May 3.

Members and their guests attended the President's Reception and Banquet at the Sheraton Park Hotel, Washington, D.C., the evening of May 2. Presentation of the Academy's Third Vladimir K. Zworykin Award for Electronic Engineering was made during the banquet to Dr. Ivar Giaever, a 1973 Nobel laureate associated with the Research and Development Laboratories of the General Electric Corporation. Dr. Giaever was particularly cited for his original contributions to the field of electronic tunneling, superconductivity, and *in situ* protein detection.

The recipient of the Ninth Founders Medal, also presented at the banquet, was J. Erik Jonsson, Honorary Chairman of the Board, Texas Instruments, Inc. Mr. Jonsson was cited for his utilization of engineering knowledge to improve the quality of life through pioneering efforts in the manufacture of high technology products and innovative use of technology in solving basic problems of the city. His Founders Lecture dealt with the theme of the application of technology to the solution of urban problems.

The Ladies' Program for members' wives was held on May 3. This included a visit to Gunston Hall and a walking tour of Old Town Alexandria.

BUSINESS SESSION

One hundred and thirty-six members attended the Business Session of the Tenth Annual Meeting of the NAE, held on May 2, 1974, in the Auditorium of the National Academy of Sciences Building. Present were:

William C. Ackermann
Willis A. Adcock
William G. Agnew
Philip M. Arnold
Wm. Howard Arnold, Jr.
Holt Ashley
Howard C. Barnes
Jordan J. Baruch
Richard H. Battin
Benjamin B. Bauer
Robert F. Bauer
Samuel S. Baxter
Donald S. Berry
James Boyd
Arthur E. Bryson, Jr.
Henri Busignies
John D. Caplan
Roy W. Carlson
Jack E. Cermak
Carl C. Chambers
Paul F. Chenea
Frederick J. Clarke
Floyd L. Culler, Jr.
C. Chapin Cutler
Lee L. Davenport
Frank W. Davis
W. Kenneth Davis
Richard D. DeLauer
Walter S. Douglas
Jacob H. Douma
Robert M. Drake, Jr.
Phillip Eisenberg
James C. Elms
Charles W. Elston
Bob O. Evans
William L. Everitt
James R. Fair, Jr.
Robert M. Fano
Karl L. Fetters
Daniel J. Fink
Donald G. Fink
Alexander H. Flax
E. Montford Fucik
Elmer L. Gaden, Jr.
Joseph G. Gavin. Jr.
Ivan A. Getting
James F. Gibbons
T. Keith Glennan
Edward J. Gornowski
Harold B. Gotaas
Jerrier A. Haddad
Lawrence R. Hafstad
Albert C. Hall
Paul D. Haney
Thomas J. Hanratty
Donald R. F. Harleman
Willis M. Hawkins
Ira G. Hedrick
S. W. Herwald
John P. Hirth
Claude R. Hocott
Frederic A. L. Holloway
Grace M. Hopper
Arthur E. Humphrey
J. Donovan Jacobs
Robert I. Jaffee
H. Richard Johnson
James R. Johnson
Wendell E. Johnson
J. Erik Jonsson
Donald L. Katz
Thomas C. Kavanagh
John R. Kiely
Augustus B. Kinzel
Chalmer G. Kirkbride
Helmut E. Landsberg
Joseph C. Lawler
Stephen Lawroski
Jerome F. Lederer
Thomas M. Leps
Salomon Levy
W. Deming Lewis
John G. Linvill
J. Ross Macdonald
W. Robert Marshall
Hans A. Mauch
Gerald T. McCarthy
William B. McLean
Dwight F. Metzler
George E. Mueller
James H. Mulligan, Jr.
Robert C. McMaster
Eugene F. Murphy
Phillip S. Myers
Theodore J. Nagel
Joseph H. Newman
David Okrent
Bruce S. Old
Elburt F. Osborn
Thomas O. Paine
Robert J. Parks
Alfred L. Parme
Donald O. Pederson
William S. Pellini
Maynard L. Pennell
Joseph M. Pettit
Milton Pikarsky
Robert Plunkett
William B. W. Rand
Joe B. Rosenbaum
Paul Rosenberg
Robert W. Rummel
Robert C. Seamans, Jr.
Milton C. Shaw
Joseph F. Shea
William E. Shoupp
Samuel Silver
Donald B. Sinclair
Ronald Smelt
George E. Solomon
Morgan Sparks
Alfred D. Starbird
Chauncey Starr
Morris Tanenbaum
Richard H. Tatlow III
John J. Taylor
Anton Tedesko
John A. Tillinghast
Myron Tribus
Mac E. Van Valkenburg
Aubrey J. Wagner
Harvey A. Wagner
Ernst Weber
James W. Westwater
Elmer P. Wheaton
Vladimir K. Zworykin

President's Announcements

President Robert C. Seamans, Jr., noted the deaths of Academy members Arthur T. Ippen and Walter G. Whitman since the 1973 Autumn Meeting.

The President announced the appointment of an Auditing Committee to serve for a one-year term ending with the close of the 1975 Annual Meeting, and comprised of Karl L. Fetters, Chairman, and Harry F. Barr and Thomas O. Paine.

Report of the Secretary

Secretary J. H. Mulligan, Jr., announced the election of the following individuals as officers of the National Academy of Engineering for four-year terms commencing with the close of the 1974 Annual Meeting and ending with the close of the 1978 Annual Meeting:

President: Robert C. Seamans, Jr.
Vice President: William E. Shoupp.
Treasurer: Edward N. Cole.
Secretary: J. H. Mulligan, Jr.

He also announced that in the same election four individuals were elected to serve as members of the Council for three-year terms commencing with the close of the 1974 Annual Meeting and ending with the close of the 1977 Annual Meeting: Arthur E. Bryson, Jr., Edward L. Ginzton, Robert C. Gunness, and Morris Tanenbaum.

The Secretary reported that the Eleventh Membership Election concluded in April, 1974, had resulted in the election of 78 new members to the Academy.

Report of the Treasurer

The Treasurer submitted a report for the fiscal year ended June 30, 1973. As of July 1, 1972, the balance in the NAE general fund was $138,153. The balance as of June 30, 1973, was $117,254. The Report of the Treasurer was accepted.

Report of the Auditing Committee

The Auditing Committee for 1973–74, comprised of Thomas O. Paine, Chairman, Chalmer G. Kirkbride, and William G. Shepherd, reviewed the Report of the Treasurer, NAS, for the fiscal year ended June 30, 1973, including the Auditor's Report prepared by Price Waterhouse & Co. for the NAS; and the Report of the Treasurer of the NAE for the same period, including the audit of NAE accounts prepared by Price Waterhouse & Co. The Committee recommended that these reports be accepted by the membership of the NAE. The Committee noted with concern, however, the declining balance of the general fund of the Academy, but indicated its encouragement at management's clear recognition of the problem and steps being taken to rectify it. The Committee concurred with the recommenda-

tions stated in the Report of the Auditing Committee 1972–73 that the Committee be maintained and that a basic function of the Committee remain one of review to ascertain continuation of the sound practices developed in the last few years.

Amendment to Bylaws

A motion was passed without dissent to amend Article VII, Section 3 of the Bylaws as follows (language added is indicated by italics):

> There shall be a Committee on Membership, composed of not less than sixteen nor more than thirty members appointed by the Council, after taking into account the various branches of engineering represented in the Academy. The Council shall annually name the chairman *and vice chairman* of the Committee. *The vice chairman shall, under normal circumstances, succeed to a one-year term as chairman.*

Future of the NAE

President Seamans reviewed the development of organizational alternatives for operation of the NAE and actions by the NAS and NAE relative to the matter of their joint governance of the NRC which had occurred since the Business Session on May 4, 1973. He noted that, in accordance with the resolution voted by the membership at that time, a mail ballot had been provided for voting on two organizational options for those members unable to attend the 1974 Annual Meeting, and that a similar ballot was available for those members present who had not voted or wished to change their previous vote. He then presented the following motion, passed unanimously by the Council of the NAE on May 2, 1974:

> The Council unanimously reaffirms its action of February 8, 1974, recommending to the membership of the National Academy of Engineering at the 1974 Annual Meeting that it approve adoption of the Plan for Operation of the NAE as Part of the NAS Corporation in general accordance with the *Statement of Principles Underlying Joint Operation of NRC by the NAS and NAE* (October 24, 1973) and the *Terms of Reference for the Assembly of Engineering of the National Research Council* (December 8, 1973).

It was noted that July 1, 1974, is the proposed date for implementation of the *Statement of Principles,* pending approval of the document by the memberships of the NAS and NAE.

At the conclusion of discussion on this subject the final vote count was taken, and President Seamans reported that the membership of the National Academy of Engineering, by a combination of mail ballot and vote at this meeting, had voted:

> To endorse the action of the Council and approve adoption of the Plan for Operation of the NAE as Part of the NAS Corporation in general accordance with the *Statement of Principles Underlying Joint Operation of the NRC by the NAS and NAE* (October 24, 1973) and the *Terms of Reference for the Assembly of Engineering of the National Research Council* (December 8, 1973).

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Report of the President

President Seamans highlighted activities of the Academy during the past year and briefly described the following new NAE programs which had been established since the 1973 Annual Meeting:

As units of the Aeronautics and Space Engineering Board:

Ad hoc Committee on Advanced Supersonic Technology, *Chairman,* George E. Solomon.

Ad hoc Committee on Alternative Aircraft Fuels, *Chairman,* Abe Silverstein.

As units of the Marine Board:

Panel on Buoy Technology Assessment, *Chairman,* Herman E. Sheets.

Panel on Operational Safety in Marine Mining, *Chairman,* J. Robert Moore.

As a unit of the Committee on Environmental Engineering:

Ad hoc Committee on Navy Environmental Protection Program, *Chairman,* William C. Ackermann.

As new Academy units:

Ad hoc Committee on Technology Transfer and Utilization, *Chairman,* Joseph H. Newman.

Steering Committee for a Workshop on Simulation of Earthquake Effects on Structures, *Chairman,* Abel Wolman.

Task Force on Energy, *Chairman,* W. Kenneth Davis.

Board on Engineering Manpower and Educational Policy, *Chairman* Mac E. Van Valkenburg.

Committee on Minorities in Engineering, *Chairman,* Richard J. Grosh.

The President also commented on new Academy responsibilities relative to the organization of the NRC, including the proposed Assembly of Engineering, and outlined initiatives which the NAE or the Assembly of Engineering might consider undertaking. In conclusion, he urged increased membership participation as a means of further strengthening the NAE in the next phase of its technological and financial development.

Technical Session

The Technical Session, held on May 3, 1974, consisted of a series of presentations on NAE program activities by committee chairmen. The session was chaired by William E. Shoupp, Vice President-elect of the Academy. The following reports were presented:

Aeronautics and Space Engineering Board

Willis M. Hawkins, *Chairman,* Senior Vice President—Science and Engineering, Lockheed Aircraft Corporation.

Space Applications Board

Allen E. Puckett, *Chairman,* Executive Vice President and Assistant General Manager, Hughes Aircraft Company.

Committee on Transportation

Seymour W. Herwald, *Chairman,* Vice President, Engineering and Development, Westinghouse Electric Corporation.

Marine Board

William E. Shoupp, *Chairman,* Senior Vice President, Research Laboratories, Westinghouse Electric Corporation.

Committee on Telecommunications

Henri Busignies, *Chairman,* Senior Vice President and Chief Scientist, International Telephone and Telegraph Corporation.

NAE Office of the Foreign Secretary

Bruce S. Old, *Foreign Secretary,* Senior Vice President, Arthur D. Little, Inc.

Committee on Technology Transfer and Utilization

Joseph H. Newman, *Chairman,* Senior Vice President, Tishman Research Corporation.

Committee on Environmental Engineering

William C. Ackermann, *Chairman,* Chief, Illinois State Water Survey.

Integrated Utility Systems Board

G. O. Wessenauer, *Chairman,* Consultant, Chattanooga, Tennessee.

Bay Area Rapid Transit Impact Program Advisory Committee (BART)

Seymour W. Herwald, *Chairman,* Vice President, Engineering and Development, Westinghouse Electric Corporation.

Task Force on Energy

W. Kenneth Davis, *Chairman,* Vice President, Bechtel Power Corporation.

Study Panel for the National Science Foundation Experimental Research and Development Incentives Program

Edward J. Gornowski, *Chairman,* Executive Vice President, Exxon Research and Engineering Company.

Commission on Education

W. Robert Marshall, *Chairman,* Dean, College of Engineering, The University of Wisconsin—Madison.

Committee on Minorities in Engineering

Richard J. Grosh, *Chairman,* President, Rensselaer Polytechnic Institute.

Committee on Public Engineering Policy

Edward Wenk, Jr., *Chairman,* Professor of Engineering and Public Affairs and Director, Program on Social Management of Technology, The University of Washington, Seattle.

ARTICLES OF ORGANIZATION

Approved by the Council of The National Academy of Sciences December 5, 1964

Article I. Creation and Completion of Organization

The National Academy of Sciences, under the authority conferred upon it by its Charter enacted by the Congress, adopts the following Articles of Organization for the National Academy of Engineering.

Section 1. The National Academy of Engineering (hereinafter called the "Academy") shall be an institution with the powers, limitations, and restrictions contained in these articles of organization.

Sec. 2. The following persons are named as the Founding Members of the Academy: Hendrik Wade Bode, Walker Lee Cisler, Hugh Latimer Dryden, Elmer William Engstrom, William Littell Everitt, Antoine Marc Gaudin, Michael Lawrence Haider, George Edward Holbrook, John Herbert Hollomon, Jr., Thomas Christian Kavanagh, Augustus Braun Kinzel, James Noble Landis, Clarence Hugo Linder, Clark Blanchard Millikan, Nathan Mortimore Newmark, William Hayward Pickering, Simon Ramo, Arthur Emmons Raymond, Thomas Kilgore Sherwood, Julius Adams Stratton, Chauncey Guy Suits, Frederick Emmons Terman, Charles Allen Thomas, Eric Arthur Walker, Ernst Weber.

Sec. 3. The Founding Members are authorized to complete the organization of the Academy by the selection of officers and employees, the adoption of bylaws not inconsistent with these articles or organization, the election of such additional members as they may deem appropriate prior to the first annual meeting of the Academy, and the doing of such further acts as may be necessary for such purpose.

Article II. Objects and Purposes

The objects and purposes of the Academy shall be:

1. To provide means of assessing the constantly changing needs of the nation and the technical resources that can and should be applied to them; to sponsor programs aimed at meeting these needs; and to encourage such engineering research as may be advisable in the national interest.
2. To explore means for promoting cooperation in engineering in the United States and abroad, with a view to securing concentration on problems significant to society and encouraging research and development aimed at meeting them.
3. To advise the Congress and the executive branch of the Government, whenever called upon by any department or agency thereof, on matters of national import pertinent to engineering.
4. To cooperate with the National Academy of Sciences on matters involving both science and engineering.
5. To serve the nation in other respects in connection with significant problems in engineering and technology.
6. To recognize in an appropriate manner outstanding contributions to the nation by leading engineers.

Article III. Powers

The Academy shall have power:

1. To adopt, alter, and use an official seal.
2. To adopt, amend, and alter bylaws, not inconsistent with these articles of organization, for the regulation of its affairs.
3. To elect additional members.
4. To choose such officers, members of its Council, managers, agents, and employees as the business of the Academy may require.
5. To control and administer any property, real or personal, necessary or proper for attaining the objects and carrying into effect the purposes of the Academy.
6. To make contracts for the performance of services and for the disposition of funds or property which are under its control, in accordance with procedures to be established jointly by the Councils of the National Academy of Engineering and the National Academy of Sciences.
7. To do any other acts and things, not inconsistent with these articles of organization, as may be necessary and proper to carry out the purposes of the Academy.—

provided, however, that the foregoing powers shall not be construed to authorize any act which is inconsistent with section 501(c)(3) of the Internal Revenue Code or comparable statutory tax-exemption provisions, or with the provisions of the Act of Incorporation of the National Academy of Sciences, as amended.

Article IV. Principal Office; Scope of Activities

The principal office of the Academy shall be located in the District of Columbia. The activities of the Academy may be conducted there or elsewhere.

Article V. Membership

A person shall be qualified as a candidate for membership in the Academy if he personally has made identifiable contributions or accomplishments in one or both of the following categories:

1. Important contributions to engineering theory and practice, including significant contributions to the literature of engineering.
2. Demonstration of unusual accomplishments in the pioneering of new and developing fields of technology.

A candidate for membership shall be recognized by his associates and others for his professional integrity, as well as for his engineering accomplishments. Effectiveness and efficiency in leadership of organizations that have conducted pioneering or complex programs or that have made noteworthy contributions to the field of engineering education should be weighed as supplementing the primary qualifications outlined above.

Article VI. Council; Composition; Responsibilities

Section 1. The composition, terms of office, and manner of election of the Council of the Academy shall be established by its bylaws, except that the President of the National Academy of Sciences, by virtue of his office, shall be a member of the Council of the National Academy of Engineering and of its Executive Committee.

Sec. 2. The Council shall be the governing board of the Academy and shall, during intervals between meetings of the members, be responsible for the general policies

and programs of the Academy. The Council shall be responsible for the control of all funds administered by the Academy.

SEC. 3. The Council may authorize the payment of compensation to the officers and staff of the Academy for their services as may from time to time be appropriate. In addition, the Council may authorize reimbursement of the officers, members of the Council and of all committees, and chairmen of sections for traveling and other incidental expenses incurred in carrying on the work of the Academy.

ARTICLE VII. OFFICERS

The officers of the Academy shall be a president, one or more vice presidents, a secretary, a treasurer, and such other officers as may be prescribed in its bylaws.

ARTICLE VIII. COOPERATION BETWEEN THE ACADEMIES

SECTION 1. The Council of the National Academy of Engineering and the Council of the National Academy of Sciences shall each select an equal number of persons to serve as a Joint Board to recommend policies and modes of operation for accomplishing the most effective cooperation between the two Academies and to perform such other functions as may be assigned to it by joint action of the Councils of the two Academies.

SEC. 2. The National Academy of Engineering shall be solely responsible for the content of reports on projects which it undertakes, and such reports may be issued in its own name.

SEC. 3. Prior to the expiration of each term of office of the chairman of the Division of Engineering and Industrial Research* of the National Research Council, the Council of the National Academy of Engineering shall present to the Council of the National Academy of Sciences the name or names of persons whom the Council of the National Academy of Engineering recommends for appointment to the position.

SEC. 4. In dealing with the Congress and in matters involving other countries, the National Academy of Engineering shall work jointly with the National Academy of Sciences.

ARTICLE IX. MINUTES; FINANCIAL RECORDS

SECTION 1. The Academy shall keep minutes of the proceedings of its members, Council, and committees having authority under the Council. It shall also keep books and records of its financial transactions.

SEC. 2. After the close of each fiscal year, the accounts of the Academy shall be audited by independent certified public accountants. A report of such audit shall be made to the Councils of the National Academy of Engineering and the National Academy of Sciences.

ARTICLE X. RESTRICTIONS ON ACTIVITIES

SECTION 1. No part of the income or assets administered by the Academy shall inure to any member or official of the Academy or member of the Council, or be distributable to any such person during the life of the Academy or upon its dissolution or final liquidation. Nothing in this section, however, shall be construed to prevent the payment of reasonable compensation to any such person as authorized in Section 3 of Article VI hereof.

SEC. 2. No substantial part of the activities of the Academy shall consist of carrying on propaganda or otherwise attempting to influence legislation.

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*Now Division of Engineering.

Article XI. Use of Assets on Dissolution or Liquidation

Upon final dissolution or liquidation of the Academy, and after discharge or satisfaction of all the outstanding obligations and liabilities for which it is responsible, the remaining assets in the hands of the Academy shall be distributed in a manner which is consistent with the purposes of the National Academy of Engineering and in accordance with all applicable restrictions and obligations of the National Academy of Sciences. Except as provided in Article XII hereof, such distribution shall be determined by the Council of the National Academy of Sciences.

Article XII. Disposition of Assets Upon Incorporation

Should the Academy be incorporated independently at a later date, all permanent assets under its control (whether by way of endowment or otherwise) shall be transferred to such new corporation, provided that such transfer is not inconsistent with Section 501(c)(3) of the Internal Revenue Code and comparable statutory tax-exemption provisions. The disposition of any funds or property which the Academy is then administering under grants, contracts, and the like shall be determined by agreement between the presidents of the National Academy of Engineering and the National Academy of Sciences.

Article XIII. Amendments

Any proposed amendment to these articles of organization shall be considered by the Council of the Academy and if two thirds of the Council approve the same, it shall be submitted to the Council of the National Academy of Sciences. If the latter approves the proposed amendment, the Council of the National Academy of Engineering shall report thereon to the members of that Academy at their next stated meeting. If the proposition is considered favorably by a majority of the members present, it shall be submitted, by notice given to all members of the Academy not less than thirty days in advance, for final action at their next stated meeting. Members who are unable to attend that meeting may send their votes on the proposed amendment to the secretary, and such votes shall be counted as if the members were present. If the proposed amendment is approved by a majority of the votes cast, it shall be declared adopted.

BYLAWS

Adopted by the Founding Members of the National Academy of Engineering, December 10, 1964, and as amended by the membership of the Academy on March 17, 1965; March 24, 1966; February 20, 1967; April 25, 1968; October 31, 1968; May 2, 1969; April 30, 1970, and May 2, 1974.

Article I. Seal

The seal of the National Academy of Engineering (hereinafter called the "Academy") shall be in the form of a circle and shall have inscribed thereon:

NATIONAL ACADEMY OF ENGINEERING, 1964, OFFICIAL SEAL

Article II. Members Emeriti, and Foreign Associates

Section 1. *Composition.* The Academy shall consist of members, members emeriti, and foreign associates. There shall be no age limit on any of these categories.

SEC. 2. *Members.* The qualifications of candidates for membership in the Academy are stated in Article V of the Articles of Organization. Members must be citizens of the United States.

SEC. 3. *Members Emeriti.* Members having reached the age of seventy who have been on the rolls of the Academy for five years and who wish to be relieved of the status of active membership may, at their own request, be transferred to the roll of members emeriti. A member emeritus shall not be subject to dues or assessments and shall not be eligible to serve as an officer, a member of the Council, or a chairman of a standing committee. A member emeritus shall have all other privileges of a member, including the right to vote on Academy matters and to serve as a member of committees.

SEC. 4. *Foreign Associates.* Candidates for election as foreign associates shall meet the requirements for qualification for membership, but shall be nationals of other countries. Foreign associates shall have the privilege of attending meetings and of reading and communicating papers to the Academy, but shall take no part in its business and shall not be subject to its dues or assessments. A foreign associate of the Academy who becomes a citizen of the United States shall have all the privileges and duties of a member of the Adacemy, including listing in the roster of members, unless he shall request otherwise.

SEC. 5. *Dues.* The amount of the annual membership dues shall be recommended by the Council and fixed by the members and shall be payable by the members within thirty days after commencement of the fiscal year for which they are assessed. In the case of newly elected members, dues shall commence with the fiscal year next following the date of election and shall be payable within thirty days of acceptance of election.

SEC. 6. *Nomination and Election.* Nomination and election of members and foreign associates of the Academy shall be in accordance with procedures developed by the Committee on Membership and approved by the Council. The procedures shall provide for the Council to fix annually the maximum number of new members and new foreign associates to be elected, for nominations to be submitted by members of the Academy to the Committee on Membership, for evaluation of these nominations and subsequent recommendations to the Council by the Committee on Membership, and for presentation of nominees by the Council to the members of the Academy for election.

SEC. 7. *Notification and Acceptance.* Each member-elect or foreign associate-elect shall, immediately following his election, be notified thereof in writing by the secretary. Each person elected to membership must accept the invitation, in writing, before the close of the next stated meeting of the Academy. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

A diploma, with the official seal of the Academy and the signatures of the officers, shall be supplied by the secretary to each member on his acceptance of membership and to foreign associates on their election.

SEC. 8. *Termination.* Resignation from membership shall be addressed to the president and acted on by the Council.

ARTICLE III. MEETINGS OF THE ACADEMY

SECTION 1. *Stated Meetings.* The Academy shall hold one stated meeting, called the annual meeting, in the second quarter of each year in the City of Washington, District of Columbia, and another stated meeting, called the autumn meeting, at a place to be determined by the Council. The Council shall also have the power to fix the date of each meeting. Written notice of the time and place of each meeting shall be given to each member of the Academy not less than thirty days prior thereto.

SEC. 2. *Annual Meeting.* The annual meeting shall consist of business sessions and technical sessions. At the business sessions, the meeting shall receive any reports deemed appropriate by the officers and the Council; shall consider matters referred to it by the Council, and shall transact such other business as may properly come before it. At the technical sessions, the meeting shall receive and discuss communications on engineering subjects.

SEC. 3. *Autumn Meeting.* If matters of business are included by the Council in the call of the autumn meeting, one part of the meeting shall consist of a business session. Otherwise, the autumn meeting shall consist solely of technical sessions.

SEC. 4. *Special Meetings.* The Council may call special meetings of the Academy at such times and places and for such purposes as it may designate in the notice of call. The Council shall give not less than thirty days' written notice of the time, place, and purpose of all special meetings.

SEC. 5. *Voting.* Each member and member emeritus of the Academy shall be entitled to one vote on each matter submitted to a vote at any meeting, but no member whose dues have been in arrears for a period of six months prior to the meeting shall be entitled to vote.

SEC. 6. *Quorum.* Forty members, present in person, shall constitute a quorum at any business session of a stated or special meeting.

ARTICLE IV. FISCAL YEAR

The fiscal year of the Academy shall be from July 1 of each year to June 30 of the year following.

ARTICLE V. COUNCIL

SECTION 1. *Membership; Term.* The Council of the Academy shall consist of the president, vice president, and treasurer of the Academy; the president of the National Academy of Sciences; the vice chairman of the National Research Council; and twelve members of the Academy to be elected by the membership. In addition, the immediate past president of the Academy shall be a member of the Council for a period of one year immediately following the conclusion of his term of office.

The terms of the twelve members of the Council who are elected by the membership shall be arranged on a staggered basis. Thereafter, at each annual meeting, four members of the Academy shall be elected to serve on the Council for a term of three years. The term of each member of the Council shall expire at the close of the annual meeting at which his successor is elected, except that the term of a retiring president of the Academy shall expire one year after his retirement.

SEC. 2. *Vacancies.* Any vacancy on the Council between annual meetings may be filled by the majority of the remaining members of the Council. The person so elected shall serve until the next annual meeting of the Academy, at which time a successor shall be elected, as nearly as possible in accordance with Section 4 of Article VII of these bylaws, to fill the unexpired term.

SEC. 3. *Functions.* Subject to the provisions of the Articles of Organization of the Academy and these bylaws, the Council shall have paramount authority with respect to the funds, activities, policies, and purposes of the Academy. The Council shall have power to adopt the annual general budget of the Academy and to appoint and fix the salaries of the personnel who may be deemed necessary for the conduct of its affairs.

SEC. 4. *Meetings.* The Council shall meet immediately following the annual meeting of the Academy, and notice of such meeting shall not be required. The Council shall also meet at least three other times per year with the time and place of each meeting set forth in a written notice to all members of the Council at least ten days prior to the date of each meeting.

In addition, the Council shall hold such special meetings as the president or three members of the Council, by written request to the president, may call, at such time and place and for such purpose as is designated by the president or by those members who have called the meeting. The president shall give to all members of the Council not less than five days' written or three days' telegraphic notice of the time, place, and purpose of each special meeting.

Eight members of the Council shall constitute a quorum at all meetings thereof.

SEC. 5. *Executive Committee.* There shall be an Executive Committee of the Council, consisting of the president, vice president, and treasurer of the Academy; the president of the National Academy of Sciences; and four members appointed annually by, and from, the Council of the Academy. The president of the Academy shall be the chairman of the Executive Committee and the secretary of the Academy shall act as secretary of the Committee. Four members of the Committee shall constitute a quorum at all meetings thereof.

During intervals between meetings of the Council, the Executive Committee may exercise all the powers of the Council except that the Committee may not fill vacancies on the Council or among the officers of the Academy, exercise the powers of the Council with respect to nominations to membership in the Academy, or do any other acts that are expressly prohibited to the Committee by the Council.

The Executive Committee may, in the discretion of the president of the Academy, conduct any of its affairs by mail, telephonic, or telegraphic vote of all the members of such Committee, provided that any question so decided shall have been transmitted to every member of the Committee in the same wording. An affirmative vote of a majority of the Councillors shall be necessary for action, and all members of the Committee shall be appraised of the vote before the result of the poll on questions so submitted is recorded by the chairman.

The Executive Committee shall hold such meetings as the chairman or any three members of the Committee may by written request call, at such time and place and for such purposes as are designated by the chairman or by the three members who have called the meeting. The chairman shall give to every member of the Committee not less than five days' written or three days' telegraphic notice of the time, place, and purpose of each meeting of the Committee.

The Executive Committee shall keep regular minutes and shall report on its proceedings to the Council.

ARTICLE VI. OFFICERS

SECTION 1. *General.* The officers of the Academy shall be a president and a vice president, who shall be members of the Council, and such other officers, including a secretary and a treasurer (who need not be Academy members), as the Council from time to time may determine.

SEC. 2. *Election; Term.* The president, vice president, secretary, and treasurer shall be elected for a term of four years commencing with the close of the annual meeting at which their election is announced and ending with the close of the annual meeting at which the election of their successors is announced. The aforesaid officers shall be elected as specified in Section 4 of Article VII of these bylaws. In case of a vacancy the election shall be held as nearly as possible in the same manner prior to the next business meeting of the Academy and shall be for the unexpired term, except that a vacancy in the office of the treasurer or secretary may be filled by appointment of the president until the next business session of the Academy.

The president, vice president, secretary, and treasurer shall be elected for a term of four years commencing with the close of the annual meeting at which their election is announced and ending with the close of the annual meeting at which the election of their successors is announced. Any other offices created by the Council shall be filled by appointment of the Council, for such terms as the Council may determine.

SEC. 3. *Duties of Officers.*

(*a*) *President.* The president shall be the chief executive officer of the Academy and, with the Council, shall direct the general business of the Academy. He shall preside at all meetings of the Academy and the Council. He shall submit a report each year of the activities of the Academy to the Council at its regular meeting next preceding the annual meeting and to the Academy at its annual meeting. He shall be ex officio a member of all standing committees, in addition to those committee members specified in Article VII of these bylaws. In general, he shall have all the powers and duties of supervision and management usually vested in the office of the president of any institution of this character.

(*b*) *Vice President.* The vice president shall be vested with all the powers and required to perform all the duties of the president in his absence or during his disability and shall perform such other duties as may be prescribed by the Council. He shall be ex officio a member of all standing committees in addition to those committee members specified in Article VII of these bylaws.

(*c*) *Secretary.* The secretary shall attend all meetings of the Academy and all meetings of the Council and the standing committees. He shall record all the proceedings of such sessions and meetings in a book or books kept for that purpose and, after approval by the Council, shall enter the minutes of business and technical meetings of the Academy in its permanent records.

He shall conduct and be responsible for the correspondence of the Academy, as directed by the Council and the president.

He shall acknowledge receipt of all contributions made to the Academy, shall keep records thereof, and shall report them promptly to the Council for its consideration. He shall keep a record of all grants of money and awards of prizes made by the Academy, in the form prescribed by the president and Council.

He shall give proper notice of all meetings of the Academy and the Council and of all nominations for officers, membership in the Council, and membership in the Academy.

He shall have custody of the seal of the Academy and shall affix it to all documents as authorized by the Council or the president.

(*d*) *Treasurer.* The treasurer shall be responsible for all receipts and disbursements of the Academy; shall ensure that full and accurate accounts thereof are kept; and shall be responsible for the deposit, in such institutions as may be designated by the Council, of all monies, securities, and other valuable effects that are under the administration or control of the Academy. In fulfilling the foregoing responsibilities, he may use the services of the staff of the Academy or he may arrange for use of the services of the National Academy of Sciences. He shall give such bond as the Council may require.

He shall ensure that dues, assessments, and subscriptions are collected from the members and that appropriate records thereof are kept. He shall disburse the funds of the Academy as may be ordered by the Council or the president and shall render to the Council or the president, whenever it may be required, an account of all his transactions as treasurer.

Not later than the first day of December of each year, the treasurer shall prepare and submit to the Council a full report of the financial affairs of the Academy for the preceding fiscal year, including all receipts and disbursements. He shall also prepare and present to the Council at least sixty days prior to the annual meeting and to the Academy at its annual meeting a financial statement for that part of the current fiscal year ending on December 31.

SEC. 4. *Delegation of Duties of Officers.* In case of the absence or disability of any officer of the Academy or for any reason deemed sufficient by the Council, the powers or duties, or both, of such officer may be delegated by the Council to any other officer or member of the Council.

Article VII. Committees

Section. 1. *Finance Committee.* There shall be a Finance Committee consisting of the treasurer, the president of the National Academy of Sciences, and not more than six members of the Academy appointed annually by the president. The treasurer of the Academy shall be chairman of the Finance Committee. The Committee shall prepare and present to the Council the annual general budget of the Academy and shall determine matters relating to the purchase and sale of securities or other investments that are under the administration or control of the Academy. The Committee shall have the power, subject to the approval of the Council, to employ competent investment counsel to advise the Committee.

Sec. 2. *Auditing Committee.* At each annual meeting of the Academy the president shall appoint an Auditing Committee consisting of three members, one of whom shall be named by the president as chairman of the Committee. The Committee shall arrange for an audit, by independent certified public accountants, of the accounts of the Academy for the current fiscal year and shall present the report of audit to the Academy at the next annual meeting, together with such comments and recommendations as the Committee may deem appropriate. The Committee may cause to be made any other examinations of the financial records, the accounting records, and system of internal control of the Academy that, in its judgment, are necessary for the determination of the adequacy and accuracy of the accounts of the Academy.

Sec. 3. *Committee on Membership.* There shall be a Committee on Membership, composed of not less than sixteen nor more than thirty members appointed by the Council, after taking into account the various branches of engineering represented in the Academy. The Council shall annually name the chairman and vice chairman of the Committee. The vice chairman shall, under normal circumstances, succeed to a one-year term as chairman.

The members of the Committee shall be appointed for terms of three years, each of which, as nearly as possible, shall be on a staggered basis. The functions of the Committee shall be to analyze the membership structures of the Academy, to originate nominations, and to appraise nominations received from the members.

Sec. 4. *Nominating Committee.* The president, with the approval of the Council shall annually appoint a Nominating Committee composed of five members, one of whom shall be a member of the Council and one of whom shall be named as chairman, to prepare nominations to fill any vacancies that will occur in that year in the Council or among the officers of the Academy. There shall be complete rotation of the members of the Committee each year, except that the chairman of the Committee in any given year shall automatically become a member (but not the chairman) of the Committee for the following year; and no member of the Committee may serve again until three years after his term has expired.

Not less than ninety days prior to the opening of the annual meeting in each year, any group of not less than forty members of the Academy may, by written petition presented directly to the Council, suggest the name of a person to be nominated to any given post. Any such petition shall be referred by the secretary to the Nominating Committee for its comments. Not less than sixty days prior to the opening of the annual meeting, the Nominating Committee shall report to the Council the Committee's list of nominations, together with its comments on any suggestions made by petition. Not less than forty-five days prior to the opening of the annual meeting, the Council, after considering the Committee's report and any suggestions made by petition, shall nominate one person for each post to be filled. The secretary shall promptly submit this list of nominations to the members of the Academy for voting by

unsigned, confidential mail ballots, each such ballot to contain a provision for write-in votes. The elections shall be determined by the ballots received not less than fourteen days prior to the opening of the annual meeting. After expiration of the time specified for receiving the ballots, the secretary shall open the ballots and tabulate the results, which shall be announced at the annual meeting.

SEC. 5. *Project Committee.* There shall be a Project Committee composed of not less than ten nor more than twenty members appointed by the president, which shall recommend the initiation of studies and organization of symposia and conferences by the Academy, shall review requests for studies and investigations and recommend to the Council suitable action on each, and shall perform such other duties in connection with the programs of the Academy as the Council may direct. The members of the Committee shall be appointed for terms of three years, each of which, as nearly as possible, shall be on a staggered basis.

SEC. 6. *Other Committees.* The Council or the president may appoint such other committees, composed of members of the Academy or nonmembers, or both, as shall be deemed appropriate to carry out the purposes of the Academy and shall define the function and authority of each committee, within the limitation of this Article VII.

SEC. 7. *General.* Except as otherwise provided in these bylaws, any committee may, in the discretion of its chairman, conduct any of its affairs by mail, telephonic, or telegraphic vote of all the members of such committee, provided that any question so decided shall first have been transmitted to every member of the committee in the same wording. An affirmative vote of a majority of the committee shall be necessary for action, and all members of the committee shall be apprised of the vote before the chairman of the committee records the result of the poll on the question so submitted.

A majority of the members of a committee shall constitute a quorum at all meetings thereof.

ARTICLE VIII. REPORTS AND PUBLICATIONS

SECTION 1. *Annual Report.* After the close of each fiscal year, the secretary shall prepare an annual report containing a record of the activities of the Academy during that fiscal year, including a copy of the treasurer's report. After approval by the Council, this report shall be transmitted to the president of the National Academy of Sciences and shall be transmitted to the members of the National Academy of Engineering at the annual meeting next following.

SEC. 2. *Other Reports and Publications.* The Academy may arrange for the issuance of such other reports and publications as may be desirable.

ARTICLE IX. AMENDMENTS

Amendments to these bylaws may be made only by the members of the Academy by action taken at any stated or special meeting by a majority of the votes cast, provided that the amendment has been proposed by resolution adopted at a previous meeting of the Academy, by resolution adopted by the Council, or by written proposal signed by forty members of the Academy; and provided also that notice of the proposed amendment has been sent to all members of the Academy not less than thirty days prior to the meeting at which the amendment is presented for action.

ARTICLE X. PARLIAMENTARY PROCEDURE

The rules contained in *Robert's Rules of Order* shall govern the Academy in all cases to which they are applicable and in which they are not inconsistent with the bylaws or the special rules of order of this Academy.

ORGANIZATION OF THE ACADEMY

July 1, 1973—June 30, 1974

Officers

	Terms Expire		Terms Expire
President: Robert C. Seamans, Jr.	(1974)	Robert C. Seamans, Jr.	(1978)
Vice President: Chauncey Starr	(1974)	William E. Shoupp	(1978)
Treasurer: Thomas C. Kavanagh	(1974)	Edward N. Cole	(1978)
Secretary: J. H. Mulligan, Jr.	(1974)	J. H. Mulligan, Jr.	(1978)

Council

William C. Ackermann (1975)
Robert W. Cairns (1974)
Paul F. Chenea (1975)
W. Kenneth Davis (1975)*
John H. Dessauer (1976)*
Donald N. Frey (1974)
Frederic A. L. Holloway (1976)*
Ralph Landau (1976)
W. Deming Lewis (1975)*
Clarence H. Linder (1974)**
J. Ross Macdonald (1974)
Kenneth G. McKay (1974)
Joseph M. Pettit (1976)
Robert C. Seamans, Jr., *ex officio* (1974)*
Chauncey Starr, *ex officio* (1974)*
Thomas C. Kavanagh, *ex officio* (1974)*
Philip Handler, *ex officio* (1975)* #

(All member terms expire at end of Annual Meeting of year indicated.)

Members elected at the 1974 Annual Meeting: Arthur E. Bryson, Jr. (1977)*, Edward L. Ginzton (1977), Robert C. Gunness (1977), Morris Tanenbaum (1977), Robert C. Seamans, Jr., *ex officio* (1978), William E. Shoupp, *ex officio* (1978), and Edward N. Cole, *ex officio* (1978).

MEMBERS OF THE ACADEMY

Ackermann, William C. (1967), Chief, Illinois State Water Survey, P.O. Box 232, Urbana, Illinois 61801

Adcock, Willis A. (1974), Technical Director, Solid-State Products Group, Texas Instruments Inc., P.O. Box 5012, Dallas, Texas 75222

Adler, Robert (1967), Vice President and Director of Research, Zenith Radio Corp., 6001 West Dickens Avenue, Chicago, Illinois 60639

Agnew, William G. (1974), Technical Director, General Motors Research Laboratories, 12 Mile and Mound Roads, Warren, Michigan 48090

Allen, H. Julian (1966), (Retired Director, Ames Research Center, NASA), 769 Melville Avenue, Palo Alto, California 94301

Alvarez, Luis W. (1969), Professor of Physics, Lawrence Berkeley Laboratory, The University of California, Berkeley, California 94720

Amdahl, Gene M. (1967), President and Chairman of the Board of Directors, Amdahl Corp., 1160 Kern Avenue, Sunnyvale, California 94086

Amundson, Neal R. (1970), Regents' Professor of Chemical Engineering and Head, Department of Chemical Engineering and Materials Science, The University of Minnesota, Minneapolis, Minnesota 55455

Arnold, Philip M. (1970), Vice President, Phillips Petroleum Company, 332 Frank Phillips Building, Bartlesville, Oklahoma 74004

*Member of the Executive Committee of the Council.
**Honorary member of the Council.
#Not a member of the Academy of Engineering.

Arnold, William Howard, Jr. (1974), General Manager, Pressurized Water Reactor Systems Division, Westinghouse Electric Corporation, Nuclear Center, Box 355, Pittsburgh, Pennsylvania 15230

Ashley, Holt (1970), Professor, Department of Aeronautics /Astronautics, Stanford University, Durand Building, Room 369, Stanford, California 94305

Atwood, J. Leland (1974), (Retired President and Chief Executive, Rockwell International Corp.), P.O. Box 90343, Airport Station, Los Angeles, California 90009

Auerbach, Isaac L. (1974), President, Auerbach Corp. for Science and Technology, 121 North Broad Street, Philadelphia, Pennsylvania 19107

Austin, James B. (1967), (Retired Administrative Vice-President, United States Steel Corp.), 114 Buckingham Road, Pittsburgh, Pennsylvania 15215

Avila, Charles F. (1968), (Director and Retired Chairman of the Board, Boston Edison Company), 272 Atlantic Avenue, Swampscott, Massachusetts 01907

Babb, Albert L. (1972), Professor and Chairman, Department of Nuclear Engineering, Professor of Chemical Engineering, The University of Washington, 303 Benson Hall, BF–10, Seattle, Washington 98195

Bachman, Walter C. (1967), (Retired Vice President and Chief Engineer, Gibbs and Cox, Inc.), Wayside, Short Hills, New Jersey 07078

Bacon, Vinton W. (1969), Professor of Civil Engineering, The University of Wisconsin—Milwaukee, 3200 North Cramer Street, EMS Building, Room E 332, Milwaukee, Wisconsin 53201

Bailey, Stuart L. (1973), Consultant, Atlantic Research Corporation, 5390 Cherokee Avenue, Alexandria, Virginia 22314

Bainer, Roy (1965), Dean Emeritus, College of Engineering, The University of California, Bainer Hall, Room 3030, Davis, California 95616

Baird, Jack A. (1971), Vice President, American Telephone and Telegraph Company, 195 Broadway, Room 2639, New York, New York 10007

Baker, Robert A., Sr. (1967), Executive Vice President, Public Service Electric and Gas Company, 80 Park Place, Newark, New Jersey 07101

Ballhaus, William F. (1973), President, Beckman Instruments, Inc., 2500 Harbor Boulevard, Fullerton, California 92634

Banks, Harvey O. (1973), President, Harvey O. Banks, Consulting Engineer, Inc., 3 Kittie Lane, Belmont, California 94002

Bardeen, John (1972), Professor of Electrical Engineering and Physics, Department of Physics, The University of Illinois—Urbana, Urbana, Illinois 61801

Barlow, Edward J. (1968), President, Instrument Group, Varian Associates, 611 Hansen Way, Palo Alto, California 94303

Barnes, Howard C. (1974), Assistant Vice President and Director of UHV Research, American Electric Power Service Corp., 2 Broadway, New York, New York 10004

Barr, Harry F. (1965), (Retired Vice President, Engineering Staff, General Motors Corp.), 25620 Meadowdale Lane, Franklin, Michigan 48025

Barrow, Thomas D. (1974), Director and Senior Vice President, Exxon Corp., 1251 Avenue of the Americas, New York, New York 10020

Baruch, Jordan J. (1974), Lecturer on Business Administration, Faculty Member, Harvard University, Graduate School of Business Administration, Morgan Hall, Room 4, Boston, Massachusetts 02163

Battin, Richard H. (1974), Associate Department Head, Charles Stark Draper Laboratory, Inc., 75 Cambridge Parkway, Cambridge, Massachusetts 02142

Bauer, Benjamin B. (1974), Vice President, CBS Laboratories, 227 High Ridge Road, Stamford, Connecticut 06905

Bauer, Robert F. (1969), Chairman of the Board, Global Marine Inc., 811 West Seventh Street, Los Angeles, California 90017

Baxter, Samuel S. (1970), Consulting Engineer, 7048 Castor Avenue, Philadelphia, Pennsylvania 19149

Beckman, Arnold O. (1967), Chairman of the Board, Beckman Instruments, Inc., 2500 Harbor Boulevard, Fullerton, California 92634

Beedle, Lynn S. (1972), Professor of Civil Engineering and Director, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pennsylvania 18015

Bell, Milo C. (1968), Professor, College of Fisheries, The University of Washington, Seattle, Washington 98195

Bellport, Bernard P. (1970), (Retired Chief Engineer, Bureau of Reclamation, U.S. Department of the Interior), Engineering Consultant, 1900 Zinnia Street, Golden, Colorado 80401

Benedict, Manson (1967), Institute Professor, Emeritus, Massachusetts Institute of Technology, Room 24–109, Cambridge, Massachusetts 02139

Beranek, Leo L. (1966), President, Boston Broadcasters, Inc., 5 TV Place, Needham, Massachusetts 02192

Bergen, William B. (1974) President, North American Space Group, Rockwell International Corp., 1700 East Imperial Highway, El Segundo, California 90245

Berry, Donald S. (1966), Murphy Professor of Civil Engineering, Northwestern University, Evanston, Illinois 60201

Biot, Maurice A. (1967), Consultant, Avenue Paul Hymans 117, B–1200, Brussels, Belgium

Bird, R. Byron (1969), Vilas Research Professor of Chemical Engineering, The University of Wisconsin—Madison, 1415 Johnson Drive, Madison, Wisconsin 53706

Bisplinghoff, Raymond L. (1965), Deputy Director, National Science Foundation, 1800 G Street, N.W., Room 520, Washington, D.C. 20550

Bitzer Donald L. (1974), Professor of Electrical Engineering, The University of Illinois—Urbana, Urbana, Illinois 61801

Blasingame, Benjamin P. (1971), Manager, Santa Barbara Operations, Delco Electronics Division, General Motors Corp., 6767 Hollister Avenue, Goleta, California 93017

Blume, John A. (1969), President, URS/John A. Blume and Associates, Engineers, Sheraton-Palace Hotel, 130 Jessie Street, San Francisco, California 94105

Bode, Hendrik W. (1964), Professor, Harvard University, Pierce Hall, Room 321, Cambridge, Massachusetts 02138

Boundy, Ray H. (1967), (Retired Vice President and Director of Research, The Dow Chemical Company), 906 West Sugnet Road, Midland, Michigan 48640

Bowhill, Sidney A. (1971), Professor of Electrical Engineering, The University of Illinois—Urbana, Urbana, Illinois 61801

Bowman, Robert A. (1970), (Retired Senior Vice President and Director, Bechtel Corp.), Route 6, Box 326, Rogers, Arkansas 72756

Boyd, James (1967), President, Materials Associates, Apartment 1404, 700 New Hampshire Avenue, N.W., Washington, D.C. 20037

Boyle, Willard S. (1974), Executive Director, Pennsylvania Laboratories, Bell Laboratories, 555 Union Boulevard, Allentown, Pennsylvania 18103

Branscomb, Lewis M. (1974), IBM Vice President and Chief Scientist, IBM Corp., Old Orchard Road, Armonk, New York 10504

Bromberg, Robert (1969), Vice President, Research and Engineering, TRW Systems Group, One Space Park, Building E–1, Room 5075, Redondo Beach, California 90278

Brooks, Harvey (1968), Dean of Engineering and Applied Physics, Gordon McKay Professor of Applied Physics, Harvard University, 217 Pierce Hall, Cambridge, Massachusetts 02138

Brooks, Norman H. (1973), Professor of Environmental Science and Civil Engineering, and Academic Officer for EES, W. M. Keck Laboratories, California Institute of Technology, Pasadena, California 91109

Brown, Burton P. (1973), Systems Consultant, General Electric Company, P.O. Box 1122–CSP 9–48, Syracuse, New York 13201

Brown, George H. (1965), (Retired Executive Vice President, Patents and Licensing, RCA Corp.), 117 Hunt Drive, Princeton, New Jersey 08540

Brown, Gordon S. (1965), Institute Professor, Emeritus, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 4–234, Cambridge, Massachusetts 02139

Brown, Harold (1967), President, California Institute of Technology, Room 340–32, Pasadena, California 91109

Brumer, Milton (1969), Senior Partner of Ammann and Whitney, Consulting Engineers, 111 Eighth Avenue, Room 800, New York, New York 10011

Bryson, Arthur E., Jr., (1970), Paul Pigott Professor of Engineering and Chairman, Department of Aeronautics and Astronautics, Stanford University, Durand Building, Stanford, California 94305

Buchsbaum, Solomon J. (1973), Executive Director, Research, Communications Sciences Division, Bell Laboratories, Crawford Corner Road, Holmdel, New Jersey 07733

Bucy, J. Fred, Jr. (1974), Executive Vice President, Texas Instruments Inc., P.O. Box 5484, MS #284, Dallas, Texas 75222

Bueche, Arthur M. (1974), Vice President—Research and Development, General Electric Company, P.O. Box 8, Schenectady, New York 12301

Burnham, D. C. (1968), Chairman, Westinghouse Electric Corporation, Westinghouse Building, Gateway Center, Pittsburg, Pennsylvania 15222

Burriss, Stanley W. (1968), Vice President, Lockheed Aircraft Corp., P.O. Box 504, Sunnyvale, California 94088

Busemann, Adolf (1970), Professor Emeritus of Fluid Mechanics, Department of Aerospace Engineering Sciences, The University of Colorado, Engineering Center, Boulder, Colorado 80302

Bush, Spencer H. (1970), Senior Staff Consultant, Battelle Northwest Laboratories, P.O. Box 999, Richland, Washington 99352

Busignies, Henri (1966), Senior Vice President and Chief Scientist, International Telephone and Telegraph Corp., 320 Park Avenue, New York, New York 10022

Cairns, Robert W. (1969), Executive Director, American Chemical Society, 1155 16th Street, N.W., Washington, D.C. 20036

Caldwell, Joseph M. (1973), Retired Chief, Engineering Division, Directorate of Civil Works, Office of the Chief of Army Engineers), 2732 North Kensington Street, Arlington, Virginia 22207

Cannon, Robert H., Jr. (1973), Assistant Secretary of Transportation for Systems Development and Technology, U.S. Department of Transportation, 400 7th Street, S.W., Room 10414, Washington, D.C. 20590

Caplan, John D. (1973), Executive Director, Research Laboratories, General Motors Corp., 12 Mile and Mound Roads, Warren, Michigan 48090

Carlson, Roy W. (1974), Consultant, 55 Maryland Avenue, Berkeley, California 94707

Carrier, George F. (1974), T. Jefferson Coolidge Professor of Applied Mathematics, Harvard University, Cambridge, Massachusetts 02138

Casagrande, Arthur (1966), Professor of Soil Mechanics and Foundation Engineering, Emeritus, Harvard University, Pierce Hall, Cambridge, Massachusetts 02138

Casagrande, Leo (1974), Consulting Engineer, Casagrande Consultants, 40 Massachusetts Avenue, Arlington, Massachusetts 02174

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Cassidy, William F. (Retired, USA), (1967), (Retired, Corps of Engineers, United States Army), 1848 River Shore Drive, Indialantic, Florida 32903

Cermak, Jack E. (1973), Professor-in-Charge, Fluid Mechanics Program, Department of Civil Engineering, Colorado State University, Fort Collins, Colorado 80521

Chadwick, Wallace L. (1965), (Formerly Vice President, Southern California Edison Company), Consulting Engineer, 904 Pacific Mutual Building, 523 West Sixth Street, Los Angeles, California 90014

Chambers, Carl C. (1970), University Professor of Engineering, The University of Pennsylvania, 220 South 33rd Street, Philadelphia, Pennsylvania 19174

Charyk, Joseph V. (1973), President, Communications Satellite Corp., 950 L'Enfant Plaza, S.W., Washington, D.C. 20024

Chenea, Paul F. (1969) Vice President, Research Laboratories, General Motors Corp., 12 Mile and Mound Roads, Warren, Michigan 48090

Chesebrough, Harry E. (1967), (Retired Vice President, Chrysler, Corp.), 471 Dunston Road, Bloomfield Hills, Michigan 48013

Chestnut, Harold (1974), Consultant, Systems Engineering, Corporate Research and Development, General Electric Company, Building 37–577, One River Road, Schenectady, New York 12345

Chodorow, Marvin (1967), Director, Microwave Laboratory, Stanford University, Stanford, California 94305

Chow, Ven Te (1973), Professor of Hydraulic Engineering, Hydrosystems Laboratory, The University of Illinois at Urbana-Champaign, Urbana, Illinois 61801

Churchill, Stuart W. (1974), Carl V. S. Patterson Professor, School of Chemical and Biochemical Engineering, The University of Pennsylvania, 211 A. Towne Building, D3, Room 392, Philadelphia, Pennsylvania 19174

Cisler, Walker L. (1964), Chairman of the Board, The Detroit Edison Company, 2000 Second Avenue, Detroit, Michigan 48226

Clarke, Frederick J. (U.S.A.), (1973), 4801 Upton Street, N.W., Washington, D.C. 20016

Clauser, Francis H. (1970), Chairman, Division of Engineering and Applied Science, California Institute of Technology, 102 Thomas Laboratory, Pasadena, California 91109

Cleary, Edward J. (1967), Consulting Engineer and Professor, Department of Environmental Health, The University of Cincinnati, 421 Bond Place, Cincinnati, Ohio 45206

Clough, Ray W. (1968), Professor of Civil Engineering, The University of California, Davis Hall, Room 775, Berkeley, California 94720

Cohen, Karl P. (1967), Chief Scientist—Nuclear Energy Division, General Electric Company, 175 Curtner Avenue, San Jose, California 95125

Cohen, Morris (1972), Ford Professor of Materials Science and Engineering, Massachusetts Institute of Technology, Room 13–5046, Cambridge, Massachusetts 02139

Cohn, Nathan (1969), (Retired Executive Vice President, Leeds and Northrup Company), Consulting Engineer, 1457 Noble Road, Jenkintown, Pennsylvania 19046

Cole, Edward N. (1970), President, General Motors Corporation, 3044 West Grand Boulevard, Detroit, Michigan 48202

Collins, Arthur A. (1968), President, Arthur A. Collins Inc., Suite 509W, 13601 Preston Road, Dallas, Texas 75240

Cortright, Edgar M. (1973), Director, Langley Research Center, NASA, Mail Stop 106, Hampton, Virginia 23665

Craven, John P. (1970), Dean of Marine Programs, The University of Hawaii, 2540 Dole Street, Honolulu, Hawaii 96822

Cross, Ralph E. (1968), President, The Cross Company, Fraser, Michigan 48026

Culler, Floyd L., Jr. (1974), Deputy Director, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37830

Cullum, A. Earl, Jr. (1970), Managing Partner, A. Earl Cullum, Jr. and Associates—Consulting Engineers, Inwood Post Office, P.O. Box 7004, Dallas, Texas 75209

Currie, Malcolm R. (1971), Director of Defense Research and Engineering, OSD—Office of the Secretary of Defense, The Pentagon, Room 3E1006, Washington, D.C. 20301

Cutler, C. Chapin (1970), Director, Electronic and Computer Systems Research Laboratory, Bell Laboratories, Room 4C502, Crawford Corner Road, Holmdel, New Jersey 07733

Dacey, George C. (1973), Vice President, Transmission Systems, Bell Laboratories, Crawford Corner Road, Holmdel, New Jersey 07733

Davenport, Lee L. (1973), President, GTE Laboratories Inc., 1 Stamford Forum, Stamford, Connecticut 06904

David, Edward E., Jr. (1966), Executive Vice President—Research, Development and Planning, Gould Inc., 8550 West Bryn Mawr Avenue, Chicago, Illinois 60631

Davis, Frank W. (1967), President, Convair Aerospace Division of General Dynamics Corp., P.O. Box 748, Fort Worth, Texas 76101

Davis, Harmer E. (1967), Director Emeritus, I.T.T.E. and Professor Emeritus, Civil Engineering, The University of California, 109 McLaughlin Hill, Berkeley, California 94720

Davis, W. Kenneth (1970), Vice President, Bechtel Power Corp., P.O. Box 3965, 50 Beale Street, Room 11/B–12, San Francisco, California 94119

Deere, Don U. (1967), Consultant, Engineering Geology and Rock Mechanics, Bivens Lake Estates, 2522 S.W. 14th Drive, Gainesville, Florida 32608

DeLauer, Richard D. (1969), Executive Vice President, TRW Inc., One Space Park, Redondo Beach, California 90278

Dessauer, John H. (1967), (Retired Executive Vice President, Research and Engineering, and Director, Xerox Corp.), P.O. Box 373, 57 Monroe Avenue, Pittsford, New York 14534

Dickieson, Alton C. (1970), (Retired Vice President—Transmission Systems Development, Bell Telephone Laboratories, Inc.), Consultant, P.O. Box 1243, Sedona, Arizona 86336

Donovan, Allen F. (1969), Senior Vice President, Technical Aerospace Corp., P.O. Box 92957, Los Angeles, California 90009

Douglas, Donald W. (1967), (Retired, Founder, Douglas Aircraft Company), 4 Crest Road East, Rolling Hills, California 90274

Douglas, Walter S. (1967), Senior Partner, Parsons, Brinckerhoff, Quade and Douglas, One Penn Plaza, 250 34th Street, New York, New York 10001

Douma, Jacob H. (1971), Chief, Hydraulic Design Branch Office, Chief of Engineers, U.S. Department of the Army, 1000 Independence Avenue, S.W., Room 5–G–073, Washington, D.C. 20314

Drake, Robert M., Jr. (1974), Corporate Vice President, Research and Development, Combustion Engineering, Inc., 900 Long Ridge Road, Stamford, Connecticut 06902

Draper, Charles S. (1965), Senior Scientist, Charles Stark Draper Laboratory, Inc., 68 Albany Street, Cambridge, Massachusetts 02139

Dresselhaus, Mildred S. (1974), Abby Rockefeller Mauze Professor of Electrical Engineering, Massachusetts Institute of Technology, Room 13–3005, Cambridge, Massachusetts 02139

Drucker, Daniel C. (1967), Dean, College of Engineering, The University of Illinois—Urbana, 106 Engineering Hall, Urbana, Illinois 61801

Eckert, Ernst R. G. (1970), Regents' Professor, Emeritus, Associate to the Dean, Institute of Technology, 125 Mechanical Engineering Building, The University of Minnesota, Minneapolis, Minnesota 55455

Eckert, J. Presper (1967), Vice President, UNIVAC, Division of Sperry-Rand Corp., P.O. Box 500, Blue Bell, Pennsylvania 19422

Edgerton, Harold E. (1966), Institute Professor, Emeritus, Massachusetts Institute of Technology, Room 4–405, Cambridge, Massachusetts 02139

Eggers, Alfred J., Jr. (1972), Assistant Director for Research Applications, National Science Foundation, 1800 G Street, N.W., Room 504, Washington D.C. 20550

Eisenberg, Phillip (1974), President HYDRONAUTICS, Inc., 7210 Pindell School Road, Laurel, Maryland 20810

Eliassen, Rolf (1971), Chairman of the Board, Metcalf and Eddy, Inc., 1029 Corporation Way, Palo Alto, California 94305

Elmendorf, Charles H., III (1971), Assistant Vice President—Engineering, American Telephone and Telegraph Company, 195 Broadway, Room 2320, New York, New York 10007

Elms, James C. (1974), Director, Transportation Systems Center, U.S. Department of Transportation, Kendall Square, Cambridge, Massachusetts 02142

Elston, Charles W. (1967), Manager—Operational Planning, Steam Turbine—Generator Division, General Electric Company, 1 River Road, Schenectady, New York 12345

Emmons, Howard W. (1965), Division of Engineering and Applied Physics, Harvard University, 29 Oxford Street, Pierce Hall 308, Cambridge, Massachusetts 02138

Engstrom, Elmer W. (1964), (Retired President and Chief Executive Officer, RCA Corp.), 75 B Amherst Lane, Rossmoor, Jamesburg, New Jersey 08831

Evans, Bob O. (1970), IBM Vice President and President, System Development Division, IBM Corporation, 1000 Westchester Avenue, White Plains, New York 10604

Everett, James L., III (1974), President, Philadelphia Electric Company, 2301 Market Street, Philadelphia, Pennsylvania 19101

Everitt, William L. (1964), Dean Emeritus of Engineering, The University of Illinois at Urbana-Champaign, 106 Engineering Hall, Urbana, Illinois 61801

Faget, Maxime A. (1970), Director of Engineering and Development, Lyndon B. Johnson Space Center, NASA, Houston, Texas 77058

Fair, James R., Jr. (1974), Engineering Director, Corporate Engineering Department, Monsanto Company, 800 North Lindbergh Boulevard, St. Louis, Missouri 63166

Fano, Robert M. (1973), Ford Professor of Engineering, Department of Electrical Engineering, Massachusetts Institute of Technology, 545 Technology Square, Room 513, Cambridge, Massachusetts 02139

Felker, Jean Howard (1974), Vice President, Business Information Systems Programs, Bell Laboratories, Room 4A1008, P.O. Box 2020, New Brunswick, New Jersey 08903

Ference, Michael, Jr. (1971), (Retired Vice President—Research, Ford Motor Company), Riverside Park Place, 1050 Wall Street, Ann Arbor, Michigan 48105

Ferguson, Phil M. (1973), Professor of Civil Engineering, The University of Texas at Austin, 3102 Beverly Road, Austin, Texas 78703

Ferri, Antonio (1967), Executive Director, Center for Interdisciplinary Programs and Astor Professor of Aerospace Sciences, Aerospace Laboratory, West 177th Street and Harlem River, Bronx, New York 10453

Fetters, Karl L. (1965), (Retired Vice President—Research, Youngstown Sheet and Tube Company), 2 Oak Drive, Poland, Ohio 44514

Field, A. J. (1974), President, Global Marine Inc., 811 West Seventh Street, Los Angeles, California 90017

Field, Lester M. (1967), Vice President and Chief Scientist, Hughes Aircraft Company, 3011 Malibu Canyon Road, Building 250, Malibu, California 90265

Fine, Morris E. (1973), Associate Dean for Graduate Study and Research, and Walter P. Murphy Professor of Materials Science, Technological Institute, Northwestern University, Evanston, Illinois 60201

Fink, Daniel J. (1974), Vice President and General Manager, Space Division, General Electric Company, Valley Forge Space Center, P.O. Box 8555, Philadelphia, Pennsylvania 19101

Fink, Donald G. (1969), Executive Director and General Manager, The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, New York 10017

Fisher, Harold W. (1969), (Retired Vice President and Director, Exxon Corp.), P.O. Box 1792, Duxbury, Massachusetts 02332

Fisk, James B. (1966), Retired President, Bell Laboratories, Mountain Avenue, 3B–405, Murray Hill, New Jersey 07974

Flawn, Peter T. (1974), President, The University of Texas—San Antonio, San Jacinto Building, Room 225, San Antonio, Texas 78284

Flax, Alexander H. (1967), President, Institute for Defense Analyses, 400 Army-Navy Drive, Arlington, Virginia 22202

Fletcher, James C. (1970), Administrator, NASA, 400 Maryland Avenue, S.W., Room 7137, Washington, D.C. 20546

Folsom, Richard G. (1965), (President Emeritus, Rensselaer Polytechnic Institute), 585 Oakville Crossroad, Napa, California 94558

Fontana, Mars G. (1967), Regents' Professor, Duriron Professor and Chairman, Department of Metallurgical Engineering, The Ohio State University, 116 West 19th Avenue, Room 141, Columbus, Ohio 43210

Forrester, Jay W. (1967), Germeshausen Professor, Massachusetts Institute of Technology, 50 Memorial Drive, Room E52–454, Cambridge, Massachusetts 02139

Foster, John S., Jr. (1969), Vice President-Energy, Research and Development, TRW Inc., One Space Park, Building E2/10090, Redondo Beach, California 90278

Frey, Donald N. (1967), Chairman of the Board, Bell and Howell Company, 7100 McCormick Boulevard, Chicago, Illinois 60645

Frosch, Robert A. (1971), Assistant Executive Director, United Nations Environment Programme, c/o United Nations Environment Programme, P.O. Box 30552, Nairobi, Kenya

Frye, John C. (1971), Chief, Illinois State Geological Survey, National Resources Building, Room 121, Urbana, Illinois 61801

Fubini, Eugene G. (1966), E.G. Fubini Consultants, Limited, Suite 1200, Xerox Building, 1901 North Fort Myer Drive, Arlington, Virginia 22209

Fucik, E. Montford (1974), Chairman of the Board, Harza Engineering Company, 150 South Wacker Drive, Chicago, Illinois 60606

Gaden, Elmer L., Jr. (1974), Professor, Department of Chemical Engineering and Applied Chemistry, Columbia University, 353 Engineering Terrace, New York, New York 10027

Gagnebin, Albert P. (1974), (Former Chairman of the Board, The International Nickel Company of Canada, Ltd.), 143 Grange Avenue, Fair Haven, New Jersey 07701

Gaudin, Antoine M. (1964), Robert H. Richards Professor of Mineral Engineering, Emeritus, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 6–202, Cambridge, Massachusetts 02139

Gavin, Joseph G., Jr. (1974), Chairman of the Board, Grumman Aerospace Corp., Executive Offices—Plant 5, Bethpage, Long Island, New York 11714

Gerwick, Ben C., Jr. (1973), Professor of Civil Engineering, The University of California, Berkeley, 500 Sansome Street, San Francisco, California 94111

Getting, Ivan A. (1968), President, The Aerospace Corporation, P.O. Box 92957, Los Angeles, California 90009

Geyer, John C. (1970), Principal Research Scientist, The Johns Hopkins University, Homewood Ames 513, Baltimore, Maryland 21218

Gibbons, James F. (1974), Professor of Electronics, Stanford University, Stanford, California 94305

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Reed, Eugene D. (1971), Executive Director, Ocean Systems Division, Bell Laboratories, Whippany, New Jersey 07981

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Richards, Robert B. (1970), Manager, International Operations, General Electric Company, 175 Curtner Avenue, Mail Code 363, San Jose, California 95125

Richart, Frank E., Jr. (1969), Professor of Civil Engineering, The University of Michigan, Ann Arbor, Michigan 48104

Rickover, H. G. (USN), (1967), Director, Division of Naval Reactors, U.S. Atomic Energy Commission, Washington, D.C. 20545

Robinson, Denis M. (1970), Chairman of the Board, High Voltage Engineering Corp., South Bedford Street, Burlington, Massachusetts 01803

Roddis, Louis H., Jr. (1967), Vice Chairman, Consolidated Edison Company of New York, Inc., 4 Irving Place, Room 1602, New York, New York 10003

Rohlich, Gerhard A. (1970), C. W. Cook Professor of Environmental Engineering, Department of Civil Engineering, The University of Texas at Austin, 305 Engineering Laboratory Building, Austin, Texas 78712

Root, L. Eugene (1965), (Retired President, Lockheed Missiles and Space Company, Inc., and Group Vice President, Lockheed Aircraft Corp.), 1340 Hillview Drive, Menlo Park, California 94025

Rosen, Harold A. (1973), Manager, Commercial Systems Division, Hughes Aircraft Company, P.O. Box 92919—Airport Station, Los Angeles, California 90009

Rosenbaum, Joe B. (1973), Research Director, Salt Lake City Metallurgy Research Center, U.S. Bureau of Mines, 1600 East 1st South, Salt Lake City, Utah 84112

Rosenberg, Paul (1970), President, Paul Rosenberg Associates, 330 Fifth Avenue, Pelham, New York 10803

Rosenblith, Walter A. (1973), Professor and Provost, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 3–240, Cambridge, Massachusetts 02139

Ross, Ian M. (1973), Vice President, Network Planning and Customer Services, Bell Laboratories, Holmdel, New Jersey 07733

Ross, Philip N. (1968), Manager, Power Systems Planning, Westinghouse Electric Corp., 700 Braddock Avenue, Room 8L15, East Pittsburgh, Pennsylvania 15112

Rouse, Hunter (1966), Carver Professor and Engineering Dean Emeritus, The University of Iowa, Iowa City, Iowa 52240

Rowand, Will H. (1968), (Retired Vice President, The Babcock and Wilcox Company), P.O. Box 6485, Litchfield Park, Arizona 85340

Roy, Rustum (1973), Director, Materials Research Laboratory and Professor of the Solid State, The Pennsylvania State University, 202 Materials Research Laboratory, University Park, Pennsylvania 16802

Rummel, Robert W. (1973), Vice President—Technical Development, Trans World Airlines, Inc., 605 Third Avenue, New York, New York 10016

Rutledge, Philip C. (1968), Partner, Mueser, Rutledge, Wentworth and Johnston, 415 Madison Avenue, New York, New York 10017

Schade, Henry A. (1973), (Profesor of Naval Architecture, Emeritus, The University of California, Berkeley), 88 Norwood Avenue, Kensington, California 94707

Schairer, George S. (1967), Vice President—Research, The Boeing Company, P.O. Box 3999, MS 85–30, Seattle, Washington 98124

Schriever, Bernard A. (Retired, USAF), (1967), Management Consultant, Schriever and McKee, Inc., 1025 Connecticut Avenue, N.W., Washington, D.C. 20036

Schwartzwalder, Karl (1970), (Retired Director of Research and Development, AC Spark Plug Division, General Motors Corp.), 11511 Terrace Road, Holly, Michigan 48442

Scott, Ronald F. (1974), Professor of Civil Engineering, California Institute of Technology, Pasadena, California 91109

Seamans, Robert C., Jr. (1968), President, National Academy of Engineering, 2101 Constitution Avenue, N.W., Washington, D.C. 20418

Sears, William R. (1968), Professor of Aerospace and Mechanical Engineering, The University of Arizona, Tucson, Arizona 85721

Seed, H. Bolton (1970), Professor of Civil Engineering, The University of California, Davis Hall, Room 441, Berkeley, California 94720

Severud, Fred N. (1968), Consultant, Severud-Perrone-Sturm-Bandel, 415 Lexington Avenue, New York, New York 10017

Shapiro, Ascher H. (1974), Ford Professor of Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139

Shaw, Milton C. (1968), Professor and Head, Department of Mechanical Engineering, Carnegie-Mellon University, Schenley Park, Room SH401, Pittsburgh, Pennsylvania 15213

Shea, Joseph F. (1971), Senior Vice President and General Manager, Equipment Division, Raytheon Company, Equipment Development Laboratories, Boston Post Road, Wayland, Massachusetts 01778

Shea, Timothy E. (1967), (Retired Vice President, Western Electric Company), 92 Pine Grove Avenue, Summit, New Jersey 07901

Sheets, Herman E. (1967), Chairman and Professor, Department of Ocean Engineering, The University of Rhode Island, 202 Lippitt Hall, Kingston, Rhode Island 02881

Shepherd, Mark, Jr. (1970), President and Chief Executive Officer, Texas Instruments Inc., 13500 North Central Expressway, P.O. Box 5474, Mail Station 236, Dallas, Texas 75222

Shepherd, William G. (1969), Department of Electrical Engineering, The University of Minnesota, 258 Electrical Engineering, Minneapolis, Minnesota 55455

Sherwood, Thomas K. (1964), Professor, The University of California, 17 Senior Avenue, Berkeley, California 94708

Shoupp, William E. (1967), Senior Vice President, Research Laboratories, Westinghouse Electric Corp., Beulah Road, Pittsburgh, Pennsylvania 15235

Siegman, Anthony E. (1973), Professor of Electrical Engineering, Microwave Laboratory, Stanford University, Stanford, California 94305

Siess, Chester P. (1967), Head, Department of Civil Engineering, The University of Illinois at Urbana-Champaign, 1114 Civil Engineering Building, Urbana, Illinois 61801

Silver, Samuel (1968), Professor of Engineering Science, Department of Electrical Engineering and Computer Sciences, The University of California, 497 Cory Hall, Berkeley, California 94720

Silverstein, Abe (1967), (Retired Director, Lewis Research Center, NASA), Consultant, 21160 Seabury Avenue, Fairview Park, Ohio 44126

Simpson, John W. (1966), President, Power Systems Company, Westinghouse Electric Corp., Westinghouse Building, Gateway Center, Pittsburgh, Pennsylvania 15222

Sinclair, Donald B. (1965), (Retired Chairman of the Board, General Radio Company), 250 Beacon Street, Boston, Massachusetts 02116

Sjoberg, Sigurd A. (1974), Deputy Director, Lyndon B. Johnson Space Center, NASA, Houston, Texas 77058

Skilling, John B. (1965), Partner, Skilling, Helle, Christiansen, Robertson, 2200 The Financial Center, 1215 Fourth Avenue, Seattle, Washington 98161

Sliepcevich, Cedomir M. (1972), George Lynn Cross Research Professor of Engineering, The University of Oklahoma, 1215 Westheimer Drive, Norman, Oklahoma 73069

Smelt, Ronald (1971), Vice President and Chief Scientist, Lockheed Aircraft Corp., P.O. Box 551, Burbank, California 91520

Smith, Levering (USN), (1965), Director, Strategic Systems Projects, U.S. Department of the Navy, Washington, D.C. 20376

Smith, Mark K. (1967), (Formerly Vice President, Texas Instruments Inc.), Pine Tree Road, Norwich, Vermont 05055

Smith, Wilbur S. (1968), President, Wilbur Smith and Associates, 4500 Jackson Boulevard, Columbia, South Carolina 29209

Smullin, Louis D. (1970), Professor of Electrical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 38–294, Cambridge, Massachusetts 02139

Soderberg, C. Richard (1974), Institute Professor, Emeritus, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

Solomon, George E. (1967), General Manager, TRW Systems Group, TRW Inc., One Space Park, E2/11092, Redondo Beach, California 90278

Souders, Mott (1970), Consultant, 125 Requa Road, Piedmont, California 94611

Spaght, Monroe E. (1969), Director, Royal Dutch Petroleum Company, Shell Centre, London, SE1 7NA, England

Sparks, Morgan (1973), President, Sandia Laboratories, Albuquerque, New Mexico 87115

Sparks, William J. (1967), (Retired National Chairman, The Scientific Research Society of America), 5129 Granada Boulevard, Coral Gables, Florida 31346

Sporn, Philip (1965), Consultant, 74 Trinity Place, Suite 1511, New York, New York 10006

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Squires, Lombard (1967), Consultant, U.S. Atomic Energy Commission, 939 Nelsons Walk, Naples, Florida 33940

Starbird, Alfred D. (Retired, USA), (1973), Deputy Director (Test and Evaluation), Office of the Secretary of Defense, The Pentagon, Washington, D.C. 20301

Starr, Chauncey (1965), President, Electric Power Research Institute, 3412 Hillview Avenue, Palo Alto, California 94304

Stever, H. Guyford (1965), Director, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550

Stratton, Julius A. (1964), President Emeritus, Massachusetts Institute of Technology, Room 14N–112, Cambridge, Massachusetts 02139

Suits, C. Guy (1964), (Retired Vice President and Director of Research, General Electric Company), Crosswinds, Pilot Knob, New York 12844

Suomi, Verner E. (1966), Professor, University of Wisconsin; and Director, Space Science and Engineering Center, 1225 West Dayton Street, Room 1011, Madison, Wisconsin 53706

Sutherland, Ivan E. (1973), Vice President and Chief Scientist, Evans and Sutherland Computer Corp., Three Research Road, Salt Lake City, Utah 84112

Swearingen, John E. (1969), Chairman of the Board, Standard Oil Company (Indiana), 200 East Randolph Drive, Chicago, Illinois 60601

Tanenbaum, Morris (1972), Vice President, Transmission Equipment, Western Electric, 1 Boston Place, Boston, Massachusetts 02108

Tatlow, Richard H., III (1967), President, Abbott Merkt and Company, Inc., 630 Third Avenue, New York, New York 10017

Taylor, John J. (1974), General Manager, Breeder Reactor Divisions, Nuclear Energy Systems, Westinghouse Electric Corp., Pittsburgh, Pennsylvania 15230

Teal, Gordon K. (1969), (Retired Vice President and Chief Scientist, Texas Instruments Inc.), Consultant, 5222 Park Lane, Dallas, Texas 75220

Tedesko, Anton (1967), Consulting Engineer, 26 Brookside Circle, Bronxville, New York 10708

Tenenbaum, Michael (1974), President, Inland Steel Company, 30 West Monroe Street, Chicago, Illinois 60603

Terman, Frederick E. (1964), Vice-President and Provost Emeritus, Stanford University, McCullough Building, Room 174, Stanford, California 14305

Thomas, Charles A. (1964), (Retired President and Chairman of the Board, Monsanto Company), 7701 Forsyth Boulevard, Room 947, St. Louis, Missouri 63105

Tillinghast, John A. (1974), Senior Executive Vice President—Engineering and Construction, American Electric Power Service Corp., 2 Broadway, New York, New York 10004

Todd, Frederick H. (1965), (Retired, Naval Ship Research and Development Center, U.S. Department of the Navy), 15305 Rosecroft Road, Rockville, Maryland 20853

Tribus, Myron (1973), Vice President, Corporate Research, Xerox Corp., 800 Phillips Road, Webster, New York 14580

Truxal, John G. (1965), Dean of Engineering, State University of New York at Stony Brook, Stony Brook, New York 11790

Turner, Howard S. (1973), Chairman and Chief Executive Officer, Turner Construction Company, 150 East 42nd Street, New York, New York 10017

Van Valkenburg, Mac E. (1973), Professor of Electrical Engineering and Research Professor, Department of Electrical Engineering, The University of Illinois—Urbana, Urbana, Illinois 61801

Villard, Oswald G., Jr. (1966), Professor, Electrical Engineering Department, Stanford University; and Senior Scientific Advisor, Stanford Research Institute, 333 Ravenswood Avenue, Menlo Park, California 94025

von Braun, Wernher (1967), Vice President for Engineering and Development, Fairchild Industries, Germantown, Maryland 20767

Wagner, Aubrey J. (1973), Chairman, Board of Directors, Tennessee Valley Authority, 403 New Sprankle Building, Knoxville, Tennessee 37902

Wagner, Harvey A. (1970), Consulting Engineer, 12900 East Outer Drive, Detroit, Michigan 48224

Walker, Eric A. (1964), Vice President—Science and Technology, Aluminum Company of America, 1501 Alcoa Building, Pittsburgh, Pennsylvania 15219

Watkins, Dean A. (1968), Chairman of the Board, Watkins-Johnson Company, 3333 Hillview Avenue, Palo Alto, California 94304

Waynick, Arthur H. (1969), Professor Emeritus, The Pennsylvania State University, 833 Thomas Street, University Park, Pennsylvania 16802

Weber, Ernst (1964), Chairman, Division of Engineering, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418

Wells, Edward C. (1967), Director and Consultant, The Boeing Company, P.O. Box 3707, Mail Stop 10–52, Seattle, Washington 98124

Wenk, Edward, Jr. (1969), Professor of Engineering and Public Affairs and Director, Program in Social Management of Technology, The University of Washington, 428 Aerospace Research Laboratory, Seattle, Washington 98195

Wessenauer, G. O. (1968), (Retired Manager of Power, Tennessee Valley Authority), Consultant, 2931 Nurick Drive, Chattanooga, Tennessee 37415

Westwater, James W. (1974), Professor and Head of Chemical Engineering, The University of Illinois—Urbana, 113 Roger Adams Laboratory, Urbana, Illinois 61801

Wheaton, Elmer P. (1967), Vice President, Lockheed Missiles and Space Company, Lockheed Aircraft Corp., P.O. Box 504, Sunnyvale, California 94088

Wheelon, Albert D. (1970), Vice President and Group Executive, Space and Communications Group, Hughes Aircraft Company, 909 North Sepulveda Boulevard, El Segundo, California 90245.

Whinnery, John R. (1965), Professor of Electrical Engineering, Department of Electrical Engineering and Computer Sciences, The University of California, Berkeley, California 94720

White, Robert M. (1968), Administrator, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Room 5130, Washington, D.C. 20230

Wiesner, Jerome B. (1966), President, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 3–208, Cambridge, Massachusetts 02139

Wilbur, Lyman D. (1967), (Retired Vice President, Morrison-Knudsen Company, Inc.), Consulting Engineer, 4502 Hillcrest Drive, Boise, Idaho 83705

Wilson, Stanley D. (1967), Executive Vice President, Shannon and Wilson, Inc., 1105 North 38th Street, Seattle, Washington 98103

Wilson, Thornton A. (1974), Chairman of the Board and Chief Executive Officer, The Boeing Company, P.O. Box 3707, Seattle, Washington 98124

Winter, George (1970), Professor of Engineering (The Class of 1912 Chair), Cornell University, Hollister Hall, Ithaca, New York 14850

Wolman, Abel (1965), Professor Emeritus of Sanitary Engineering, The Johns Hopkins University, Baltimore, Maryland 21218

Wood, Carlos C. (1967), (Retired Vice President—Engineering, Sikorsky Aircraft Division of United Aircraft Corp.), 145 Bonniebrook Drive, Napa, California 94558

Young, James F. (1967), Vice President—Technical Resources, General Electric Company, 570 Lexington Avenue, New York, New York 10022

Zadeh, Lofti A. (1973), Professor in Electrical Engineering and Computer Sciences, The University of California, Berkeley, California 94720

Zinn, Walter H. (1974), (Retired Vice President, Combustion Engineering Corp.), 1155 Ford Lane, Dunedin, Florida 33528

Zworykin, Vladimir K. (1965), Honorary Vice President, RCA Laboratories, David Sarnoff Research Center, Princeton, New Jersey 08540

PROFILE OF MEMBERSHIP

Ages of Members—Age Distribution of Present Members

Year born	Age in 1973	Number of members, 1973	Age in 1974	Number of members, 1974
1878 to 1889	95–84	3	96–85	4
1890 to 1899	83–74	15	84–75	15
1900 to 1909	73–64	134	74–65	142
1910 to 1919	63–54	181	64–55	203
1920 to 1929	53–44	93	54–45	132
1930 to 1939	43–34	3	44–35	8
Total		429		504

Geographical Distribution of Members

	Number of members, 1973	Number of members, 1974
State:		
Alabama	1	1
Arizona	3	4
Arkansas	1	1
California	104	120
Colorado	4	5
Connecticut	3	5
Delaware	1	1
District of Columbia	28	32
Florida	9	10
Georgia	1	1
Hawaii	1	2
Idaho	1	1
Illinois	28	36
Indiana	3	4
Iowa	2	2
Maryland	8	9
Massachusetts	39	48
Michigan	14	15
Minnesota	4	5
Missouri	5	6
New Jersey	22	29
New Mexico	2	3
New York	50	59
North Carolina	1	1
Ohio	11	11
Oklahoma	2	2
Pennsylvania	24	31
Rhode Island	1	1
South Carolina	2	2
Tennessee	2	3
Texas	19	23
Utah	2	3
Vermont		1
Virginia	9	9
Washington	10	11
West Virginia	1	
Wisconsin	5	6
Outside of United States:		
Belgium	1	1
Canada	1	1
England	1	1
Kenya	1	1
Switzerland	1	1
Thailand	1	1
Total	429	504

Affiliation Distribution of Members

Affiliation	Number of members, 1973	Number of members, 1974
Industrial	182	214
Academic	137	159
Governmental	35	37
Consulting	22	27
Retired	45	58
Other	8	9
Total	429	504

Awards of the Academy

Name	Awards	Year
Engstrom, Elmer William	Steinmetz	1965
Bush, Vannevar	Founders	1966
McDonnell, James Smith	do	1967
Zworykin, Vladimir Kosma	do	1968
Nyquist, Harry	do	1969
Draper, Charles S	do	1970
Johnson, Clarence L	do	1971
Land, Edwin H	do	1972
Sutherland, Ivan E	Zworykin	1972
Lewis, Warren K	Founders	1973
Bitzer, Donald L	Zworykin	1973
Jonsson, J. Erik	Founders	1974
Giaever, Ivar	Zworykin	1974

Presidents of the Academy

	Term of Office	
	From—	To—
Augustus Braun Kinzel	December 1964	April 1966.
Eric Arthur Walker	April 1966	April 1970.
Clarence H. Linder	April 1970	May 1973.
Robert C. Seamans, Jr	May 1973	Present.

Deceased Members

	Date of birth	Date of election	Date of death
Ammann, Othmar Herman	Mar. 26, 1879	April 1965	Sept. 22, 1965
Chilton, Thomas H	Aug. 14, 1899	1966	Sept. 15, 1972
Dryden, Hugh Latimer	July 2, 1898	Founding member	Dec. 2, 1965
Fair, Gordon M	July 27, 1894	1967	Feb. 11, 1970
Fenske, Merrell R	June 5, 1904	1967	Sept. 28, 1971
Furnas, Clifford Cook	Oct. 22, 1900	1967	Apr. 27, 1969
Gibbs, William Francis	Aug. 24, 1886	October 1965	Sept. 6, 1967
Gilbreth, Lillian M	May 24, 1878	do	Jan. 2, 1972
Gilliland, Edwin R	July 10, 1909	April 1965	Mar. 10, 1973
Ippen, Arthur T	July 28, 1907	1967	Apr. 5, 1974
Jenks, Stephen M	Feb. 18, 1901	1968	Apr. 12, 1974
Kyle, John M., Jr	Dec. 3, 1904	1967	Sept. 30, 1970
Mentzer, William C	May 27, 1907	1968	Dec. 23, 1971
Millikan, Clark Blanchard	Aug. 23, 1903	Founding member	Jan. 2, 1966
Molnar, Julius P	Feb. 23, 1916	1969	Jan. 11, 1973
Morton, Jack A	Sept. 4, 1913	1967	Dec. 10, 1971
Prutton, Carl F	July 30, 1908	1966	July 15, 1970
Sikorsky, Igor I	May 25, 1889	1968	Oct. 26, 1972
Whitman, Walter G	Nov. 30, 1895	1974	Apr. 6, 1974
Wilhelm, Richard Herman	Jan. 1, 1909	1968	Aug. 6, 1968

COMMITTEES OF THE ACADEMY

AERONAUTICS AND SPACE ENGINEERING BOARD

Established March 27, 1967

"The Board shall survey the problems, the opportunities, and the implications of aeronautical developments and of man's advance into space and shall look for ways to develop wise and vigorous national engineering, scientific, and educational programs as applied to aerospace. The Board and its committees will make recommendations as to what engineering objectives are attainable and the priority that should be accorded them, as to how to bring engineering talents to bear on aerospace problems of national importance, and as to how to improve engineering education, including the enhancement of public responsibility on the part of engineers in these areas. The Board shall have advisory and consultative responsibilities, responding to specific requests for assistance as well as taking the initiative when appropriate."

Membership, 1972–1973

Chairman, Willis M. Hawkins, *Vice Chairman,* Rudolf Kompfner. *Members:* H. Julian Allen, Leo L. Beranek, Arthur E. Bryson, Jr., Allen F. Donovan, Antonio Ferri, Alexander H. Flax, Peter C. Goldmark, Donald J. Jordan, Raymond Ketchledge, William B. McLean, Brockway McMillan, Rene H. Miller, Allen E. Puckett, William R. Sears, Abe Silverstein, Donald B. Sinclair, George E. Solomon, Gordon K. Teal, and Charles H. Townes (ex officio, Chairman, Space Science Board).

Membership, 1973–1974

Chairman, Willis M. Hawkins, *Vice Chairman,* George E. Solomon. *Members:* H. Julian Allen, Leo L. Beranek, Arthur E. Bryson, Jr., Allen F. Donovan, Alfred J. Eggers, Jr., Antonio Ferri, Morris E. Fine, Alexander H. Flax, Robert R. Gilruth, Donald J. Jordan, Raymond W. Ketchledge. Lester Lees, Hans W. Liepmann, Robert G. Loewy, William B. McLean, Rene H. Miller, Allen E. Puckett, Robert W. Rummel, William R. Sears, Abe Silverstein, Donald B. Sinclair, Albert D. Wheelon, and Richard M. Goody (*ex officio,* Chairman, Space Science Board).

AUDITING COMMITTEE

Established December 10, 1964

"The Committee shall arrange for an audit, by independent certified public accountants, of the accounts of the Academy for the current fiscal year and shall present the report of audit to the Academy at the next annual meeting, together with such comments and recommendations as the Committee may deem appropriate. The Committee may cause to be made any other examination of the financial records, the accounting records, and the system of internal control of the Academy which, in its judgment, is necessary for the determination of the adequacy and accuracy of the accounts for the Academy."

Chairman, Chalmer G. Kirkbride. *Members:* John C. Geyer, John L. McLucas, Clarence H. Linder (ex officio, President, NAE), and Chauncey Starr (ex offico, Vice President, NAE). (Terms expire at close of Annual Meeting, May 1973.)

Chairman, Thomas O. Paine. *Members:* Chalmer G. Kirkbride, William G. Shepherd, Robert C. Seamans, Jr. (ex officio, President, NAE), and Chauncey Starr (ex officio, Vice President, NAE). (Terms expire at close of Annual Meeting, May 1974.)

AWARDS COMMITTEE

Established April 29, 1965

"The Committee shall formulate general policies regarding awards and honors administered by the National Academy of Engineering and shall submit such policies and specific recommendations for approval by the Council. The Committee shall formulate a general program designed to meet the needs and desires of the Academy in the matter of awards and honors and shall implement the establishment of new awards and honors, as may be approved by the Council. The Committee shall select, subject to approval by the Council, the recipients of existing awards and honors. The Committee shall make plans for a Founders Lecture to be held annually or from time to time at the National Academy of Engineering by an individual known for his outstanding contributions to engineering and shall make recommendations to the Council as to policies and procedures to be followed in implementing such plans."

Chairman, Richard J. Grosh. *Members:* Paul F. Chenea, Martin Goland, George M. Low, Thomas L. Martin, Jr., John J. McKetta, Jr., C. Guy Suits, and John G. Truxal. (Terms expire at close of Annual Meeting, May 1973.)

Chairman, Richard J. Grosh. *Members:* Lynn S. Beedle, Paul F. Chenea, George M. Low, Thomas L. Martin, Jr., John J. McKetta, Jr., and C. Guy Suits. (Terms expire at close of Annual Meeting, May 1974.)

BAY AREA RAPID TRANSIT (BART) IMPACT PROGRAM ADVISORY COMMITTEE

Established July 1, 1972

"The Committee shall provide advice and assistance to the Department of Transportation and the Department of Housing and Urban Development on the engineering, socio-economic, and environmental aspects of the BART Impact Program being conducted by the Departments over a 5-year period, mid-1972 to mid-1977."

Membership, 1972–1973

Chairman, Seymour W. Herwald. *Members:* Michael Cafferty, J. Douglas Carroll, Jr., William L. Garrison, Peter C. Goldmark, Britton Harris, Samuel Z. Klausner, Everett S. Lee, Marvin L. Manheim, Wilfred Owen, Milton Pikarsky, Philburn Ratoosh, James P. Romualdi, William M. Spreitzer, Kenneth E. F. Watt, and Edward C. Wells.

Membership, 1973–1974

Chairman, Seymour W. Herwald. *Members:* J. Douglas Carroll, Jr., William L. Garrison, Peter C. Goldmark, Britton Harris, Samuel Z. Klausner, Everett S. Lee, Marvin L. Manheim, Wilfred Owen, Milton Pikarsky, Philburn Ratoosh, James P. Romualdi, William M. Spreitzer, Kenneth E. F. Watt, and Edward C. Wells.

BIOGRAPHICAL MEMOIRS COMMITTEE

Established October 20, 1965

"The Committee shall prepare in an appropriate fashion the Biographical Memoirs of the National Academy of Engineering."

Chairman, Lombard Squires. *Member:* Antoine M. Gaudin. (Terms expire at close of Annual Meeting, May 1973.)

Chairman, Lombard Squires. (Term expires at close of Annual Meeting, May 1974.)

AD HOC COMMITTEE FOR THE BUREAU OF MINES

Established July 6, 1972

"The Committee will undertake a review and evaluation of the research programs and the mineral intelligence and mineral information activities of the Bureau of Mines. Consideration will be given to their timeliness, effectiveness, and adequacy of financial support. As a result of this review and evaluation, the Committee will determine the need for a National Academy of Engineering Standing Committee with panels, as appropriate, to provide continuous advice and guidance on the technical research programs, their priorities, and the adequacy of supporting resources. If the Ad hoc Committee deems it desirable to establish a Standing Committee, a proposed program of Committee activities and functions will be developed."

Membership, 1972–1973

Chairman, Oscar T. Marzke. *Members:* Charles F. Barber, Earl H. Beistline, Joseph P. Brennan, M. D. Hassialis, C. R. Hocott, George E. Kruger, Ian K. MacGregor, Guy T. McBride, Charles D. Michaelson, Wilburn C. Schroeder, Sam H. Schurr, Karl Schwartzwalder, Eric A. Walker, and John Paul Weir.

AD HOC DEVELOPMENT COMMITTEE

(Formerly Committee on Gifts and Endowments)

Established April 29, 1965

"The Committee shall seek to increase the income of the National Academy of Engineering by means of obtaining gifts, grants, and endowments for the Academy, both immediately and thereafter."

Chairman, Donald N. Frey. *Members:* Edward L. Gintzton, John D. Harper, J. Erik Jonsson, John R. Kiely, and David Packard.

COMMISSION ON EDUCATION

Established January 1, 1969

"The Commission on Education was established by the National Academy of Engineering to initiate, monitor, coordinate and advise on programs and policies influencing technological education and technology for education."

Membership 1972–1973 and 1973–1974

Chairman, W. Robert Marshall, Jr., *Vice Chairman,* John G. Truxal. *Members:* George Bugliarello, David C. Evans, Lester M. Field, Joseph Fisher, E. P. Gyftopoulos, Newman A. Hall, Thomas L. Martin, Jr., Louis T. Rader, Andrew Schultz, Jr., Chauncey Starr, Charles A. Wedemeyer, H. A. Bolz (*ex officio*), and M. R. Lohmann (ex officio).

TASK FORCE ON ENERGY PROGRAM PLANNING

Established October 1, 1973

"To develop in detail within the next six months recommendations for not more than three action programs in the energy field which are judged to be feasible for completion by units of the NAE and/or the NRC in a timely manner; the final recommendations of the Task Force in this regard should include information regarding the specific results which are anticipated, the manner in which the information is expected to be utilized and by whom; the estimated funding required, and government agencies or other organizations who are viewed as potential sponsors of the work should also be identified."

Chairman, W. Kenneth Davis. *Members:* William C. Ackermann, Richard G. Folsom, J. Herbert Hollomon, Frederic A. L. Holloway, Lester Lees, Thomas O. Paine, and Howard S. Turner.

TASK FORCE ON ENERGY

Established December 13, 1973

"To define and describe a government/industry program which will substantially increase the U.S. domestic energy supply (and/or decrease the domestic energy supply deficit) by 1980 or the early 1980's."

Chairman, W. Kenneth Davis. *Members:* William C. Ackermann, Richard G. Folsom, J. Herbert Hollomon, Frederic A. L. Holloway, Lester Lees, Thomas O. Paine, Louis H. Roddis, Jr., Thomas K. Sherwood, Myron Tribus, and Howard S. Turner.

COMMITTEE ON ENGINEERING MANPOWER POLICY

Established October 1971

"Established by the National Academy of Engineering to study the major influences on the nature and stability of engineering employment and to recommend remedial actions. The study will include economic, political, sociological, legislative, managerial and technological factors which may have primary impact on the situation, and inferences will be drawn as to how these factors might be affected to achieve desired engineering manpower goals consistent with national priorities."

Chairman, Bob O. Evans, *Assistant to the Chairman,* Hans Cherney. *Members*: Philip M. Arnold, John A. Blume, Paul F. Chenea, Arthur Gilmore, Eli Ginzberg, Hubert Heffner, Thomas F. Jones, Brockway McMillan, and Maynard L. Pennell.

BOARD ON ENGINEERING MANPOWER AND EDUCATIONAL POLICY

Established February 8, 1974

"The Board was established as a successor to the NAE Commission on Education with an expansion in scope of activities. The objectives of the Board are twofold: (a) to define and address the problems associated with improving the match between supply and demand of the nation's engineering manpower, and (b) to define and address educational policy problems associated with improving the quality and effectiveness of education for the engineering profession."

Organizing Committee. Chairman, Mac E. Van Valkenburg. *Members*: C. Chapin Cutler, Edward J. Gornowski, Robert G. Loewy, Joseph H. Newman, Donald O. Pederson, Myron Tribus, and Howard S. Turner.

COMMITTEE ON ENVIRONMENTAL ENGINEERING

(Formerly Committee on Engineering Aspects of Environmental Quality)

Established February 6, 1970

"The Committee shall pinpoint critical environmental problems and set in motion mechanisms for clarifying and defining the issues to be resolved. The Committee will make recommendations to the NAE Council, the Environmental Studies Board, and other appropriate groups regarding priority pro-

grams and action required to initiate such programs. The Committee will also direct the development and implementation of programs or actions by the NAE that will most effectively utilize the talents and interests of the Academy members, in combination with whatever other individuals or groups as may be necessary to perform selected tasks."

Membership, 1972–1973

Chairman, William C. Ackermann. *Members*: John C. Frye, Eugene G. Fubini, Frederic A. L. Holloway, Helmut E. Landsberg, Jack E. McKee, Elburt F. Osborn, Lombard Squires, and Edward Wenk, Jr.

Membership, 1973–1974

Chairman, William C. Ackermann. *Members:* John C. Frye, Frederic A. L. Holloway, Helmut E. Landsberg, Jack E. McKee, Elburt F. Osborn, Lombard Squires, and Edward Wenk, Jr.

FINANCE COMMITTEE

Established December 10, 1964

"The Committee shall prepare and present to the Council the annual general budget of the Academy and shall determine matters relating to the purchase and sale of securities or other investments which are under the administration or control of the Academy. The Committee shall have the power, subject to the approval of the Council, to employ competent investment counsel to advise the Committee."

Chairman, Thomas C. Kavanagh. *Members*: Nathan Cohn, A. Earl Cullum, Jr., W. Kenneth Davis, John H. Dessauer, Clarence H. Linder (ex officio, President, NAE), Chauncey Starr (ex officio, Vice President, NAE), and Philip Handler (ex officio, President, NAS). (Terms expire at close of Annual Meeting, May 1973.)

Chairman, Thomas C. Kavanagh. *Members*: Edward N. Cole, Richard G. Folsom, Thomas F. Jones, Hilliard W. Paige, Mark Shepherd, Jr., Howard S. Turner, Robert C. Seamans, Jr. (ex officio, President, NAE), Chauncey Starr (ex officio, Vice President, NAE), and Philip Handler (ex officio, President, NAS). (Terms expire at close of Annual Meeting, May 1974.)

INTEGRATED UTILITY SYSTEMS BOARD

Established September 1, 1972

"Established by the National Academy of Engineering to review studies of the integrated utility systems concept and analyze data on various implemented and conceptual integrated utility systems. The Board's work will be designed to assist the Department of Housing and Urban Development and other government agencies in evaluating the practicality of developing processing plants capable of serving all the utility needs of future community development."

Membership, 1972–1973 and 1973–1974

Chairman, G. O. Wessenauer, *Vice Chairman,* S. William Gouse, Jr. *Members:* Vinton W. Bacon, James G. Abert, Fred S. Dubin, Jerome Kretchmer, Frederick C. Lindvall, Weiming Lu, Louis H. Roddis, Jr., William E. Shoupp, and Joseph C. Swidler.

COMMITTEE ON THE INTERPLAY OF ENGINEERING WITH BIOLOGY AND MEDICINE

Established June 27, 1967

"The Committee shall identify and broadly define some program opportunities and needs on the basis of current engineering theory and practice, and the applicability of them to problems of biology and medicine. The Committee acts in an advisory role primarily to the National Institutes of Health, and secondarily to other government agencies concerned with the support and encouragement of engineering in biology and medicine. The Committee will also work to delineate clearly the characteristics and limitations of modern engineering and the means by which the national engineering capability can be effectively directed towards the fundamental and applied problems of concern to the National Institutes of Health."

Membership, 1972–1973

Chairman, W. Robert Marshall, Jr. *Members:* Daniel A. Brody, Elsworth R. Buskirk, Cesar A. Caceres, Murray Eden, Charles D. Flagle, Dwight Emary Harken, Leon D. Harmon, Jack H. Irving, Augustus B. Kinzel *, A. Latham, Jr., William K. Linvill, Robert W. Mann, Saul Padwo, Leon Podolsky, David D. Rutstein, John G. Truxal *, Herman R. Weed, and Vladimir K. Zworykin.*

* Honorary member

MARINE BOARD

(Formerly Committee on Ocean Engineering)

Established March 17, 1965

"The Board shall furnish advice on policy, programs, organizations, and facilities needed for the most effective utilization of marine resources and on the engineering application of oceanographic knowledge for the public welfare and defense."

Membership, 1972–1973

Chairman, William E. Shoupp. *Members:* Walter C. Bachman, Robert F. Bauer, Leo L. Beranek, John P. Craven, Harold W. Fisher, Antoine M. Gaudin, Claude R. Hocott, Arthur T. Ippen, Alfred A. H. Keil, John R. Kiely, Edwin A. Link, George C. Nickum, Erman A. Pearson, William B. W. Rand, Herman E. Sheets, Elmer P. Wheaton, Victor Boatwright (ex officio), George Mechlin, Jr. (ex officio) and Robert L. Wiegel (ex officio).

Membership, 1973–1974

Chairman, William E. Shoupp, *Vice Chairman,* Elmer P. Wheaton. *Members:* Walter C. Bachman, Robert F. Bauer, John P. Craven, Harold W. Fisher, Ben C. Gerwick, Jr., Earnest F. Gloyna, Claude R. Hocott, Arthur T. Ippen, Alfred A. H. Keil, John R. Kiely, Christian J. Lambertsen, George C. Nickum, Erman A. Pearson, William B. W. Rand, Herman E. Sheets, and James H. Wakelin, Jr.

COMMITTEE ON MEMBERSHIP

Established December 10, 1964

"The Committee shall meet, as directed by its chairman, to analyze the membership structure of the Academy, to originate nominations, and to appraise nominations received from the members."

Membership, 1972–1973

Chairman, Harmer E. Davis. *Members:* Vinton W. Bacon, Gordon S. Brown, Nathan Cohn, Michael Ference, Jr., Lester M. Field, Alexander H. Flax, Richard G. Folsom, Ivan A. Getting, J. Herbert Hollomon, Wilfrid E. Johnson, John R. Kiely, Jack E. McKee, Eugene F. Murphy, Philip N. Ross, Hunter Rouse, Anton Tedesko, Edward C. Wells, George Winter, and James F. Young.

Membership, 1973–1974

Chairman, Martin Goland, *Vice Chairman,* John R. Kiely. *Members:* Vinton W. Bacon, Edward J. Barlow, Raymond L. Bisplinghoff, James Boyd, Gordon S. Brown, Nathan Cohn, Daniel C. Drucker, Alfred J. Eggers, Jr., Michael Ference, Jr., Richard G. Folsom, Ivan A. Getting, Wilfrid E. Johnson, John A. Logan, Jack E. McKee, John J. McKetta, Jr., George E. Mueller, Eugene F. Murphy, Philip N. Ross, Thomas K. Sherwood, William E. Shoupp, John W. Simpson, Morris Tanenbaum, Anton Tedesko, Edward C. Wells, George Winter, and James F. Young.

COMMITTEE ON MINORITIES IN ENGINEERING

Established September 17, 1973

"The Program on Minorities in Engineering was established to provide national leadership in coordinating a nationwide effort aimed at achieving a tenfold increase in minority engineering graduates within a decade. The program comprises the advisory activities of a National Advisory Council on Minorities in Engineering and the operating activities of a standing Committee on Minorities in Engineering."

Chairman, Richard J. Grosh, *Vice Chairman,* Arthur G. Hansen. *Members:* Pepe Barron, Jack A. Baird, James E. Bostic, Jr., Herman R. Branson, Randolph W. Bromery, Calvin H. Conliffe, Cesar DeLeon, Cleveland Dennard, David Ford, Paul E. Gray, Jerrier A. Haddad, W. Robert Marshall, Peter McDonald, Joseph E. Milano, T. J. Olsen, P. A. Pierre, Lindon E. Saline, Andrew Schultz, Jr., Herman B. Smith, Jr., Morris Tanenbaum, Morris Thompson, and Robert C. Seamans, Jr., (ex officio, President, NAE).

National Advisory Council on Minorities in Engineering. Chairman, Reginald H. Jones, *Vice Chairman,* Richard J. Grosh. *Members:* Holt Ashley, S. D. Bechtel, Jr., Lewis M. Branscomb, Donald C. Burnham, John C. Calhoun, James E. Cheek, John D. deButts, John Z. DeLorean, Alfredo de los Santos, Jr., Christopher Edley, John D. Harper, Theodore M. Hesburgh, J. K. Jamieson, Vernon V. Jordan, E. R. Kane, Melvin R. Laird, Alex C. Mair, C. Peter McColough, William R. Orthwein, Jr., Robert W. Sarnoff, Edgar B. Speer, Leon H. Sullivan, James F. Towey, Alexander B. Trowbridge, Roy Wilkins, F. Perry Wilson, and Robert C. Seamans, Jr. (ex officio, President, NAE).

AD HOC STUDY PANEL OF THE NATIONAL SCIENCE FOUNDATION EXPERIMENTAL RESEARCH AND DEVELOPMENT INCENTIVES PROGRAM

Established October 1, 1972

"The *ad hoc* Study Panel will review the organization, planning, proposed direction, and development of the NSF Experimental R&D Program, including additional experimental solutions involving financial incentives under consideration by the Foundation. The Panel will also consider the problem of moving federally funded R&D into civilian applications.

Membership, 1972–1973

Chairman, Lombard Squires. *Members:* Arnold O. Beckman, Edward J. Brenner, Malcolm R. Currie, James E. Gorham, Edward J. Gornowski, Roy W. Gould, Ward J. Haas, Lawrence R. Hafstad, James Hillier, Donald G. Marquis, James P. Mitchell, Bruce S. Old, John W. Simpson, Morris Tanenbaum, Eric A. Walker, and John W. Whelan.

Membership, 1973–1974

Chairman, Edward J. Gornowski. *Members:* Thomas J. Allen, Arnold O. Beckman, Edward J. Brenner, James E. Gorham, Ward J. Haas, Lawrence H. Hafstad, James Hillier, James P. Mitchell, Bruce S. Old, Frank N. Piasecki, John W. Simpson, Lombard Squires, Morris Tanenbaum, Eric A. Walker, and John W. Whelan.

NOMINATING COMMITTEE

Established December 10, 1964

"Not less than 30 days prior to the annual meeting in each year, the Committee shall submit to the secretary, for transmission to the membership, nominations to fill any vacancies which will occur in that year in the Council or officers."

Chairman, A. Earl Cullum, Jr. *Members:* Paul F. Chenea, Martin Goland, Seymour W. Herwald, and James R. Killian, Jr. (Terms expire at close of Annual Meeting, May 1973.)

Chairman, Edward E. David, Jr. *Members:* Harvey Brooks, A. Earl Cullum, Jr., T. Keith Glennan, and Ralph Landau. (Terms expire at close of Annual Meeting, May 1974.)

PROJECT COMMITTEE

Established September 23, 1965

"The Committee shall screen prospective projects prior to the preparation of proposals, shall evaluate prepared proposals prior to submission to the Council of the National Academy of Engineering or to the Governing Board of the National Research Council, and shall suggest the undertaking of projects in overlooked areas from time to time. The Project Committee shall review reports for technical soundness and adequate implementation of a project."

Membership, 1972–1973

Chairman, Henri G. Busignies. *Members:* Marvin Chodorow, Donald N. Frey, Harold B. Gotaas, William J. Hall, Hubert Heffner, Seymour W. Herwald, John E. Jacobs, Robert I. Jaffee, J. Erik Jonsson, John A. Logan, K. D. Nichols, Louis T. Rader, Eberhardt Rechtin, and Paul Rosenberg.

Membership, 1973–1974

Chairman, Courtland D. Perkins. *Members:* Donald N. Frey, Harold B. Gotaas, William J. Hall, Hubert Heffner, J. Erik Jonsson, and John A. Logan.

COMMITTEE ON PUBLIC ENGINEERING POLICY

Established March 24, 1966

"The Committee shall aid the interdependence between the federal government and engineering and shall study and advise on the needs of the engineering community, essentially without regard to existing programs and budgetary requirements."

Membership, 1972–1973

Chairman, Edward Wenk, Jr. *Members:* Vinton W. Bacon, Raymond Bauer, Samuel S. Baxter, Donald S. Berry, Gordon S. Brown, William D. Carey, Daniel C. Drucker, Joseph Fisher, Martin Goland, Alfred A. H. Keil, James R. Killian, W. Deming Lewis, Ruben F. Mettler, Charles J. Meyers, Abe Silverstein, Chauncey Starr, Gilbert F. White, Franklin Williams, and Abel Wolman.

Membership, 1973–1974

Chairman, Edward Wenk, Jr. *Members:* Vinton W. Bacon, Raymond Bauer, Samuel S. Baxter, Gordon S. Brown, William D. Carey, Joseph V. Charyk, Daniel C. Drucker, Joseph Fisher, Bernard R. Gifford, Walter R. Hibbard, Jr., W. Deming Lewis, Charles J. Meyers, Nelson W. Polsby, Milton Pikarsky, Louis H. Roddis, Jr., Abe Silverstein, Chauncey Starr, Franklin Williams, and Abel Wolman.

SPACE APPLICATIONS BOARD

Established February 1, 1972

"Established by the National Academy of Engineering to advise NASA and other government agencies on the application of space technology to national needs, emphasizing ways to augment its positive effects on society. Through a series of studies related to national needs and technological capabilities in space application areas, the Board will assist in broadening the interest and understanding of industry, universities, government and the public in the potential benefit of space applications to the nation and mankind.

An Organizing Committee has been established to recommend to the NAE the composition, functions and membership of the Board."

Organizing Committee. Chairman, Allen E. Puckett. *Members*: Daniel J. Fink, George Berbner, William B. Heroy, Francis A. Johnson, Samuel Lenher, William Magruder, George Solomon, Chauncey Starr, Robert M. White, Stuart G. Younkin, and George Zissis.

Membership, 1972–1973 and 1973–1974

Board Chairman, Allen E. Puckett. *Members:* A. R. Baldwin, O. C. Boileau, Jack M. Campbell, John F. Collins, Emilio Q. Daddario, Daniel J. Fink, Leonard H. Goldenson, Peter C. Goldmark, William B. Heroy, Martin L. Johnson, Thomas F. Malone, William A. Nierenberg, Stanley de J. Osborne, J. Edward White, Joshua Menkes (liaison, Space Science Board), George E. Solomon (liaison, Aeronautics and Space Engineering Board), and George Zissis (liaison, Committee on Remote Sensing Programs for Earth Resource Surveys).

AD HOC COMMITTEE ON TECHNOLOGY TRANSFER AND UTILIZATION

Established July 1973

"The NSF requested that the Committee identify the major federal agencies that have conducted programs directed toward technology transfer and utilization; determine and describe the methods used by those agencies in advancing the programs; evaluate effectiveness of these methods; assess the extent to which these agencies have evaluated their own methods; and,

on the basis of the background information developed, recommend policies that the NSF or the Federal Government should consider."

Chairman, Joseph H. Newman. *Members*: Guy Black, Robert W. Cairns, Richard N. Foster, Aaron J. Gellman, Harold P. Green, Porter Homer, Charles N. Kimball, Lawrence Levy, Wilfred S. Martin, Bruce S. Old, J. Richard Perrin, Harvey J. Sarles, Eric A. Walker, and James F. Young.

COMMITTEE ON TELECOMMUNICATIONS

Established December 14, 1967

"Established by the National Academy of Engineering to provide advice to the Federal Government on telecommunications technology and its relationship to national policies and programs. The Committee submitted a report to a consortium of federal departments in June 1971, which identified approximately eighteen potential applications of telecommunications technology to improve city functions. These are under consideration as federally sponsored pilot projects."

Membership, 1972–1973

Chairman, William L. Everitt. *Members:* Robert Adler, Stuart L. Bailey, George H. Brown, Henri G. Busignies, Lee L. Davenport, Richard P. Gifford, Peter C. Goldmark, Gustav Heningburg, Robert A. Henle, William H. Huggins, Edward C. Jordan, Kenneth G. McKay, Joseph M. Pettit, William H. Pickering, Louis D. Smullin, and Ernst Weber.

Membership, 1973–1974

Chairman, Henri G. Busignies. *Members:* Raymond M. Alden, Stuart L. Bailey, Jack A. Baird, Edward A. Berg, George H. Brown, Lee L. Davenport, Lynn W. Ellis, William L. Everitt, Robert M. Fano, Richard P. Gifford, Peter C. Goldmark, Gustav Heningburg, Robert A. Henle, William H. Huggins, Edward C. Jordan, John G. Linvill, Kenneth G. McKay, Sidney Metzger, Joseph M. Pettit, Eberhardt Rechtin, Harry M. Trebing, and John R. Whinnery.

COMMITTEE ON TRANSPORTATION

Established February 1970

"The Committee wil make recommendations as to how to develop and maintain liaison and working relationships with government and nongovernment communities in the review and assessment of transportation-related engineering objectives and priorities in their interrelationship with the environment; consider and propose methods for best utilizing engineering talent on transportation problems of national importance; and how best to provide a forum to bring scientists, engineers and other relevant disciplines together for thoughtful discussion and surveys of problems, implications, and opportunities in transportation endeavors."

Membership, 1972–1973

Chairman, Seymour W. Herwald. *Members:* Kurt W. Bauer, Donald S. Berry, William L. Garrison, J. Herbert Hollomon, Robert Horonjeff, J. Erik Jonsson, John R. Kiely, Samuel Z. Klausner, A. Scheffer Lang, O. T. Marzke, Edward J. O'Donnell,

Wilfrd Owen, James P. Romualdi, Wilbur S. Smith, William M. Spreitzer, Edward C. Wells, and Charles J. Zwick.

Membership, 1973–1974

Chairman, Seymour W. Herwald. *Members:* Kurt W. Bauer, Donald S. Berry, William L. Garrison, Lawrence R. Hafstad, J. Herbert Hollomon, Robert Horonjeff, J. Erik Jonsson, John R. Kiely, Samuel Z. Klausner, A. Scheffer Lang, O. T. Marzke, Edward J. O'Donnell, Wilfred Owen, James P. Romualdi, Wilbur S. Smith, William M. Spreitzer, John G. Truxal, Edward C. Wells, and Charles J. Zwick.

COMMITTEES OF THE ACADEMIES/NATIONAL RESEARCH COUNCIL

"The National Academy of Engineering undertakes certain activities jointly with the National Academy of Sciences and the National Research Council. Further information on these joint committees, which are listed below, can be found in the annual reports of the National Academy of Sciences and the National Research Council.

NAS-NAE Joint Board
Advisory Committee to the Department of Housing and Urban Development
Environmental Studies Board
Evaluation Panels for National Bureau of Standards
Committees on Pollution Abatement and Control
Science and Engineering Committee Advisory to the National Oceanic and Atmospheric Administration

APPENDIX III

INSTITUTE OF MEDICINE

AUTUMN MEETING, 1972

The second autumn meeting of the Institute of Medicine was held on November 9 and 10, 1972, in Washington, D.C., and included both reports on matters pertaining to the Institute's program and presentations on topics of general interest. The sessions were open to the press; one speech was published.

SESSION I. THE INSTITUTE'S PROGRAM

Opening Comment by the President of the Institute of Medicine

John R. Hogness.

Program Strategy

Irving M. London, Chairman of the Harvard-MIT Program in Health Sciences and Technology, Cambridge, Massachusetts; Chairman of the Institute of Medicine standing committee on program development.

A draft statement of principles and procedures for the Institute's program, with a recommended plan of activities for the year ending June 30, 1973, was discussed by Dr. London and thereafter subjected to detailed scrutiny by Institute members in small group sessions.

SESSION II. SCIENCE POLICY

The Place of Science and Technology in Medicine

Lewis Thomas, Dean, Yale University School of Medicine, New Haven, Connecticut.

Dr. Thomas' address was published as the first Occasional Paper of the Institute, under the title, "Aspects of Biomedical Science Policy."

Institute of Medicine Initiatives in the Area of Science Policy

Donald S. Fredrickson *, Director of Intramural Research, National Heart and Lung Institute, Bethesda, Maryland.

Status of the Review of the National Cancer Program Plan
(Institute activity)

Lewis Thomas, Chairman of the ad hoc Institute review panel.

National Health Care Plans: Social Policy Perspectives

Robert M. Ball, Commissioner of the Social Security Administration.

SESSION III. INSTITUTE STUDIES

Report on the Cost of Education Study

Julius Richmond, Director of the Judge Baker Guidance Center, Boston, and Professor and Chairman of Preventive and Social Medicine at Harvard.

*Dr. Fredrickson was later appointed President of the Institute of Medicine (January, 1974), effective July 1, 1974.

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Report of the Study of Contrasts in Health Status

David M. Kessner, Study Director and Research Associate of the Institute of Medicine.

Open discussion from the floor.

The meeting closed with a session for new members, presided over by Dr. Hogness with participation from the Institute staff.

SPRING MEETING, 1973

The second spring meeting of the Institute of Medicine was held on May 9 and 10. The program dealt with the plans of three new Institute committees, the progress of studies expected to result in policy statements, and the programs of three institutions concerned with ethical issues of medicine and health care. The format included both plenary sessions and small group discussion.

SESSION I. INSTITUTE OVERVIEW COMMITTEES

Introduction to Reports from the Committee Chairmen

John R. Hogness.

Purpose and Plans of the Committee on Education in the Health Professions

Carleton B. Chapman, Vice President, The Commonwealth Fund, New York, New York.

Purpose and Plans of the Committee on Science Policy for Medicine and Health

Leon O. Jacobson, Dean of the Division of Biological Sciences, Pritzker School of Medicine, University of Chicago, Chicago, Illinois.

Purpose and Plans of the Committee on National Health Care Plans

Henry W. Riecken, Professor of Behavioral Sciences, School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania.

SESSION II. PROGRAM ACTIVITIES

Members assembled in groups to continue discussion of the work of the three survey committees, and to learn about the progress being made on four Institute of Medicine policy statements. The chairmen of the respective committees led concurrent sessions on these items in the Institute's program:

Education in the Health Professions

Carleton B. Chapman.

Science Policy for Medicine and Health

Leon O. Jacobson.

National Health Care Plans

Henry W. Riecken.

Health Maintenance Organizations (policies permitting a "fair market" test)

Paul Ward, Executive Director, California Committee on Regional Medical Programs, Oakland, California.

Mechanisms of Health Care Quality Assurance

Robert J. Haggerty, Professor and Chairman of Pediatrics, University of Rochester School of Medicine and Dentistry, Rochester, New York.

The Supply of Hospital Beds for Acute Care

Robert M. Heyssel, Executive Vice President and Director, The Johns Hopkins Hospital, Baltimore, Maryland.

The "Catastrophic Illness" Approach to National Health Insurance

Herman M. Somers, Professor of Politics and Public Affairs, Woodrow Wilson School of Public and International Affairs, Princeton University, New Jersey.

PRINCIPAL ADDRESS:

A Political Hypochondriac Looks at the Future of Medicine

Don K. Price, Dean of the John Fitzgerald Kennedy School of Government, Harvard University, Cambridge, Massachusetts.

SESSION III. ETHICS AND HEALTH CARE

The programs of three institutions engaged in analytical study of contemporary ethical problems in medicine and health care were described to members in plenary session.

The Joseph and Rose Kennedy Institute for the Study of Human Reproduction and Bioethics (Washington, D.C.)

Andre E. Hellegers, Director.

Institute of Medicine Committee on Human Value Issues in Health Care

F. C. Redlich, member of the faculty in psychiatry at Yale University, on sabbatical at the Center for Advanced Study in the Behavioral Sciences, Stanford University, Stanford, California.

Institute of Society, Ethics and the Life Sciences (Hastings-on-Hudson, New York)

Daniel Callahan, Director.

CLOSING REMARKS: John R. Hogness.

AUTUMN MEETING, 1973

The third autumn meeting of the Institute of Medicine was held at the National Academy of Sciences headquarters on November 15. The meeting was designed as a debate. Three pairs of speakers argued the merits of three respective resolutions concerning medical practice, research, and education. No attempt was made to develop an Institute consensus on the issues posed.

The first resolution and debaters: *That specific standards for professional practice be defined and serve as the basis for taking corrective action against practitioners who fail to meet these standards.*

PRO: F. William Dowda, Practicing Physician, Atlanta, Georgia.

CON: Kerr L. White, Professor of Medical Care and Hospitals, Johns Hopkins School of Public Health.

The second resolution and debaters: *That the definition of priorities for biomedical research is primarily the responsibility of society as a whole rather than the scientific community.*

PRO: Paul H. O'Neill, Associate Director of Human and Community Affairs, Office of Management and Budget, Executive Office of the President, Washington, D.C.

CON: Robert Q. Marston, Distinguished Fellow of the Institute of Medicine, National Academy of Sciences, Washington, D.C.; Scholar in Residence, University of Virginia School of Medicine, Charlottesville, Virginia.

The third resolution and debaters: *That capitation grants for health professional students should be paid directly to the students rather than to the teaching institutions.*

PRO: Stuart H. Altman, Deputy Assistant Secretary for Planning and Evaluation, Department of Health, Education, and Welfare, Washington, D.C.

CON: Eli Ginzberg, Director of the Program in Conservation of Human Resources, Columbia University, New York, New York.

An introductory session for members elected in 1973 was held during the afternoon of November 14. The agenda included presentation and discussion of the Institute's organization and program activities.

SPRING MEETING, 1974

The Institute's third spring meeting, the second general meeting of the 1974 fiscal year, was held on May 8 and 9. It was devoted entirely to issues of health manpower. The program consisted of principal speakers, panel discussions, and membership small-group discussions. The invited papers and final summation were published by the Institute as *Manpower for Health Care.*

SESSION I. IS THERE A PROBLEM OF SUPPLY?

Remarks by the Moderator

John R. Hogness, Past President of the Institute of Medicine; President of the University of Washington, Seattle, as of April 1, 1974.

An Overview of the Factors and Issues Involved

Merlin K. DuVal, Vice President for Health Sciences, University of Arizona, Tucson, Arizona.

Health Manpower Forecasting: Current Methodology and its Impact on Health Manpower Policy

Uwe E. Reinhardt, Assistant Professor of Economics, Princeton University, Princeton, New Jersey.

Small group discussions followed.

SESSION II. WHAT ARE THE PROBLEMS OF DISTRIBUTION?

Remarks by the Moderator

Adam Yarmolinsky, Ralph Waldo Emerson Professor of the University of Massachusetts, Boston, Massachusetts.

The Distribution of Physicians Geographically and by Specialty

Kenneth M. Endicott, Administrator, Health Resources Administration, Department of Health, Education, and Welfare, Rockville, Maryland.

The Use of Non-Physicians in Health Care

Charles E. Lewis, Professor of Medicine, Public Health and Nursing, School of Medicine, University of California at Los Angeles.

Small group discussions followed.

SESSION III. WHAT POLICY ACTIONS NEED TO BE TAKEN NOW?

Remarks by the Moderator

Donald S. Fredrickson, President designate of the Institute of Medicine; Director of Intramural Research of the National Heart and Lung Institute.

Proposals for U.S. Action

Henry E. Simmons, Deputy Assistant Secretary for Health, Department of Health, Education, and Welfare.

The Approach Taken by Canada

John R. Evans, President, University of Toronto.

The presentations by Dr. Simmons and Dr. Evans were followed by comments from a panel consisting of:

John A. D. Cooper, President of the Association of American Medical Colleagues, Washington, D.C.

Walter J. McNerney, President of the Blue Cross Association, Chicago, Illinois.

Leo J. Gehrig, Vice President of the American Hospital Association, Chicago, Illinois.

Small group discussions followed.

A summary of the day-and-a-half proceedings, including some observations from the small-group discussions, was presented by John Iglehart, health affairs reporter for *National Journal Reports.*

Dr. Fredrickson's formal succession to the Institute presidency was marked in brief ceremonies on the afternoon of May 8. John R. Hogness, departing president, was presented with an illuminated scroll of tribute, signed by all the present and past Council members. Academy president Philip Handler attended to give official notice of the transfer of authority from Dr. Hogness to Dr. Fredrickson.

CHARTER AND BYLAWS

INSTITUTE OF MEDICINE

Preamble

The growth of knowledge in the health sciences has greatly expanded the capabilities of medicine. Rising expectations of better health and of improved quality of life for all members of our society now include good health care as a universal human right and as a goal of this society. The provision of such care places increasingly heavy demands on health services and on their complex relations with other sectors of society. The resulting expansion of requirements for health manpower and the continuing need to provide for further scientific progress present grave challenges to our medical and social institutions. These developments have generated the need for a national institution, composed of individuals of distinction and achievement, committed to the advancement of the health sciences and education and to the improvement of health care.

Charter

Under the terms of its charter, the National Academy of Sciences is enjoined to marshal the scientific and technical wisdom of the United States in the national interest, particularly to provide advisory services to departments of the United States government. The problems posed in provision of health services are so large, complex and important as to require, for their solution, the concern and competences not only of medicine, but also of other disciplines and professions. To provide an instrument adequate to these complex problems, and as an indication of the great significance of health care in our national life, the Council of the National Academy of Sciences hereby authorizes the creation of the Institute of Medicine. This Institute shall be broadly based in medicine and the medical sciences, and related aspects of such other fields as the behavioral and social sciences, administration, law and engineering. The Institute of Medicine shall be concerned with the protection and advancement of the health of the public, including, *inter alia:* the provision of health care; education for the health and medical professions and sciences; and the promotion of biomedical research and development.

In the pursuit of this purpose, the Institute of Medicine will

(1) identify, for study and analysis, important issues and problems that relate to health and medicine;

(2) prepare authoritative statements on these issues and problems when, in the judgment of the Institute, such statements would be in the interest of the public;

(3) initiate and conduct studies largely concerned with broad aspects of national policy and planning for health care and health related education and research;

(4) develop proposals for specific studies, generally concerned with the technical, substantive aspects of medical care or its scientific basis, by the National Research Council or other bodies;

(5) review, at the request of the President of the National Academy of Sciences, programs, proposals and reports generated by the National Research Council;

(6) respond to requests from the federal government and other agencies for studies and advice on matters relating to health and medicine;

(7) establish liaison with the major scientific and professional societies concerned with health and medicine;

(8) identify appropriate individuals to serve on study groups operating under the aegis of other units of the NAS/NRC; and

(9) disseminate information to the public and the relevant professions.

I.

Membership

1. The membership of the Institute shall consist of not more than four hundred (400) persons selected from the fields of health and medicine—clinical medicine, medical education, the medical sciences, nursing, dentistry and other health professions—and from other fields related to health and medicine such as the natural, social and behavioral sciences, law, administration, government service and engineering. No more than three-quarters of the members shall be drawn from the fields of health and medicine.

2. Membership in the Institute shall be based upon

a. Professional achievement in a medical, scientific or other professional field and the relevance of such achievement to the problems of medicine; and

b. Demonstrated interest, concern and involvement with problems and critical issues in health care, prevention of disease, medical education and medical research; and

c. Expressed willingness to commit a significant portion of time to work, within the Institute, on such problems or issues.

3. The charter membership of the Institute shall consist of those members of the Board on Medicine who signify their desire and willingness to accept the responsibilities of membership in the Institute, together with those members of the Section on Medical Sciences of the National Academy of Sciences who similarly signify their desire and willingness to accept the responsibilities of membership in the Institute and are within the age limitations for membership specified below. Within six months of the formal activation of the Institute, the Council shall nominate a number of qualified individuals sufficient to bring the total membership to no more than one hundred (100), subject to the approval of the Council of the National Academy of Sciences for appointment by the President of the Academy. In subsequent years, the members of the Institute shall elect additional members, subject to the approval of the President and the Council of the National Academy of Sciences.

4. Members shall be elected for a term of five years, and may be reelected for not more than one additional term of five years. Upon completing the number of terms for which he has been elected, or at the end of the calendar year in which he reaches his sixty-sixth birthday, whichever is the earlier, a member shall become a Senior Member. Senior Members shall not be counted in the authorized total of membership. They may participate in all the activities of the Institute, except that they shall not be officers or members of the Council, nor shall they cast a vote in the affairs of the Institute.

II.

Officers and Committees

1. The governance of the Institute shall be the responsibility of the officers and committees noted below. In each instance, initiative in the selection of such in-

dividuals shall rest with the Institute; appointment to these positions shall be made by the President of the National Academy of Sciences.

2. A Council consisting of twenty-one (21) members shall serve as the governing body of the Institute.

3. The initial membership of the Council shall consist of those members of the Board on Medicine who signify their desire and willingness to accept the responsibilities of membership in the Institute and service on its Council. Initial members shall be designated by lot to serve for a term of one, two, or three years, one-third of the membership to serve for each term, respectively. Vacancies on the Council shall be filled by election by the membership of the Institute, for a term of three years. Members may be elected to successive terms. No more than three-fourths of the members shall be selected from the fields of health and medicine.

4. An Executive Committee of the Council will act for the Council in the interim between meetings of the Council.

5. The Executive Committee will be composed of five (5) members of the Council, designated at the beginning of each year by the President with the approval of the Council. The President of the Institute shall serve as chairman of the Executive Committee.

6. At least one member shall be from a field other than the health professions.

7. The Committee will meet on call by the President.

8. Actions of the Executive Committee are subject to ratification by the Council.

9. The President of the Institute shall be a full-time paid officer nominated by the Council and appointed by the President of the National Academy of Sciences with the approval of the Council of the National Academy of Sciences. He shall normally serve an initial term of no more than five years, renewable by the same appointive procedure. He shall employ such other persons as are necessary for the business of the Institute, subject to the approval of the Council.

10. The President of the Institute shall serve as Chairman of the Council. The Council may elect from its membership such other officers as it may wish to designate.

11. Subject to the approval of the Council, the President shall appoint a Program Committee, a Membership Committee, and a Finance Committee and shall make appropriate provision for rotation of membership on these committees. The President may appoint such other internal committees as he deems appropriate.

12. The membership of Committees conducting studies and preparing reports for dissemination outside the National Academy of Sciences shall be subject to review by the President of the Academy.

III.

Program and Budget

1. With the advice of the Program Committee, the President shall annually prepare and submit to the Council of the Institute and to the Council of the National Academy of Sciences for approval a program of studies to be conducted by the Institute, including ongoing studies. Subject to appropriate financing, the President shall have authority to make arrangements for the conduct of such studies as are contained within the approved program.

2. With the approval of the Council of the Institute and of the President of the National Academy of Sciences, the President of the Institute shall make appropriate arrangements for the release of reports of studies, including interim reports. Approval by the Council shall constitute certification of the scientific competence and validity of such reports and recommendation for their public release.

3. With the advice of the Finance Committee, the President shall prepare and submit to the Council at least once a year a budget for the operations of the Institute, including the costs of individual studies. The Council shall forward its recommended budget for approval to the President and the Council of the National Academy of Sciences. The President is authorized to expend and to delegate the expenditure of funds within the currently approved budget. Between annual budgetary submissions, the President may be authorized by the President, National Academy of Sciences, to make expenditures outside the previously authorized budget, provided financing is assured.

4. In consultation with the President of the National Academy of Sciences and the Council of the Institute, the President of the Institute shall engage in appropriate fund raising activities including development of an endowment for support of the activities of the Institute.

5. Through its President and staff, the Institute shall maintain appropriate liaison with all units of the National Research Council and maintain a special relationship with the Division of Medical Sciences of the National Research Council (NRC). The Chairman of the Division of Medical Sciences, NRC, shall be an *ex officio* member of the Council of the Institute and shall also serve as member and chairman of a four-member joint Institute-NRC committee. The other members of the joint committee shall be: the President of the Institute, one member of its Council, and a fourth member to be appointed by the President of the National Academy of Sciences. This committee must approve all projects to be conducted for the Institute by the Division of Medical Sciences, NRC. In the event there should be significant disagreement concerning the initiation of a project, the issue shall be decided by the President and Council of the National Academy of Sciences. A member of the Council of the Institute, to be elected by the Council of the Institute, shall serve as a member of the executive committee of the Division of Medical Sciences, NRC.

6. Programs which are undertaken by the Institute outside of the United States or which have substantial international implications shall be developed and operated in consultation with the Foreign Secretary of the National Academy of Sciences.

IV.

Annual Report

1. The President shall prepare an annual report on the work of the Institute, and shall submit it, through the Council, to the President and Council of the National Academy of Sciences no later than two months after the conclusion of each fiscal year.

V.

Amendments and Bylaws

1. This charter may be amended by mutual agreement between the Council of the National Academy of Sciences and the Council of the Institute, acting for a majority of the membership, as ascertained either at an annual meeting or by mail ballot.

2. The Council is authorized to prepare a set of Bylaws consistent with this charter and to propose amendments to such Bylaws from time to time, subject to the approval of a majority of those voting either at an annual meeting of the membership or by mail ballot.

VI.

Effective Date

1. This charter shall take effect on a date specified by the President of the National Academy of Sciences not more than sixty days after it is approved by the Council of the National Academy of Sciences.

2. All authorities and responsibilities vested in the Board on Medicine will be transferred to the Institute of Medicine as of that date.

BYLAWS

I.

Election of Members

1. Immediately after the activation of the Institute, the Council shall designate an initial Membership Committee. Within ninety (90) days from the activation of the Institute, the initial Membership Committee shall prepare a list of candidates containing at least fifty (50) percent more names than the number of places designated by the Council to be filled in the initial election. This list shall be voted on by the Council within sixty (60) days after it is submitted; the nominees receiving the highest number of votes, up to the number of places designated and subject to the limitation of the proportion of members from the medical and health professions, shall be deemed to be elected, subject to review by the Council, National Academy of Sciences.

2. Thereafter, each year the Membership Committee shall before the last day of March prepare a list of candidates containing at least fifty (50) percent more names than the number of places designated to be filled by the Council. Thereupon, the President shall cause a mail ballot containing appropriate biographical information to be prepared and circulated to the membership, returnable by the last of April. Each member may vote for a number of candidates up to the total number designated by the Council, and the candidates receiving the largest numbers of votes up to the total number designated and subject to the limitation on the proportion of members from the medical and health professions shall be deemed to be elected, as above.

II.

Officers and Council

1. The President of the Institute shall be selected by the initial Council as soon as possible after the activation of the Institute. If no appointment has been made within ninety (90) days, the Council shall elect one of their number Acting President until such time as a President shall take office.

2. The willingness of members of the Board on Medicine to become members of the initial Council of the Institute shall be determined in advance of the date of activation of the Institute. Nominations for vacancies occurring on the Council shall be made by the Council by the last day of September and mail ballots shall be distributed to the membership thereafter, returnable by the last day of November. Names may be added to the ballot by petition, signed by ten (10) percent of the membership, and timely notice of such opportunity shall be provided to the membership.

III.

MEETINGS

1. There shall be an annual meeting of the membership of the Institute to be held in Washington D.C. or at such other place designated by the Council.

2. The Council shall meet not less than six times a year.

3. The substantive program of the Institute shall be presented annually for consideration at a meeting of the membership.

Charter and Bylaws approved by the Council of the National Academy of Sciences on August 24, 1970, and amended February 1972 and January 1973.

The Institute of Medicine was activated on December 17, 1970.

ORGANIZATION OF THE INSTITUTE

January 1, 1974

President—John R. Hogness
Executive Officer—Roger J. Bulger

COUNCIL

William O. Baker (1975)
Guido Calabresi (1976)
Martin Cherkasky (1974)
#Clifton O. Dummett (1975)
#Loretta C. Ford (1975)
Donald S. Fredrickson (1974)
Bernard G. Greenberg (1974)
*David A. Hamburg (1974)
Howard H. Hiatt (1976)
Alvin J. Ingram (1974)
David Mechanic (1974)
Dorothy P. Rice (1976)
Julius Richmond (1975)
#*Walter A. Rosenblith (1976)
*Rozella M. Schlotfeldt (1974)
Nathan J. Stark (1976)
#*Lewis Thomas (1975)
J. F. Volker (1976)
Kerr L. White (1976)
*Adam Yarmolinsky (1975)
Paul A. Marks, *ex officio*

(Terms end on December 31 of the year indicated.)

MEMBERS

(As of June 30, 1974)

Abelson, Philip H. (1973), President, Carnegie Institution of Washington, 1530 P Street, N.W., Washington, D.C. 20005.

Ahrens, E. H., Jr. (1973), Professor, The Rockefeller University, 66th Street and York Avenue, New York, New York 10021

Alberty, Robert A. (1973), Dean of Science, Massachusetts Institute of Technology, MIT 6–215, Cambridge, Massachusetts 02139

Anderson, Odin W. (1973), Professor and Director, Center for Health Administration Studies, University of Chicago, 5720 South Woodlawn Avenue, Chicago, Illinois

Andreoli, Kathleen G. (1972), Educational Director, Physician's Assistant Program, The University of Alabama in Birmingham, University Station, Birmngham, Alabama 35294

Anylan, William G. (1971), Vice President for Health Affairs, Duke University Medical Center, Durham, North Carolina 27710

*Member of Executive Committee.
#Member of Report Review Committee.

Armistead, W. W. (1973), Dean, College of Veterinary Medicine, Box 1071, University of Tennessee, Knoxville, Tennessee 37901

Arrow, Kenneth J. (1974), Professor of Economics, Project on Efficiency of Decision Making in Economic Systems, Harvard University, 1737 Cambridge Street, Room 401, Cambridge, Massachusetts 02138

Austen, W. Gerald (1974), Professor of Surgery, Chief, Surgical Services, Harvard Medical School, Massachusetts General Hospital, Department of Surgery, Fruit Street, Boston, Massachusetts 02114

Aydelotte, Myrtle K. (1973), Director, Department of Nursing, University of Iowa Hospitals and Clinics, The University of Iowa, Iowa City, Iowa 52242

Baker, William O. (1972), President, Bell Telephone Laboratories, 600 Mountain Avenue, Murray Hill, New Jersey 07974

Ball, Robert M. (1974), Scholar-in-Residence, Institute of Medicine, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, D.C. 20418

Barger, A. Clifford (1974), Robert Henry Pfeiffer Professor and Chairman, Department of Physiology, Harvard Medical School, 25 Shattuck Street, Boston, Massachusetts 02115

Barnes, Allan C. (1971), Vice President, The Rockefeller Foundation, 111 West 50th Street, New York, New York 10020

Barondess, Jeremiah A. (1971), Clinical Professor of Medicine, Cornell University Medical College, 449 East 68th Street, New York, New York 10021

Bateman, Mildred Mitchell (1973), Director, West Virginia Department of Mental Health, State Capitol, Charleston, West Virginia 25305

Bearn, Alexander G. (1971), Chairman, Department of Medicine, New York Hospital—Cornell Medical Center, 525 East 68th Street, New York, New York 10021

Beddingfield, Edgar T., Jr. (1973), Practitioner of Medicine, Wilson Clinic, Wilson, North Carolina 27893

*Beeson, Paul B. (1970), Seattle Veterans Administration Hospital, 4435 Beacon Avenue, South, Seattle, Washington 98108

*Bennett, Ivan L., Jr. (1970), Director, New York University Medical Center, 550 First Avenue, New York, New York 10016

Berg, Paul (1974), Jack, Lulu and Sam Willson Professor of Biochemistry, Stanford University Medical Center, Stanford, California 94305

Berliner, Robert W. (1971), Dean, School of Medicine, Yale University, 333 Cedar Street, New Haven, Connecticut 06510

Braunwald, Eugene (1974), Hersey Professor of the Theory and Practice of Physic (Medicine), Harvard Medical School, Physician-in-Chief, Peter Bent Brigham Hospital, 721 Huntington Avenue, Boston, Massachusetts 02115

Brodie, Bernard B. (1971), Eden Rock Gardens, Apt. 272, 3940 E. Timrod Street, Tucson, Arizona 85711

Brooks, Harvey (1973), Dean of Engineering & Applied Physics, 217 Pierce Hall, Harvard University, Cambridge, Massachusetts 02138

Bryant, John H. (1971), Joseph R. DeLamar Professor of Public Health, Director, Center for Community Health Systems, Faculty of Medicine, Columbia University, 600 West 168th Street, New York, New York 10032

Bryant, Thomas E. (1972), President, The Drug Abuse Council, 1828 L Street, N.W., Washington, D.C. 20036

Burns, John J. (1971), Vice President for Research, Hoffman-La Roche, Inc., Nutley, New Jersey 07110

Burwell, E. L. (1971), 114 Locust Street, Falmouth, Massachusetts 02540

Busse, Ewald W. (1972), Director, Medical and Allied Health Education, Duke University Medical Center, Durham, North Carolina 27710

*Denotes Charter Members.

Butler, Lewis H. (1973), Adjunct Professor of Health Policy, Health Policy Program, University of California School of Medicine, San Francisco, California 94143

Calabresi, Guido (1973), John Thomas Smith Professor of Law, Yale Law School, Drawer 410A, Yale Station, New Haven, Connecticut 06520

Callahan, Daniel (1972), Director, Institute of Society, Ethics and the Life Sciences, 623 Warburton Avenue, Hastings-on-Hudson, New York 10706

Carey, William D. (1974), Vice President, Arthur D. Little, Inc., 1735 Eye Street, N.W., Washington, D.C. 20006

Chalmers, Thomas C. (1974), President and Dean, Mt. Sinai School of Medicine of the City University of New York, Mt. Sinai Medical Center, Fifth Avenue and 100th Street, New York, New York 10029

Chapman, Carleton B. (1972), Vice President, The Commonwealth Fund, One East 75th Street, New York, New York 10021

Chase, Robert A. (1971), President and Director, National Board of Medical Examiners, University of Pennsylvania, Stanford University, National Board of Medical Examiners, 3930 Chestnut Street, Philadelphia, Pennsylvania 19104

Cherkasky, Martin (1971), Director, Montefiore Hospital and Medical Center, 111 East 210th Street, Bronx, New York 10467

*Child, Charles G., III (1970), Professor, Department of Surgery, University of Michigan Medical School, University Hospital, Ann Arbor, Michigan 48104

Christman, Luther (1972), Dean, Rush College of Nursing and Allied Health Sciences, Rush-Presbyterian-St. Luke's Medical Center, 1753 West Congress Parkway, Chicago, Illinois 60612

Cobb, Jewel P. (1974), Dean, Connecticut College, New London, Connecticut 06320

Cobbs, Price M. (1972), 3528 Sacramento Street, San Francisco, California 94118

Cohen, Seymour S. (1973), American Cancer Society Professor of Microbiology, University of Colorado School of Medicine, Denver, Colorado 80220

Cohen, Wilbur J. (1972), Dean, School of Education, The University of Michigan, East and South University Avenues, Ann Arbor, Michigan 48104

Coles, Anna B. (1974), Professor and Dean, Howard University School of Nursing, 6th and Bryant Streets, N.W., Washington, D.C. 20001

Coles, Robert (1973), Research Psychiatrist, Harvard University Health Services, 75 Mt. Auburn Street, Cambridge, Massachusetts 02138

Collen, Morris F. (1971), Director, Medical Methods Research, The Permanente Medical Group, 3779 Piedmont Avenue, Oakland, California 94611

*Comroe, Julius, Jr. (1970), Director, Cardiovascular Research Institute, University of California at San Francisco, San Francisco, California 94143

Cooke, Robert E. (1971), Vice Chancellor for Health Sciences and Professor of Pediatrics, University of Wisconsin-Madison, Room 1007–WARF Office Building, 610 North Walnut Street, Madison, Wisconsin 53706

Cooper, John A. D. (1972), President, Association of American Medical Colleges, Suite 200, One Dupont Circle, N.W., Washington, D.C. 20036

Cooper, Theodore (1974), Deputy Assistant Secretary for Health, Department of Health, Education and Welfare, HEW–N, Room 5067, 330 Independence Avenue, S.W., Washington, D.C. 20201

Cox, Jerome R., Jr. (1971), Director, Biomedical Computer Laboratory, Washington University School of Medicine, 700 South Euclid Avenue, St. Louis, Missouri 63110

Cross, Harold D. (1971), Main Road, Hampden Highlands, Maine 04445

Crow, James F. (1973), Professor of Medical Genetics, Genetics Building, University of Wisconsin, Madison, Wisconsin 53706

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*Denotes Charter Members.

Daddario, Emilio Q. (1972), Office of Technology Assessment, 119 D Street, N.E., Room 721, Washington, D.C. 20510

Danforth, William H. (1971), Chancellor, Washington University, St. Louis, Missouri 63110

Daniels, Arlene Kaplan (1974) Chief, Center for the Study of Women in Society, Scientific Analysis Corporation, 4339 California Street, San Francisco, California 94118

Denenberg, Herbert S. (1973), Visiting Professor, Temple University Law School, Chief Counsel, Pennsylvania Public Utilities Commission, (Pennsylvania Public Utilities Commission), Commonwealth of Pennsylvania, Harrisburg, Pennsylvania 17120

Densen, Paul M. (1972), Director, Center for Community Health and Medical Care, Harvard University, 643 Huntington Avenue, Boston, Massachusetts 02115

Detweiler, David K. (1974), Professor of Physiology, Director, Comparative Cardiovascular Studies Unit, University of Pennsylvania, School of Veterinary Medicine, 3800 Spruce Street, Philadelphia, Pennsylvania 19104

Deuschle, Kurt W. (1971), Ethel H. Wise Professor of Community Medicine and Chairman of the Department, Mount Sinai School of Medicine, Fifth Avenue and 100th Street, New York, New York 10029

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Dorfman, Albert (1973), Professor of Pediatrics and Biochemistry, University of Chicago, 950 E. 59th Street, Chicago, Illinois 60637

Dowda, F. William (1971), 490 Peachtree Street, N.E., Atlanta, Georgia 30308

Dummett, Clifton O. (1972), Associate Dean for Extramural Affairs, Professor and Chairman, Department of Community Dentistry, University of Southern California, School of Dentistry, P.O. Box 77006, Los Angeles, California 90007

DuVal, Merlin K. (1973), Vice President, Health Sciences, University of Arizona, Tucson, Arizona 85724

Ebert, James D. (1974), Director, Department of Embryology, Carnegie Institution of Washington, 115 West University Parkway, Baltimore, Maryland 21210

Ebert, Robert H. (1971), Dean, The Harvard Medical School, 25 Shattuck Street, Boston, Massachusetts 02115

Edwards, Adrian L. (1973), Practitioner of Internal Medicine and Cardiology, Clinical Assistant Professor of Medicine, Cornell University Medical College, 135 East 71st Street, New York, New York 10021

Eisen, Herman N. (1974), Professor of Immunology, Center for Cancer Research, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139

Eisenberg, Leon (1973), Professor and Chairman, Department of Psychiatry, Harvard Medical School, Psychiatric Service, Children's Hospital Medical Center, Boston, Massachusetts 02115

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Elam, Lloyd C. (1971), President, Meharry Medical College, 1005 18th Avenue, North, Nashville, Tennessee 37208

Ellis, Effie O. (1972), Special Assistant for Health Services, Office of the Executive Vice President, American Medical Association, 535 North Dearborn Street, Chicago, Illinois 60610

Ellwood, Paul M., Jr. (1974), President, INTERSTUDY, 123 East Grant Street, Minneapolis, Minnesota 55403

English, Joseph T. (1971), Director of Psychiatry, St. Vincent's Hospital and Medical Center of New York, 144 West 12th Street, New York, New York 10011

Enthoven, Alain C. (1972), Marriner S. Eccles Professor of Public and Private Management, Graduate School of Business, Stanford University, Stanford, California 94305

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Fischer, A. Alan (1971), Director, Family Practice Program, Indiana University School of Medicine, Fesler Hall 205, 110 West Michigan Street, Indianapolis, Indiana 46202

Fleming, Scott (1974), Senior Vice President and Regional Manager, Kaiser Foundation Health Plan, Oregon Region, and Kaiser Foundation Hospitals, Oregon Region, Kaiser-Permanente Medical Care Program, 1500 S.W. First Avenue, Portland, Oregón 97201

Ford, Loretta C. (1971), Dean, School of Nursing, University of Rochester Medical Center, 260 Crittenden Boulevard, Rochester, New York 14642

Foster, Henry W. (1972), Professor and Chairman, Department of Obstetrics and Gynecology, Meharry Medical Collegee, 1005 18th Avenue, North, Nashville, Tennessee 37208

Fredrickson, Donald S. (1971), Director of Intramural Research, National Heart and Lung Institute, National Institutes of Health, Bethesda, Maryland 20014

Freedman, Daniel X. (1974), Louis Block Professor of Biological Sciences and Chairman, Department of Psychiatry, The University of Chicago, 950 East 59th Street, Chicago, Illinois 60637

Freidson, Eliot (1972), Professor, Department of Sociology, New York University, Graduate School of Arts and Sciences, 19 University Place, New York, New York 10003

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Gamble, John R. (1974), Chairman, Department of Medicine, Pacific Medical Center, P. O. Box 7999, San Francisco, California

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Glasser, Melvin A. (1974), Director, Social Security Department, United Auto Workers International Union, 800 East Jefferson Avenue, Detroit, Michigan 48214

*Good, Robert A. (1970), President and Director, Sloan-Kettering Institute for Cancer Research, 1275 York Avenue, New York, New York 10021

Gottschalk, Carl W. (1973), Career Investigator, American Heart Association, Kenan Professor of Medicine and Physiology, Department of Medicine, The University of North Carolina, Chapel Hill, North Carolina 27514

Greenberg, Bernard G. (1972), Dean, School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27514

Greenlick, Merwyn R. (1971), Director, The Health Services Research Center, Kaiser Foundation Hospitals, 4610 S.E. Belmont Street, Portland, Oregon 97215

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Hamburg David A. (1971), Reed-Hodgson Professor of Human Biology and Psychiatry, Stanford University School of Medicine, 300 Pasteur Drive, Stanford, California 94305

Harrington, Donald C. (1972), Medical Director, Foundation for Medical Care of San Joaquin County, 540 East Market Street, P.O. Box 230, Stockton, California 95201

Harris, LaDonna (1972), President, Americans for Indian Opportunity, Incorporated, 1816 Jefferson Place, N.W., Washington, D.C. 20036

Haughton James G. (1972), Executive Director, Health and Hospitals Governing Commission of Cook County, 1900 West Polk Street, Chicago, Illinois 60612

Haviland, James W. (1973), Practitioner of Medicine, Clinical Professor of Medicine, Associate Dean for Clinical Affairs, University of Washington School of Medicine, Seattle, Washington 98195

Hawthorne, Edward W. (1972), Research Professor and Chairman, Department of Physiology and Biophysics, Howard University College of Medicine, 520 W Street, N.W., Washington, D.C. 20059

Hayes, George J. (1972), Major General MC USA, Principal Deputy Assistant Secretary of Defense (Health and Environment), Office of the Secretary of Defense, Room 3E172 Pentagon, Washington, D.C. 20301

Haynes, M. Alfred (1973), Professor and Chairman, Department of Community Medicine, Charles R. Drew Postgraduate Medical School, 1621 East 120th Street, Los Angeles, California 90059

*Denotes Charter Members.

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Haywood, H. Carl (1972), Kennedy Professor of Psychology (Professor of Neurology, Vanderbilt), The John F. Kennedy Center for Research on Education and Human Development, Box 40, George Peabody College for Teachers, Nashville, Tennessee 37203

Henderson, Maureen (1974), Professor and Chairman, Department of Social and Preventive Medicine, University of Maryland School of Medicine, 31 South Greene Street, Baltimore, Maryland 21201

Hershey, Nathan (1972), Professor of Health Law, Department of Public Health Practice, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, Pennsylvania 15261

Hess, Arthur E. (1974), Deputy Commissioner, Social Security Administration, Altmeyer Building—Room 900, 6401 Security Boulevard, Baltimore, Maryland 21235

Heyssel, Robert M. (1972), Executive Vice President and Director, The Johns Hopkins Hospital, 601 North Broadway, Baltimore, Maryland 21205

Hiatt, Howard H. (1971), Dean, Harvard School of Public Health, 677 Huntington Avenue, Boston, Massachusetts 02115

Hirsch, James G. (1974), Dean of Graduate Studies, Professor and Senior Physician, The Rockefeller University, New York, New York 10021

Hobbs, Nicholas (1974), Provost, Vanderbilt University, Nashville, Tennessee 37240

Hogness, John R. (1971), President, University of Washington, 301 Administration Building, AH-30, Seattle, Washington 98195

Holloman, John L. S. (1972), President, New York City Health and Hospitals Corporation, 125 Worth Street, New York, New York 10013

Hutt, Peter Barton (1971), Assistant General Counsel, Food and Drug Division, Department of Health, Education, and Welfare, 5600 Fishers Lane, Rockville, Maryland 20852

Ingram, Alvin J. (1971), Chief, The Campbell Clinic, Chairman of Orthopedics, University of Tennessee College of Medicine, 869 Madison Avenue, Memphis, Tennessee 38104

Isselbacher, Kurt J. (1974), Mallinckrodt Professor of Medicine, Harvard Medical School, and Chief, Gastrointestinal Unit, Massachusetts General Hospital, Boston, Massachusetts 02114

*Jacobson, Leon O. (1970), Dean, Division of Biological Sciences and the Pritzker School of Medicine, The University of Chicago, 950 East 59th Street, Box 417, Chicago, Illinois 60637

Johnson, Jean E. (1974), Professor and Director, Center for Health Research, College of Nursing, Wayne State University, 5557 Cass Avenue, Detroit, Michigan 48202

Kaplan, Henry S. (1972), Maureen Lyles D'Ambrogio Professor of Radiology and Oncology, Department of Radiology, Stanford University Medical Center, Stanford, California 94305

Keene, Clifford H. (1971), President, Kaiser Foundation Hospitals, 300 Lakeside Drive, 2730 Ordway Building, Oakland, California 94666

Kelly, James F. (1974), Executive Vice Chancellor, State University of New York, 99 Washington Avenue, Albany, New York 12210

Kempe, C. Henry (1972), Professor and Chairman, Department of Pediatrics, University of Colorado Medical Center, 4200 East Ninth Avenue, Denver, Colorado 80220

Kennedy, Donald (1971), Professor, Department of Biological Sciences, Stanford University, Stanford, California 94305

*Denotes Charter Members.

Kennedy, Eugene P. (1971), Hamilton Kuhn Professor of Biological Chemistry, Harvard Medical School, Boston, Massachusetts 02115

Kety, Seymour S. (1973), Professor of Psychiatry, Harvard Medical School, Massachusetts General Hospital, Boston, Massachusetts 02114

Kibrick, Anne (1971), Director, Department of Nursing, Boston State College, 625 Huntington Avenue, Boston, Massachusetts 02115

Kipnis, David M. (1974), Professor and Chairman, Department of Medicine, Washington University School of Medicine, Physician-in-Chief, Barnes Hospitals, 660 South Euclid Avenue, St. Louis, Missouri 63110

Kirklin, John W. (1972), Fay Fletcher Kerner Professor of Surgery and Chairman of the Department of Surgery, School of Medicine and the Medical Center, University Station, Birmingham, Alabama 35294

Klarman, Herbert E. (1971), Professor of Economics, Graduate School of Public Administration, New York University, Four Washington Square North, New York, New York 10003

Knowles, John H. (1971), President, The Rockefeller Foundation, 111 West 50th Street, New York, New York 10020

*Kunkel, Henry G. (1970), Professor, The Rockefeller University, New York, New York 10016

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STANDING COMMITTEES OF THE INSTITUTE

January 1, 1974

FINANCE COMMITTEE

Chairman, Clifford H. Keene; *Members:* William G. Anylan, Jeremiah A. Barondess, William H. Danforth, Gerard Piel, Nathan J. Stark.

MEMBERSHIP COMMITTEE

Chairman, Howard H. Hiatt; *Members:* Robert W. Berliner, Luther Christman, John A. D. Cooper, F. William Dowda, Loretta C. Ford, Edward W. Hawthorne, Herbert E. Klarman, Joshua Lederberg, Paul A. Marks, J. F. Volker, Kerr L. White, Richard S. Wilbur, Asa G. Yancey, Adam Yarmolinsky.

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*Denotes Charter Members.

PROGRAM COMMITTEE

Chairman, David A. Hamburg; *Members:* Myrtle K. Aydelotte, E. L. Burwell, Carleton B. Chapman, Emilio Q. Daddario, Albert Dorfman, Clifton O. Dummett, Alain C. Enthoven, David A. Hamburg, Walter J. McNerney, David Mechanic, C. Frederick Mosteller, James V. Neel.

PRESIDENTS OF THE INSTITUTE OF MEDICINE

	Dates of Tenure
John R. Hogness, M.D.	August 1, 1971 to April 1, 1974.*

*Roger J. Bulger, Executive Officer of the Institute, assumed the major share of the president's duties between the time of Dr. Hogness's departure and full time assumption of the office July 1, 1974, by Donald S. Frfedrickson, M.D., President Designate.

DECEASED MEMBERS—INSTITUTE OF MEDICINE

Logan, Arthur C.	November 25, 1973
Moore, Carl V.	August 13, 1972
McLeod, Colin	February 12, 1972
Welt, Louis G.	January 13, 1974
Wood, W. Barry Jr.	March 9, 1971 (Charter Member)

RESIGNED FROM INSTITUTE OF MEDICINE

Hewlett, William R.	November 22, 1972
Weed, Lawrence L.	September 19, 1973

*Resigned to become President of the University of Washington, Seattle.

APPENDIX IV

NATIONAL RESEARCH COUNCIL

EXECUTIVE ORDER ISSUED BY THE PRESIDENT OF THE UNITED STATES, MAY 10, 1956

Executive Order No. 2859 of May 11, 1918, relating to the National Research Council is hereby amended to read as follows:

"NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMY OF SCIENCES

"Whereas the National Research Council (hereinafter referred to as the Council) was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness; and

"Whereas in recognition of the work accomplished by the National Academy of Sciences through the Council in organizing research, in furthering science, and in securing cooperation of government and non-government agencies in the solution of their problems, the Council has been perpetuated by the Academy as requested by the President in Executive Order No. 2859 of May 11, 1918; and

"Whereas the effective prosecution of the Council's work requires the close cooperation of the scientific and technical branches of the Government, both military and civil, and makes representation of the Government on the Council desirable:

"Now, Therefore, by virtue of the authority vested in me as President of the United States, it is ordered as follows:

"1. The functions of the Council shall be as follows:

"(*a*) In general, to stimulate research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

"(*b*) To survey the broad possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with such projects.

"(*c*) To promote cooperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

"(*d*) To serve as a means of bringing American and foreign investigators into active cooperation with the scientific and technical services of the Department of Defense and of the civil branches of the Government.

"(*e*) To direct the attention of scientific and technical investigators to the importance of military and industrial problems in connection with national defense, and to aid in the solution of these problems by organizing specific researches.

"(*f*) To gather and collate scientific and technical information, at home and abroad, in cooperation with government and other agencies, and to render such information available to duly accredited persons.

"2. The Government shall be represented on the Council by members who are officers or employees of specified departments and agencies of the executive branch of the Government. The National Academy of Sciences shall specify, from time to time, the departments and agencies from which Government members shall be designated, and shall determine, from time to time, the number of Government members who shall be designated from each such department and agency. The head of each such specified department or agency shall designate the officers and employees from his department or agency, in such numbers as the National Academy of Sciences shall determine, who shall be members of the Council, but shall designate only those persons who are acceptable to the Academy."

This order shall not be construed as terminating the tenure of any person who has heretofore been designated as a member of the Council.

(Signed) DWIGHT D. EISENHOWER.

THE WHITE HOUSE, *May 10, 1956.*

(No. 10668)

ARTICLES OF ORGANIZATION, NATIONAL RESEARCH COUNCIL

The National Academy of Sciences, under the authority conferred upon it by its charter enacted by the Congress and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive order made by President Wilson on May 11, 1918, adopts the following articles of organization for the National Research Council.

ARTICLE I—PURPOSE

It shall be the purpose of the National Research Council to promote research in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with object of increasing knowledge, strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the Executive order of May 11, 1918. To this end and under policies determined by the National Academy of Sciences, the National Research Council shall serve, whenever possible and desirable, as the principal operating agency of the National Academy of Sciences, furnishing professional and research advice to governmental and other organizations, and administering such funds as may be entrusted to it.

ARTICLE II—MEMBERSHIP

SECTION 1. The membership of the National Research Council shall be chosen with the view of making the Council an effective agency of cooperation in the fields of science and technology named in Article I.

SEC. 2. The Council shall be composed of—

1. Representatives of national scientific and technical societies.
2. Representatives of the Government, as provided in the Executive order.
3. Representatives of other research organizations.
4. Persons whose aid may advance the objectives of the Council.

SEC. 3. The membership of the Council shall consist specifically of members of the executive board and the members of the Divisions, constituted as provided in Articles III and IV.

SEC. 4. Membership in the Council shall be limited to citizens of the United States. This, however, shall not be construed as applying to membership in committees appointed by or acting under the Council, whose members are not necessarily members of the Council, provided that members not citizens of the United States shall in no case form a majority of any committee.

Article III—Divisions

Section 1. The National Research Council shall be organized in Divisions dealing with branches of science and technology.

Sec. 2. The Divisions and the grouping of subjects in Article III, Section 1, shall be determined by the Council of the National Academy of Sciences on the recommendation of the executive board of the National Research Council.

Sec. 3. (*a*) Each Division shall consist of a chairman, one or more vice chairmen, such representatives of the Government and of national or international organizations as may seem essential for the conduct of the business of the Divisions, and members at large appointed as provided in Article VI.

(*b*) Each Division shall have an executive committee, consisting of the chairman and three or more of the members, who shall be chosen by the Division at a regular meeting, and hold office for 1 year terminating on June 30. Between meetings of a Division its executive committee shall have power to act on all matters for the Division, except those which may be reserved by the Division for its own action; but the executive committee shall report all its actions to the Division.

(*c*) The terms of office of the chairmen of Divisions shall be so arranged by the Chairman of the National Research Council that approximately one-third of these terms expire each year.

(*d*) The terms of the vice chairmen of Divisions shall be for 1 year.

Sec. 4. The chairman of each Division shall be, ex-officio, a member of all committees of the Division.

Sec. 5. Actions by the Divisions involving matters of policy shall be subject to approval by the executive board.

Article IV—Administration

Section 1. The general officers of the National Research Council shall be a Chairman, chosen as provided in Article V, Section 1, and such other officers as may be appointed by the Council of the Academy on recommendation of the Chairman of the National Research Council.

Sec. 2. The affairs of the National Research Council shall be administered by the Chairman of the National Research Council, with the advice and counsel of the executive board. Actions involving financial responsibilities or the appointment of general officers must be approved by the Council of the Academy, or the executive committee of the Council of the Academy.

Sec. 3. The executive board shall consist of the chairman and officers of the National Research Council; the chairmen of the Divisions of the Council; and ex officio, members of the executive committee of the Council of the National Academy of Sciences (who may, but shall not be required to, attend meetings of the board since matters of policy will be acted on by the Council of the Academy or its executive committee). The Council of the Academy, on the recommendation of the Chairman of the National Research Council, may add members to the executive board for specified terms of office.

Article V—Appointment and Duties of Officers of the Research Council

Section 1. The Chairman of the National Research Council shall be appointed by the Council of the National Academy of Sciences, and shall hold office at the pleasure of that Council. The Chairman shall be the executive officer of the National Research Council and shall have charge of its general administration. He shall act as chairman of its executive board in the absence of the president and vice president of the Academy.

Sec. 2. In case of the absence or disability of the Chairman of the National Research Council an Acting Chairman may be appointed by the Council of the

National Academy of Sciences, or by the executive committee of the Council of the Academy.

SEC. 3. There may be appointed by the Council of the National Academy of Sciences upon recommendation of the Chairman of the National Research Council one or more vice chairmen, who shall have such duties as may be prescribed by the Chairman of the National Research Council.

ARTICLE VI—NOMINATION AND APPOINTMENT OF OFFICERS AND MEMBERS OF DIVISIONS

SECTION 1. (*a*) The chairman of each Division shall be appointed for 3 years by the Council of the National Academy of Sciences upon nomination by the Chairman of the National Research Council in consultation with the executive committee of the Division concerned. The chairman shall direct the work of the Division. The foreign secretary of the National Academy of Sciences shall be chairman of the Policy Committee of the Office of International Relations.

(*b*) The organizations to be represented in each of the Divisions shall be determined by the executive board on the recommendation of the Division concerned.

(*c*) The representatives of organizations in each Division shall be nominated by the organizations, upon invitation of the chairman of the Division, and upon the recommendation of the Chairman of the National Research Council shall be appointed by the president of the National Academy of Sciences to membership in the National Research Council for a term of 3 years, and assigned to the Division.

(*d*) Members at large, if any, in each Division shall be nominated by the Division concerned, and upon recommendation of the Chairman of the National Research Council shall be appointed by the president of the National Academy of Sciences to membership in the National Research Council for a term of 3 years, and assigned to the Division.

SEC. 2. The Government bureaus, civil and military, to be represented in the Divisions of the National Research Council shall be determined by the executive board upon recommendation of the Chairman of the National Research Council in consultation with the divisional chairman concerned.

SEC. 3. The representatives of the Government shall be selected by the Secretaries of the departments or the heads of the independent agencies concerned, after conference with the Chairman of the National Research Council, and the names of those thus proposed shall be presented to the president of the National Academy of Sciences to be nominated by him to the President of the United States for designation for service with the National Research Council. Each Government representative shall serve during the pleasure of the President of the United States, not to exceed a term of 3 years.

SEC. 4. The term of office of officers and members, unless otherwise provided, shall terminate on June 30 of the year in which the appointments expire.

SEC. 5. Vacancies occurring in the Division may be filled for the unexpired term by the method used for the original appointment.

SEC. 6. In a national emergency the Council of the Academy, with the advice of the Chairman of the National Research Council, may reorganize any Division without regard for the procedures of Article VI.

ARTICLE VII—MEETINGS

SECTION 1. Regular meetings of the executive board shall be held in the city of Washington once each month except during July and August, at such dates as shall be determined by the Chairman of the National Research Council. A majority of the members of the board, other than those representing the executive committee of the

Council of the National Academy of Sciences, shall constitute a quorum for the transaction of business.

SEC. 2. Each Division shall hold at least one stated meeting during the year, at a time to be determined by the chairman of the Division in consultation with the Chairman of the National Research Council. Special meetings may be called at other times by the chairman of the Division.

ARTICLE VIII—REPORTS

SECTION 1. An annual report on the work of the National Research Council shall be presented by the Chairman to the National Academy of Sciences for inclusion in the annual report of the Academy to Congress.

ARTICLE IX—AMENDMENTS

SECTION 1. By action of the National Academy of Sciences on April 29, 1919, power of amendment of these articles of organization is given to the Council of the National Academy of Sciences.

BYLAWS

Executive Board

1. The executive board shall concern itself with the purposes and objectives of the National Research Council and with matters relating to the determination of broad general policy within the authority conferred upon the National Research Council by the National Academy of Sciences. It shall serve as an advisory and consultative body to the Chairman of the Research Council.

Chairman, National Research Council

2. The duties of the Chairman of the National Research Council shall be the following:

(*a*) He shall function as the executive officer of the National Research Council and shall be responsible for its administration.

(*b*) He shall prepare in April of each year, for approval by the executive board, the proposed administrative budget of the National Research Council for the ensuing year, and after such approval shall transmit the proposed budget to the finance committee of the National Academy of Sciences for presentation to the Council of the Academy for its action.

(*c*) He shall report at each meeting of the executive board all pertinent actions taken by him in the interim between meetings of the board.

(*d*) He shall, from time to time, inform the Council of the National Academy of Sciences of the activities of the Research Council.

(*e*) He shall maintain jurisdiction over all reports issued in the name of the Research Council, shall formulate such regulations as may be necessary for their proper control and shall ensure that such regulations are made known to the chairmen of Divisions, committees, boards, and heads of offices of the Research Council.

(*f*) He shall take whatever steps are necessary to ensure effective integration of the Divisions one with another.

(*g*) He shall be a member of all Divisions, committees, and boards of the National Research Council.

Committees

3. The establishment of standing committees of the executive board and the membership of such committees shall be approved by the executive board upon recommendation of the Chairman of the Research Council.

4. The establishment of divisional committees or boards shall be recommended by the chairman of the Division concerned, with the advice and counsel of the Division

or its executive committee, and approved by the Chairman of the Research Council.

5. Members of special committees or boards, organized within any Division shall be selected by the chairman of the Division and approved by the Chairman of the Research Council.

6. The establishment of special committees or boards, and the membership of such committees or boards, organized on an interdivisional basis or independent of any Division shall be approved by the Chairman of the Research Council (if possible with the advice and counsel of the executive board).

7. The terms of appointment of all committees or boards shall expire on June 30 following the date of their appointment, except that, with the approval of the Chairman of the National Research Council, members of committees or boards may be appointed for varying terms up to 5 years in order to secure rotation of membership in committees or boards which have continuing functions.

Special Funds

8. Programs to be undertaken by the National Research Council involving the solicitation of special funds for the purpose shall be approved in advance by the Council of the National Academy of Sciences or its executive committee upon recommendation by the Chairman of the Research Council.

9. The solicitation of funds for the support of programs so approved by the Council of the National Academy or its executive committee shall be made by or under the direction of the Chairman of the Research Council.

10. Budgets for the expenditures of special funds granted to the National Research Council, including those for fellowships, and grants-in-aid, shall be submitted for approval to the Chairman of the Research Council by the chairman of the Division concerned, or in the case of interdivisional or independent committees or boards by the chairman of the committee or board.

11. No member of a committee or board constituted to administer funds entrusted to the National Research Council shall receive an honorarium or salary from such funds for his services, except in cases specifically authorized in advance by the Chairman of the Research Council; but members of such committees may be reimbursed from funds for expenses incurred in the work of the committee or board.

Officers of Divisions

12. The chairman of a Division shall be a member of all committees or boards of the Division.

13. The vice chairman of each Division shall be selected from the membership of the Division by the divisional chairman concerned, with the advice and counsel of his executive committee, and shall be appointed by the divisional chairman after approval by the Chairman of the National Research Council.

14. The term of office of the vice chairman of a Division shall be for 1 year, and shall terminate on June 30 following the date of his appointment.

Reports

15. It shall be the duty of the chairmen of Divisions, chairmen of international committees or boards, and the heads of other offices to submit annual reports of the activities of their respective Divisions, committees, boards, or offices to the Chairman of the Research Council on or before July 15. The Chairman of the Research Council may request such interim reports of activities as are, in his judgment, necessary and desirable.

Amendments

16. Amendments of these bylaws may be made by the executive board at any authorized meetings of the board.

APPENDIX V

REPORT OF THE TREASURER

FISCAL YEAR 1973

Treasurer's Statement

To the Council of the National Academy of Sciences:

The financial statements and schedules that follow reflect the financial condition of the National Academy of Sciences, including the National Academy of Engineering, the Institute of Medicine, and the National Research Council, as of June 30, 1973, and the results of operations during the fiscal year ended on that date.

INVESTMENTS

Consolidated Fund—Schedules 1, 1-A, and 1-B

The investments of the Consolidated Fund of the Corporation, not including short-term investments of working capital funds, are summarized by classes of investment as follows:

	JUNE 30, 1973			
	BOOK VALUE (COST)	MARKET VALUE	PERCENT[a]	INCOME
Convertible Bonds and Notes	$ 100,000	$ 75,000	.30	$ 15,037[b]
Other Bonds and Notes	2,222,136	2,207,880	8.94	166,819
Common Stocks	12,363,259	18,374,293	74.48	162,216
Cash, Cash Equivalents, and Receivables	4,014,996	4,014,031	16.28	212,233
Total	$18,700,391	$24,671,204	100.00	$556,305

[a]Of market value.
[b]The average quarterly investment was $245,359.

During 1972–1973 the distribution of holdings by major classes of investment changed from the levels as of a year ago. The fixed-income securities changed materially, but the percentage of investments in common stocks was about identical to last year. Cash and cash equivalents on hand increased sharply due to the uncertainties of the market and the high yields of short-term securities.

The book value of investments at June 30, 1973, was $489,077 greater than at the end of the previous year. The principal items contributing to this change was a gain of $1,321,833 on sales of securities, and receipts of $200,000 from the American Geophysical Union, $6,923 for the Slipher Fund, $60,900 for the Molecular Biology Award, $60,000 for the Carnegie Fund, and $12,500 for the President's Deferred Compensation. The withdrawal of $1,173,079 by the American Geophysical Union is reflected in the net change in investment book value.

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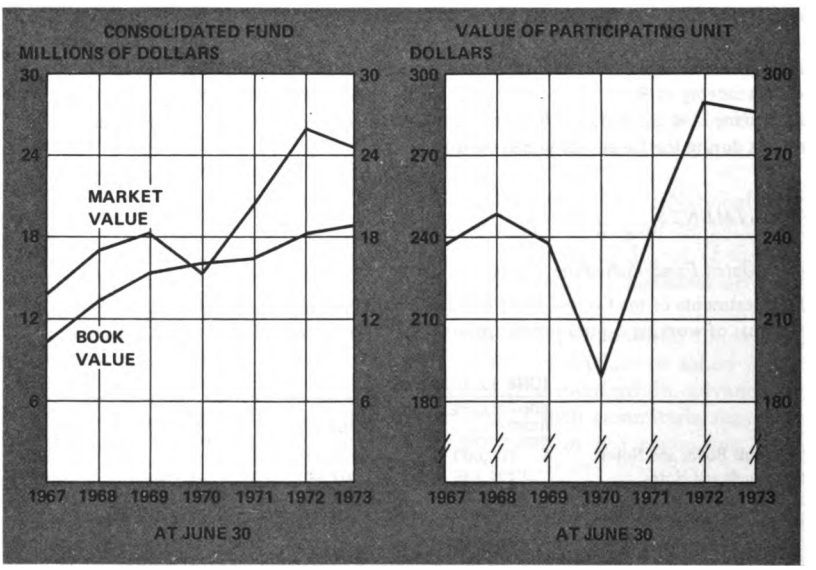
The market value of the investments owned was 131.93% of cost on June 30, 1973, compared with 143.22% at the end of the previous fiscal year. During the past year, the income on the average market value of all investments was at the rate of 2.34%, or about the same rate last year. The total rate of return for the period March 1972 to March 1973 was 8.9%. This compares favorably to the experience for the same period of the Standard and Poor's 500 averages of 7.0%, Dow Jones averages of 4.6%, and the averages of all Mutual Funds of -11.1%.

The funds participating in the Consolidated Fund are summarized in Schedule 3.

Pooled investments in the Consolidated Fund are administered like an open-end investment trust: Equities of the funds in the pool are expressed in terms of participating capital units. Each participating capital unit was assigned a value of $100 as of July 1, 1953; the value had decreased to $286.56 by June 30, 1973, from the value of $292.86 as of the end of the last fiscal year.



The Morgan Guaranty Trust Company of New York continued to act as Investment Counsel and Custodian of Securities.

In addition to the securities held in the Consolidated Fund there were, from time to time during the year, other funds on deposit for Short-Term Investments from which additional income of $239,562 was earned.

Termination Allowance Trust Fund–Schedules 2 and 2-A

In accordance with the labor laws of the Japanese Government, the Academy is liable for termination compensation to Japanese nationals who are employed by the Atomic Bomb Casualty Commission (ABCC) which is an activity of the Academy sponsored by the United States Government. The accrued liability is payable upon termination of employment.

In June 1972, the United States Government funded the amount of the liability for the termination compensation and agreed to fund annually any increase in the liability. These funds earned interest and dividends amounting to $185,217 and sustained a net capital loss of $27,690 during this reporting period.

The investments of the Termination Allowance Trust Fund are summarized as follows:

	JUNE 30, 1973			
	BOOK VALUE (COST)	MARKET VALUE	PERCENT*	INCOME
Cash Savings	$ 448,353	$ 448,353	8.96	$ 2,734
Cash Equivalents	1,600,000	1,599,552	31.98	167,903
Common Stock	3,310,689	2,954,011	59.06	14,580
Payable for Purchase of Securities Net of Accrued Interest	(222,014)	-0-	-0-	-0-
Total	$5,137,028	$5,001,916	100.00	$185,217

*Of market value.

OPERATIONS

Exhibit B is a summary statement of income and expenses and changes in fund balances in the broad traditional classes of current funds, trust and endowment funds, and plant funds.

Activities conducted in response to requests of the United States Government are financed

through cost reimbursement contracts. As expenses are incurred, bills are submitted to the Federal Government agencies for reimbursement. The payments received from the Federal Government are therefore equal to the expenses incurred for those government-sponsored activities. On the other hand, activities supported by private, nonfederal agencies are usually financed by grants and agreements which provide for the funds to be paid to the Academy in lump sum or fixed incremental payments in advance of the expenses being incurred. These funds are available for expenditure on these projects during the current year and frequently also in subsequent years. Accordingly, the item of Deferred Income on the balance sheet of $1,947,711 represents those funds on hand at the close of the year which were available for later expenditure for specific activities under private grants and agreements. The amount received from private and nonfederal sources and used in the current year was $2,895,406.

The total operating expenses for the fiscal year amounted to $44,032,116. Of this amount, approximately $2,370,000, or 5%, was spent on activities designated as "classified" under the government security regulations.

The operation of the Joseph Henry Building for the fiscal year resulted in a loss on operations of $18,972. Included in the costs of operation is an amount for the annual amortization costs of the improvements built into the building for use of both the commercial tenants and the Academy. The value of leasehold improvements remaining unamortized as of the end of the year was $617,714. The cost of the office space occupied by the Academy activities was $6.72 per square foot, including maintenance and utilities.

The following provide additional financial information on the operations during 1972–1973:

(a) In Table I below the sources of income used under contracts and grants for current purposes are summarized by agencies and organizations; and

(b) Table II below lists total current expenses by functional categories.

(c) Schedule 4 of this report reflects (1) expenditures from the current general funds in support of the two Academies, the Institute of Medicine, the National Research Council, other offices and services, and the physical plant; (2) expenditures from current restricted funds, the sources of which were agencies of the U.S. Government; and (3) expenditures from current restricted funds, the sources of which were private foundations, industrial concerns, state governments, and individuals. In (2) and (3) the major activities and principal sources of funds are indicated.

TABLE I

CURRENT FUNDS

Income by Source

U.S. GOVERNMENT AGENCIES (GRANTS AND CONTRACTS)

Department of Agriculture	$ 61,511
Department of Commerce	1,282,653
Department of Defense	
Department of the Air Force	852,793
Department of the Army	2,110,986
Department of the Navy	1,908,525
Department of Health, Education, and Welfare	3,846,576
Department of Housing and Urban Development	652,940
Department of the Interior	444,943
Department of Justice	57,547
Department of Labor	123,533
Department of State	1,551,026
Department of Transportation	4,954,907
Executive Office of the President	199,443
Agency for International Development	1,388,284
Arms Control and Disarmament Agency	3,706
Atomic Energy Commission	6,000,767
Environmental Protection Agency	915,847
General Services Administration	111,066
National Aeronautics and Space Administration	4,422,767
National Materials Policy Commission	134,679
National Science Foundation	6,616,829
Smithsonian Institution	45,943
Veterans Administration	393,214
Treasury Department	3,233
National Foundation on Arts and Humanities	21,189
Total	$38,104,907

TABLE I
continued

PRIVATE AND NONFEDERAL SOURCES (GRANTS, CONTRACTS, AND CONTRIBUTIONS)

Income Deferred from Fiscal Year 1972

Robert W. Johnson Foundation		$ 750,000*
All other sources		932,521
		1,682,521

Income Received Current Fiscal Year

American Cancer Society	$ 16,505	
American Medical Association	13,339	
Carnegie Corporation of New York	130,820	
Copernicus Society	20,000	
P. C. Cornell Trust	15,000	
Dewitt Wallace Foundation	25,000	
Exxon Corporation	10,000	
Ford Foundation	51,623	
General Electric Foundation	10,000	
Hoffman-La Roche, Inc.	26,900	
IBM Corporation	10,000	
Robert W. Johnson Foundation	308,000	
W. K. Kellogg Foundation	236,930	
Charles F. Kettering Foundation	20,000	
Eli Lilly and Company	36,150	
Andrew W. Mellon Foundation	300,000	
James Picker Foundation	354,167	
Charles Pfizer and Company	13,500	
Rockefeller Foundation	135,000	
Russell Sage Foundation	55,062	
Schering Corporation	13,565	
International Foundation	14,270	
Alfred P. Sloan Foundation	155,270	
Sterling Drug Company	15,000	
U.S. Steel Foundation	20,000	
Upjohn Company	10,500	
Various state governments	918,500	
Wyeth Laboratories	30,400	
Miscellaneous (Less than $10,000 per donor)	218,522	3,184,023
Grants Receivable June 30, 1973		68,776
Total Available for Current Fiscal Year		4,935,320
Income Applied to Current Fiscal Year		3,232,880
Deferred to Future Periods		$1,702,440

*This grant from the Robert W. Johnson Foundation was received at the end of fiscal year 1972 and reflected as an item of deferred income in the financial statements for that year.

TABLE II

ALL CURRENT FUNDS

Expenses by Functional Categories

Program Administration	$ 2,912,698
General Administration	4,696,046
Advisory and Research Activities	27,624,905
Conferences and Symposia	884,308
Fellowships and Other Support of Scholars	6,982,162
Dissemination of Information and Publication Activities	931,997
Total	$44,032,116

Expenditures for all current purposes (excluding transactions of a capital nature in the Trust and Endowment Funds and in the Plant Funds) during the past ten years are represented in the chart on page 11.

TRUST FUNDS

During the year there were additions to the Trust and Endowment Funds as follows:

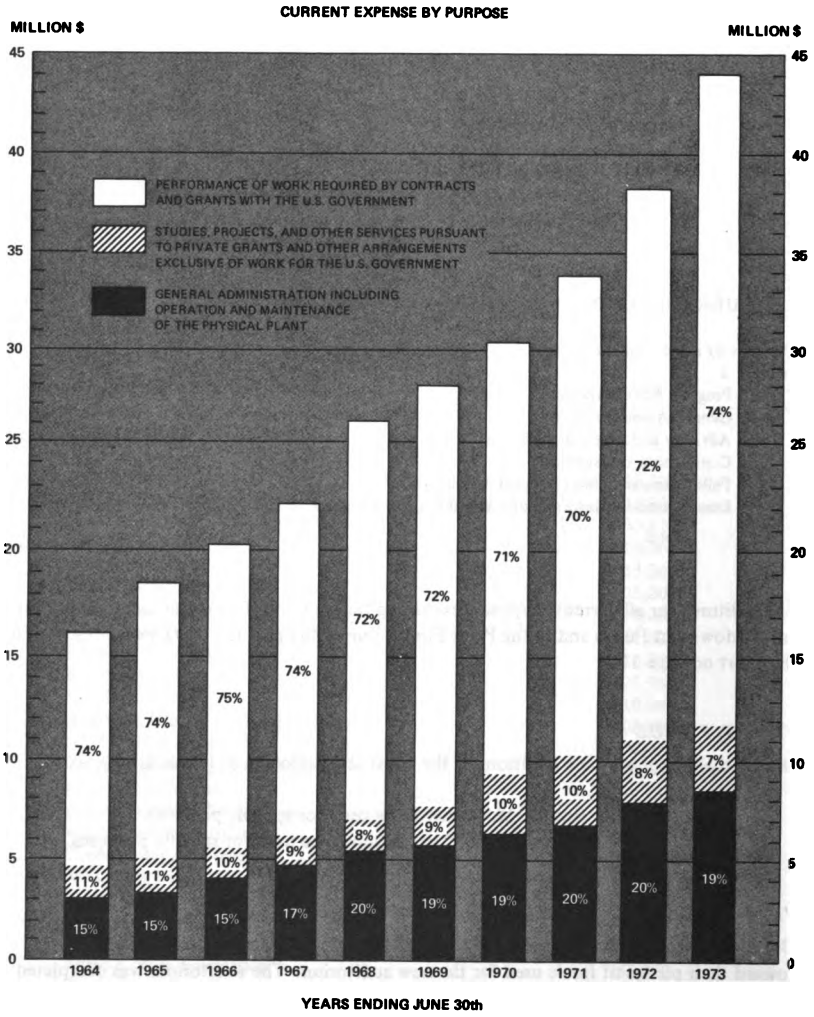
(a) a gift of $6,923 from V. M. Slipher to be used for specific purposes.
(b) a gift of $5,000 from the RCA Corporation to be used for specific purposes.

PLANT FUNDS

During the year the Academy received $3,000 from one industrial concern in payment toward their pledge of funds used for the new auditorium. The auditorium was completed in 1971, and all construction costs have been paid.

Respectfully submitted,

E. R. PIORE, *Treasurer*



Report of the Auditing Committee

November 27, 1973

Dear Dr. Handler:

In accordance with Bylaw V-7 of the National Academy of Sciences, the firm of Price Waterhouse & Co., Washington, D.C., was retained to make an audit of the accounts of the Treasurer for the fiscal year that ended June 30, 1973, and to report to the Auditing Committee.

The independent accountants have completed their examination of the financial statements and have submitted their report, a copy of which is attached, concerning financial statements to which they refer. The Auditing Committee has reviewed the report and recommends its acceptance as compliance with the governing bylaw and that the opinion of the independent accountants be published with the report of the Treasurer.

Respectfully submitted,

FREDERICK T. WALL, *Chairman*
CARYL P. HASKINS
H. S. YODER

Auditing Committee
National Academy of Sciences

Dr. Philip Handler, President
National Academy of Sciences
Washington, D.C.

Report of Independent Accountants

To the Auditing Committee of the National Academy of Sciences

In our opinion, the accompanying balance sheets (Exhibit A), the related statements of income, expenses, and changes in fund balances (Exhibit B), and the investments schedules (Schedules 1, 1-A, 1-B, 2, and 2-A) present fairly the financial position of the National Academy of Sciences (including the National Academy of Engineering, the National Research Council, and the Institute of Medicine) at June 30, 1973 and 1972, the results of its operations for the years then ended, and the supplementary information on investments in conformity with generally accepted accounting principles consistently applied. Our examinations of these statements were made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances, including at June 30, 1973 and 1972, confirmation of investments by direct correspondence with the custodian.

PRICE WATERHOUSE & CO.

Washington, D.C.
October 31, 1973

Balance Sheets

	JUNE 30 1973	JUNE 30 1972
ASSETS		
Current Assets		
Cash	$ 129,847	$ 537,017
Certificates of deposit and short-term investments, at cost which approximates market	4,193,766	4,406,002
Accounts receivable—U.S. Government	4,406,722	2,886,022
Other current receivables	1,143,216	872,651
Accrued interest on investments	169,917	99,014
Receivable from sale of securities	–	208,480
Inventories of publications and supplies, at the lower of cost (average basis) or market	611,852	502,294
Prepaid expenses and other	127,936	124,978
Total Current Assets	10,783,256	9,636,458
Investments in Marketable Securities, at cost (approximate market value $24,670,208 in 1973 and $25,856,441 in 1972—Schedule 1)	18,699,395	17,984,888
Property and Equipment, at cost (Note 2)		
Land	266,971	266,971
Buildings and improvements	8,445,827	8,397,641
Leasehold improvements, less accumulated amortization of $245,887 in 1973 and $197,494 in 1972	617,714	610,884
Furniture and equipment, less reserve for replacements of $587,465 in 1973 and $479,114 in 1972	1,774,474	1,744,799
EDP equipment, less accumulated depreciation of $12,874	405,536	–
	11,510,522	11,020,295
Termination Allowance Trust Fund (See Contra-Note 3)		
Cash and investments, less $238,379 payable for securities purchased in 1973 (Schedule 2)	5,137,028	4,711,648
Receivable from U.S. Government	729,940	–
	5,866,968	4,711,648
Total Assets	$46,860,141	$43,353,289

EXHIBIT A

	JUNE 30 1973	JUNE 30 1972
LIABILITIES AND FUND BALANCES		
Current Liabilities		
Accounts payable and accrued expenses	$ 2,631,461	$ 2,039,693
Accrued annual leave	933,720	830,781
Funds held for the American Geophysical Union (Note 4)	–	843,934
Advances on U.S. Government contracts (Note 5)	910,516	646,030
Deferred income from grants (Note 5)	1,947,711	1,918,158
Total Current Liabilities	6,423,408	6,278,596
Note Payable (Note 2)	405,536	–
Termination Allowance Liability (Note 3)	5,866,968	4,711,648
Commitments (Note 6)	–	–
Fund Balances (Exhibit B)		
General funds	2,428,199	1,804,036
Restricted funds–		
Government	–	–
Private	2,362,005	2,478,344
Trust and endowment funds	18,591,816	17,346,083
Plant funds	10,782,209	10,734,582
	34,164,229	32,363,045
Total Liabilities and Fund Balances	$46,860,141	$43,353,289

Statements of Income, Expenses, and Changes in Fund Balances

FOR THE YEARS ENDED JUNE 30, 1973 AND 1972

	CURRENT FUNDS	RESTRICTED FUNDS
	GENERAL FUNDS	GOVERNMENT
INCOME		
Grants, contracts, and contributions (Note 5)	$ 463,247	$37,919,690
Publication sales	1,202,200	–
Investment interest and dividends	436,226	185,217
Interest on certificates of deposit and short-term investments	109,914	–
Dues	25,600	–
Rental income	353,862	–
Other	48,882	–
	2,639,931	38,104,907
EXPENSES		
Personal services–		
Salaries, wages, and related benefits	4,581,671	13,711,516
Fees and other	225,279	863,426
Travel	289,685	3,090,402
Expenses allocated to rental areas	372,833	–
Other operating expenses	3,052,173	2,083,411
General expenses allocated as indirect costs to grants and contracts (1972–$5,785,552) (Note 5)	(6,516,608)	5,707,706
Subcontracts		4,048,159
Grants and fellowships	14,649	8,592,452
Government equipment and other property	–	7,835
	2,019,682	38,104,907
EXCESS OF INCOME (EXPENSES)	620,249	–
OTHER		
Net gain on sale of securities	–	–
Interfund transfers	46,697	–
Equipment acquired from current funds, net of retirements	(79,789)	–
Expenditures from and adjustments to reserves for repairs and improvements to buildings	37,006	–
FUND BALANCES, BEGINNING OF YEAR	1,804,036	–
FUND BALANCES, END OF YEAR	$2,428,199	$ –

EXHIBIT B

PRIVATE	TRUST AND ENDOWMENT FUNDS	PLANT FUNDS	TOTAL	YEAR ENDED JUNE 30, 1972 TOTAL
$2,895,406	$ 6,923	$ 3,000	$41,288,266	$36,134,378
258,026	–	–	1,460,226	1,202,965
120,079	–	–	741,522	547,746
129,648	–	–	239,562	196,669
247,878	–	–	273,478	270,733
–	–	–	353,862	389,485
162,812	–	2,712	214,406	198,822
3,813,849	6,923	5,712	44,571,322	38,940,798
1,319,912	–	–	19,613,099	17,420,287
120,587	–	–	1,209,292	1,106,742
421,064	–	–	3,801,151	3,577,031
–	–	–	372,833	379,431
671,482	–	176	5,807,242	5,563,374
808,902	–	–	–	–
88,139	–	–	4,136,298	3,168,999
477,265	–	–	9,084,366	6,879,975
–	–	–	7,835	80,806
3,907,351	–	176	44,032,116	38,176,645
(93,502)	6,923	5,536	539,206	764,153
19,915	1,165,410	–	1,185,325	945,096
(30,718)	73,400	(89,379)	–	–
(12,034)	–	83,284	(8,539)	(4,419)
–	–	48,186	85,192	193,009
2,478,344	17,346,083	10,734,582	32,363,045	30,465,206
$2,362,005	$18,591,816	$10,782,209	$34,164,229	$32,363,045

NOTES TO FINANCIAL STATEMENTS
June 30, 1973 and June 30, 1972

NOTE 1 ORGANIZATION

The National Academy of Sciences was formed under a charter that was passed as an Act of Incorporation by the United States Congress and signed into law on March 3, 1863. The Academy operates as a private, co-optative society of distinguished scholars in scientific or engineering research, dedicated to the furtherance of science and its use for the general welfare.

The Academy is exempt from federal income taxes under Section 501 (c)(3) of the Internal Revenue Code.

The accounts of the Academy include the National Academy of Engineering, the Institute of Medicine, and the National Research Council, all of which are related organizations of the Academy. The financial statements of the Academy have been prepared on the accrual basis of accounting.

NOTE 2 PROPERTY AND EQUIPMENT

Property and equipment are stated at cost. Major improvements are capitalized while routine replacements, maintenance, and repairs are charged to expense. The Academy does not provide for depreciation of buildings since it intends to obtain funds for their replacement, when required, from contributions. A reserve for replacement of equipment is provided over a ten-year life. The additions to this reserve during fiscal years 1973 and 1972 were $154,300 and $134,900, respectively. Leasehold improvements are amortized over the life of the lease and amortization for fiscal years 1973 and 1972 amounted to $48,393 and $44,043, respectively.

During fiscal year 1973 the Academy acquired an IBM 370/135 computer at a cost of $418,410. The Academy executed a 7½ percent 8-year loan from a bank to finance the purchase. The loan is secured by the computer. Depreciation of the equipment is being computed over a period of 8 years.

The Academy is the custodian of certain property and equipment that is owned by the United States Government and is furnished to the Academy for work under government contracts. The cost of these assets which is not reflected in the accompanying balance sheets approximated $3,322,000 and $3,300,000 at June 30, 1973, and 1972, respectively.

NOTE 3 ATOMIC BOMB CASUALTY COMMISSION OPERATIONS

In accordance with the labor laws of the Japanese Government, the Academy is liable for termination compensation to Japanese Nationals who are employed by the Atomic Bomb Casualty Commission (ABCC), which is an activity of the Academy sponsored by the United States Government.

In June 1972, the United States Government funded the amount of the liability for the termination compensation and agreed to fund annually any increase in the liability. The revaluations in December 1971 and February 1973 of the Japanese yen in relation to the United States dollar resulted in increases of the termination compensation liability of $669,000 and $691,000, respectively.

The assets and liabilities of the ABCC included in the accompanying financial statements have been translated into U.S. dollars at approximate rates of exchange prevailing at the dates of the balance sheets. Operating results of the ABCC for the years then ended have been translated generally at the free rates of exchange prevailing at each month end.

NOTE 4 FUNDS HELD FOR THE AMERICAN GEOPHYSICAL UNION

Prior to July 1, 1972, the American Geophysical Union (AGU) was legally a part of the Academy; however, the AGU had been granted a significant degree of autonomy and maintained separate books of account. Accordingly, the financial statements of the Academy did not include the assets, liabilities, or results of operations of the AGU. The AGU participated in the Academy's consolidated investment fund, and its equity (cost basis) in that fund is reflected as a liability in the accompanying balance sheet at June 30, 1972, in the amount of $843,934.

Effective July 1, 1972, the AGU incorporated as a separate entity and as of May 31, 1973, the AGU withdrew from the consolidated investment fund. AGU's equity (cost basis) at May 31, 1973, was $1,078,963.

NOTE 5 CONTRACT ACCOUNTING

A significant portion of the Academy's activities are performed under cost-reimbursable contracts with the United States Government. Income from these contracts is recorded as costs are incurred. The costs associated with these government contracts are subject to audit by the Defense Contract Audit Agency (DCAA), which has completed its examinations through June 30, 1972. Costs incurred during fiscal year 1973 are currently being examined by the DCAA and in the opinion of management of the Academy, no significant adjustments are expected.

Activities supported by the United States Government, individuals, or private organizations are frequently financed by grants or contracts that provide for the funds to be paid to the Academy in a lump sum or fixed incremental payments in advance of the expenses being incurred. These funds are available for expenditure on the projects during the year of receipt and frequently also in subsequent years. Accordingly, the funds received, which are available for later expenditures for specific activities under the grants or contracts, are recorded as deferred income or advances on U.S. Government contracts in the Academy's balance sheets.

NOTE 6 COMMITMENTS

The Academy leases an office building from the George Washington University under an agreement that expires in 1987. Under the terms of this agreement the Academy is committed to pay annual rentals of $710,000 and all of the taxes, insurance, and maintenance on the building. Portions of the building are sublet to commercial and other tenants.

Consolidated Fund

	BALANCE JUNE 30, 1972 (AT COST)	ADDITIONS (AT COST)
FIXED INCOME SECURITIES (Schedule 1-A)		
Cash Equivalents	$ 3,125,000	$37,339,387
Convertible Bonds and Notes	390,719	–
Other Bonds and Notes	2,867,319	–
Total Fixed Income Securities	6,383,038	37,339,387
COMMON STOCK (Schedule 1-B)	11,601,850	6,056,925
Total Investments	17,984,888	$43,396,312
Uninvested Cash	17,946	
Receivable from Sales of Securities	208,480	
TOTAL CONSOLIDATED INVESTMENT FUND	$18,211,314	
Less: Net capital gains of current year attributable to American Geophysical Union (Note 4)		

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SCHEDULE 1

SALES AND REDEMPTIONS		BALANCE JUNE 30, 1973 (AT COST)	QUOTED MARKET JUNE 30, 1973	INVESTMENT INCOME YEAR ENDED JUNE 30, 1973
PROCEEDS	NET GAIN OR (LOSS)			
$36,450,387	$ –	$ 4,014,000	$ 4,013,035	$212,233
293,750	3,031	100,000	75,000	15,037
547,641	(97,542)	2,222,136	2,207,880	166,819
37,291,778	(94,511)	6,336,136	6,295,915	394,089
6,711,860	1,416,344	12,363,259	18,374,293	162,216
$44,003,638	1,321,833	18,699,395	$24,670,208	$556,305
		996	996	
		–	–	
		$18,700,391	$24,671,204	
	(136,508)			
	$1,185,325			

Fixed Income Securities—Consolidated Fund

JUNE 30, 1973

	INTEREST RATE	MATURITY	PRINCIPAL AMOUNT	COST	QUOTED MARKET
CASH EQUIVALENTS					
Atlantic Richfield Company	–	Demand	$ 770,000	$ 770,000	$ 770,000
Bankers Trust Company	8.01%	July 1973	970,000	970,000	969,728
General Electric Company	–	Demand	97,000	97,000	97,000
GTE Sylvania, Inc.	–	Demand	93,000	93,000	93,000
International Harvester Credit Corporation	–	Demand	134,000	134,000	134,000
Irving Trust Company	7.35%	July 1973	1,000,000	1,000,000	999,620
Manufacturers Hanover Trust Co.	7.90%	July 1973	950,000	950,000	949,687
TOTAL CASH EQUIVALENTS			$4,014,000	$4,014,000	$4,013,035

SCHEDULE 1-A

	INTEREST RATE	MATURITY	PRINCIPAL AMOUNT	COST	QUOTED MARKET
CONVERTIBLE BOND					
Consolidated Freightways, Inc.	4.875%	1992	$ 100,000	$ 100,000	$ 75,000
TOTAL			$ 100,000	$ 100,000	$ 75,000
OTHER BONDS AND NOTES					
Adcor Realty Corporation	5.25%	1987	56,000	56,000	47,460
Adcor Realty Corporation	4.75%	1987	72,000	72,000	55,440
Alcan Aluminum Corp.	4.75%	1984	179,000	179,000	146,780
American Telephone & Telegraph Company	8.75%	2000	200,000	195,250	215,750
Chesebrough-Ponds, Inc.	5.00%	1976	40,000	40,000	38,200
Columbia Broadcasting System	5.50%	1991	160,000	160,000	133,200
F.M.C. Corporation	7.50%	2001	100,000	100,375	99,625
General Telephone Co.	9.25%	1999	100,000	101,000	109,000
Halliburton Company	7.95%	1995	250,000	250,656	251,250
Houston Natural Gas Corp.	9.375%	1990	210,000	210,105	222,600
Natural Gas Pipeline Co. of America	9.50%	1990	200,000	197,750	214,000
NCNB Corporation	8.40%	1995	250,000	250,000	260,000
Norfolk and Western Railway	5.50%	1981	160,000	160,000	145,200
Weyerhauser Company	8.625%	2000	250,000	250,000	269,375
TOTAL OTHER BONDS AND NOTES			$2,227,000	$2,222,136	$2,207,880

SCHEDULE 1-B

Common Stocks—Consolidated Fund

JUNE 30, 1973

	NUMBER OF SHARES	COST	QUOTED MARKET
Alcon Laboratories, Inc.	1,600	$ 41,138	$ 52,000
American Home Products Corp.	17,100	674,658	731,025
ARA Services, Inc.	4,800	629,799	573,600
Avon Products, Inc.	5,200	149,805	642,200
Baker Industries, Inc.	1,000	37,714	19,000
Baker Oil Tools, Inc.	9,700	267,691	249,775
Baxter Laboratories, Inc.	14,300	562,012	664,950
Betz Laboratories, Inc.	1,000	20,069	39,000
Charles River Breeding Labs, Inc.	1,500	46,365	41,250
Chemed Corporation	2,000	40,000	69,000
Clorox Company	5,540	69,814	134,345
Coca-Cola Bottling Co. of N.Y., Inc.	13,400	301,679	244,550
Coca-Cola Company	4,800	472,858	687,000
DeKalb AG Research	600	26,350	27,150
Deluxe Check Printers, Inc.	1,000	35,750	38,500
Eastman Kodak Company	4,800	168,683	655,200
Eli Lilly and Company	9,500	251,695	793,250
Envirotech Corp.	1,000	51,521	31,250
First National City Corp.	12,000	445,558	492,000
General Medical Corp.	14,300	668,710	266,338
Government Employees Life Insurance Co.	700	43,675	44,625
Halliburton Company	5,700	435,590	862,838
Hartz Mountain Pet Foods, Inc.	1,000	34,726	27,625
International Business Machines Corporation	4,750	471,369	1,505,750
International Flavors and Fragrances, Inc.	8,735	436,619	825,458
Lawson Products, Inc.	1,000	19,000	16,875
Loctite Corporation	1,000	44,813	49,750
Mary Kay Cosmetics, Inc.	1,600	45,800	43,200
McCormick & Co., Inc.	700	37,775	26,950
McDonalds Corporation	9,500	538,268	542,688
MGIC Investment Corp.	9,000	303,619	613,125
National Chemsearch Corp.	5,700	370,331	507,300
National Data Corp.	1,000	25,063	26,250
Peabody Galion Corp.	7,100	298,741	142,888
Pickwick International, Inc.	1,500	56,828	34,125
Polaroid Corporation	5,700	519,203	782,325
Procter and Gamble Company	6,700	364,965	696,800
Puritan Bennett Corp.	1,000	49,650	62,500
Research Cottrell, Inc.	5,500	375,269	261,250
Schering-Plough Corp.	9,600	627,479	748,800
Schlumberger Ltd.	8,600	323,748	851,400

SCHEDULE 1-B
continued

	NUMBER OF SHARES	COST	QUOTED MARKET
Sears, Roebuck and Company	5,800	$ 385,823	$ 551,725
Silo, Inc.	500	9,375	6,000
Simplicity Pattern Co., Inc.	11,500	343,626	595,125
Snap-On-Tools Corp.	1,000	56,750	55,500
S. S. Kresge Company	12,400	455,918	420,050
Victoria Station, Inc.	1,700	25,500	14,875
Walt Disney Productions	7,600	270,345	583,300
Waste Management, Inc.	14,250	380,784	277,875
WD 40 Company	1,000	21,750	14,500
Xerox Corporation	4,700	28,988	731,438
TOTAL COMMON STOCKS		$12,363,259	$18,374,293

Termination Allowance Trust Fund

	BALANCE JUNE 30, 1972 (AT COST)	ADDITIONS (AT COST)
Cash—Savings	$ –	$ 448,353
Cash Equivalents (Schedule 2-A)	4,707,415	21,792,973
Common Stocks (Schedule 2-A)	–	3,409,164
Total Investments	$4,707,415	$25,650,490
Accrued Interest Receivable	4,233	
Payable for Purchase of Securities		
Total Investment Fund	$4,711,648	
Less: Investment Advisory Fees		

SCHEDULE 2

SALES AND REDEMPTIONS		BALANCE JUNE 30, 1973 (AT COST)	QUOTED MARKET JUNE 30, 1973	INVESTMENT INCOME YEAR ENDED JUNE 30, 1973
PROCEEDS	NET GAIN OR (LOSS)			
$ –	$ –	$ 448,353	$ 448,353	$ 2,734
24,900,388	–	1,600,000	1,599,552	167,903
70,785	(27,690)	3,310,689	2,954,011	14,580
$24,971,173	$(27,690)	$5,359,042	$5,001,916	$185,217
		16,365		
		(238,379)		
		$5,137,028		
				(5,942)
				$179,275

SCHEDULE 2-A

Investments—Termination Allowance Trust Fund

JUNE 30, 1973

	INTEREST RATE	MATURITY	PRINCIPAL AMOUNT	COST	QUOTED MARKET
CASH EQUIVALENTS					
Manufacturers Hanover Trust Co. N.Y. Certificate of Deposit	7.96%	July 1973	$1,600,000	$1,600,000	$1,599,552
Total Cash Equivalents				$1,600,000	$1,599,552

SCHEDULE 2-A
continued

	NUMBER OF SHARES	COST	QUOTED MARKET
COMMON STOCKS			
ARA Services, Inc.	1,000	$ 134,310	$ 119,500
American Home Products Corp.	3,000	115,875	128,250
Avon Products, Inc.	1,000	127,245	123,500
Baker Industries, Inc.	3,000	108,404	57,000
Baker Oil Tools, Inc.	3,400	115,439	87,550
Baxter Laboratories, Inc.	1,800	96,075	83,700
Central Telephone & Utilities Corp.	4,600	113,552	107,525
Dun and Bradstreet Companies, Inc.	1,800	115,626	125,100
Eastman Kodak Company	1,000	136,150	136,500
Genuine Parts Company	1,900	62,672	64,125
International Business Machines Corporation	625	201,600	198,125
International Flavors and Fragrances, Inc.	1,000	92,694	94,500
McCormick & Co., Inc.	2,000	125,000	77,000
McDonalds Corporation	2,000	127,162	114,248
Mercantile Stores Co., Inc.	1,600	125,088	86,400
MGIC Investment Corp.	1,500	121,469	102,188
Mobil Oil Corp.	2,000	147,077	128,750
National Chemsearch Corp.	1,200	108,418	106,800
Pickwick International, Inc.	3,000	135,017	68,250
Polaroid Corporation	1,500	183,528	205,875
Procter and Gamble Company	1,000	101,586	104,000
Ralston Purina Co.	2,000	88,229	71,250
Schering-Plough Corp.	2,000	130,400	156,000
Sears, Roebuck and Company	1,000	115,150	95,125
Walt Disney Productions	1,500	149,337	115,125
Waste Management, Inc.	3,750	113,813	73,125
Xerox Corporation	800	119,773	124,500
Total Common Stocks		$3,310,689	$2,954,011

Equity in Trust and Restricted Funds

JUNE 30, 1973

	NUMBER OF PARTICIPATING CAPITAL UNITS (PCU)	CAPITAL CONTRIBUTION	ADDITION FROM EARNED INCOME
TRUST AND ENDOWMENT FUNDS (Income from which is for general purposes)			
Agassiz Fund	521.24	$ 50,000	$ –
Carnegie Endowment Fund	34,860.29	3,275,000	–
Commonwealth Fund	2,061.09	500,000	–
Ford Foundation Fund	20,706.79	5,000,000	–
Nealley Fund	204.49	19,556	–
Rockefeller Foundation Fund	4,252.60	1,000,000	–
Sloan Foundation Endowment Fund	4,254.14	1,000,000	–
General Endowment Fund	88.39	21,160	–
Staff Retirement Fund	427.48	80,264	–
	67,376.51	10,945,980	–
TRUST AND ENDOWMENT FUNDS (Income from which is for specific purposes)			
Henryk Arctowski Fund	905.28	95,736	52,403
Bache Fund	640.55	60,000	41,500
Billings Fund	245.46	26,067	4,000
Blaauw Fund	489.56	71,299	22,201
John J. Carty Fund	298.58	25,000	10,000
Thomas L. Casey Endowment Fund	3,344.82	258,081	164,300
Comstock Fund	230.36	10,400	29,847
Arthur L. Day Fund	6,917.78	1,398,474	108,000
Draper Fund	141.53	6,000	11,000
Elliot Fund	84.20	8,000	–
Gibbs Fund	120.30	5,173	8,453
Gibbs Brothers Fund	132.18	24,000	4,000
Gould Fund	441.92	40,000	28,578
Hartley Fund	12.03	1,168	32
Joseph Henry Fund	591.95	39,740	33,024
Hunsaker Fund	155.79	24,750	9,000
Kovalenko Fund	387.89	43,741	7,000
Marsh Fund	216.47	10,000	12,100
George P. Merrill Fund	45.77	10,000	–
Murray Fund	114.90	6,000	6,000
Pradel Fund	164.40	16,392	14,908
H. P. Robertson Lectureship Fund	109.00	20,325	3,000
Slipher Fund	22.46	6,923	–
Smith Fund	252.29	8,000	41,000
Thompson Fund	107.98	10,000	700

SCHEDULE 3

REALIZED CAPITAL GAIN (LOSS)	TOTAL EQUITY IN CONSOLI-DATED FUND	SHORT-TERM INVEST-MENTS	CASH	TOTAL FUND EQUITY
$ 46,749	$ 96,749	$ –	$ –	$ 96,749
3,251,020	6,526,020	–	–	6,526,020
26,976	526,976	–	–	526,976
282,626	5,282,626	–	–	5,282,626
18,339	37,895	–	–	37,895
66,173	1,066,173	–	–	1,066,173
65,148	1,065,148	–	–	1,065,148
1,122	22,282	–	–	22,282
8,750	89,014	2,200	–	91,214
3,766,903	14,712,883	2,200	–	14,715,083
46,738	194,877	4,500	8,309	207,686
38,901	140,401	14,700	4,275	159,376
13,693	43,760	–	2,642	46,402
10,069	103,569	–	8,436	112,005
24,241	59,241	5,000	5,075	69,316
245,480	667,861	–	33,664	701,525
10,409	50,656	–	(1,394)	49,262
125,578	1,632,052	–	42,336	1,674,388
10,113	27,113	2,300	2,357	31,770
7,552	15,552	1,900	1,416	18,868
9,996	23,622	1,400	(386)	24,636
4,824	32,824	–	1,028	33,852
26,214	94,792	3,690	3,392	101,874
1,079	2,279	–	(3,447)	(1,168)
46,540	119,304	–	5,802	125,106
6,392	40,142	–	(2,107)	38,035
28,919	79,660	–	624	80,284
18,882	40,982	–	487	41,469
1,628	11,628	500	371	12,499
9,568	21,568	900	722	23,190
3,378	34,678	–	1,924	36,602
3,634	26,959	1,600	1,835	30,394
161	7,084	–	73	7,157
12,726	61,726	–	(242)	61,484
9,426	20,126	–	(575)	19,551

	NUMBER OF PARTICIPATING CAPITAL UNITS (PCU)	CAPITAL CONTRIBUTION	ADDITION FROM EARNED INCOME
TRUST AND ENDOWMENT FUNDS—continued (Income from which is for specific purposes)			
Troland Fund	748.45	$ 212,000	$ –
U.S. Steel Award in Molecular Biology	202.45	60,900	–
Walcott Fund	52.12	5,000	–
G. K. Warren Fund	74.34	15,000	1,500
Watson Fund	361.02	25,000	19,400
Foundation for Microbiology Award	–	–	–
Applied Mathematics and Numerical Analysis Fund	–	–	–
Zworykin Fund	–	–	–
	17,611.83	2,543,169	631,946
CURRENT RESTRICTED FUNDS			
John A. Hutcheson Gift Fund	27.68	6,425	–
International Critical Tables	926.98	200,000	–
International Union of Physiological Sciences Congress	17.30	4,900	–
President's Deferred Compensation	87.26	23,750	–
International Union of Radio Science	42.43	10,000	–
	1,101.65	245,075	–
Total Equity in Consolidated Fund	86,089.99	$13,734,224	$631,946

Borrowed from the Carnegie Endowment Fund for leasehold improvements to Joseph Henry Building

Investments and Cash

Value of Participating Capital Unit:

June 30, 1972	$292.86
September 30, 1972	294.34
December 31, 1972	316.34
March 31, 1973	299.66
June 30, 1973	286.56

SCHEDULE 3
continued

REALIZED CAPITAL GAIN (LOSS)	TOTAL EQUITY IN CONSOLI-DATED FUND	SHORT-TERM INVEST-MENTS	CASH	TOTAL FUND EQUITY
$ 17,986	$ 229,986	$ –	$ 5,796	$ 235,782
1,115	62,015	–	18,316	80,331
4,674	9,674	1,800	439	11,913
2,571	19,071	–	98	19,169
25,480	69,880	4,600	2,270	76,750
–	–	10,000	752	10,752
–	–	22,800	1,047	23,847
–	–	5,000	156	5,156
767,967	3,943,082	80,690	145,491	4,169,263
361	6,786	–	87	6,873
16,407	216,407	110,000	28,343	354,750
416	5,316	–	157	5,473
1,119	24,869	–	506	25,375
1,048	11,048	5,000	4,301	20,349
19,351	264,426	115,000	33,394	412,820
$4,554,221	$18,920,391	$197,890	$178,885	$19,297,166
	(220,000)			
	$18,700,391			

SCHEDULE 3-A

Sources and Purposes of Trust and Endowment Funds

JUNE 30, 1973

A. Funds whose income may be used for general purposes:

AGASSIZ FUND: Bequest of Alexander Agassiz, a member of the Academy.	$ 50,000
CARNEGIE ENDOWMENT FUND: Balance of gift of $5,000,000 of the Carnegie Corporation of New York in 1919, for the purposes of the National Academy of Sciences-National Research Council, $1,725,000 of which has been used to cover the cost of the Academy building and the acquisition of other property.	3,275,000
COMMONWEALTH ENDOWMENT FUND: A grant of the Commonwealth Fund in 1968 for capital endowment of the Academy.	500,000
FORD FOUNDATION FUND: A grant of The Ford Foundation in 1967 to the National Academy of Sciences for capital endowment.	5,000,000
NEALLEY FUND: Bequest of George True Nealley in 1925 for the general purposes of the Academy.	19,556
ROCKEFELLER FOUNDATION FUND: A grant of The Rockefeller Foundation in 1967 to the National Academy of Sciences for general purposes.	1,000,000
SLOAN FOUNDATION ENDOWMENT FUND: A grant of $1,000,000 of the Alfred P. Sloan Foundation in 1968 for the general purposes of the Academy.	1,000,000
GENERAL ENDOWMENT FUND: Bequest of David Lloyd Fillman in 1970 for general purposes of the Academy.	21,160
RETIREMENT FUND: A fund established by the Academy prior to 1944 to provide for payment of annuities to staff members, upon retirement.	80,264

B. Funds whose income may be used for specifically designated purposes:

APPLIED MATHEMATICS AND NUMERICAL ANALYSIS FUND: Gift of the International Business Machines Corporation to support the NAS Award in Applied Mathematics and Numerical Analysis by an award of $5,000 approximately every three years.	22,800

SCHEDULE 3-A
continued

HENRYK ARCTOWSKI FUND: Bequest of Jane Arctowska in 1958, in memory of her husband Henryk Arctowski, for the promotion and study of solar activity changes of short or long duration and their effects upon the ionosphere and terrestrial atmosphere.	$ 95,736
BACHE FUND: Bequest of Alexander Dallas Bache, a member of the Academy (1870), to aid researches in physical and natural sciences.	60,000
BILLINGS FUND: Bequest of Mrs. Mary Ann Palmer Draper (Mrs. Henry Draper) in 1915, to support the publication of the Proceedings of the Academy or for other purposes to be determined by the Academy.	26,067
BLAAUW FUND: Bequest of Marianne Blaauw in 1951 to establish the Edmond and Marianne Blaauw Fund to support research in the field of ophthalmology.	71,299
JOHN J. CARTY FUND: Gift of the American Telephone & Telegraph Company on November 13, 1930, in recognition of the distinguished achievements of John J. Carty, and as a lasting testimonial of the love and esteem in which he was held by his many thousands of associates in the Bell System; for a gold medal and award for noteworthy and distinguished accomplishments in any field of science.	25,000
THOMAS LINCOLN CASEY ENDOWMENT FUND: Bequest of Thomas L. Casey in 1954, as a memorial to his father, Thomas Lincoln Casey, to be used in the advancement of engineering in all its applications.	258,081
COMSTOCK FUND: Gift of General Cyrus B. Comstock, a member of the Academy (1907), to promote researches in electricity, magnetism, or radiant energy through the Comstock Prize to be awarded for notable investigations.	10,400
ARTHUR L. DAY FUND: A bequest of Arthur L. Day, a member of the National Academy of Sciences, for the purpose of advancing studies of the physics of the earth.	1,398,474
DRAPER FUND: Gift of Mrs. Henry Draper in 1883, in memory of her husband, a former member of the Academy, to found the Henry Draper Medal to be awarded for notable investigations in astronomical physics; the balance of income is applied to aid research in this science.	6,000

SCHEDULE 3-A
continued

ELLIOT FUND: Gift of Margaret Henderson Elliot to found the Daniel Giraud Elliot Gold Medal and Honorarium for the most meritorious work on zoology or paleontology published in each year.	$ 8,000
GIBBS FUND: Established by gift of Wolcott Gibbs, a member of the Academy (1892), and increased by a bequest of the late Morris Loeb in 1914 for the promotion of research in chemistry.	5,173
GIBBS BROTHERS FUND: Gift of William Francis Gibbs and Frederic H. Gibbs in 1963 to found The Gibbs Brothers Medal for outstanding contribution in the field of naval architecture and marine engineering.	24,000
GOULD FUND: Gift of Mrs. Alice Bache Gould in 1897 in memory of her father, a former member of the Academy, for the promotion of research in astronomy, and supplemented by a bequest of $20,000 from the estate of Alice Bache Gould received in 1954.	40,000
HARTLEY FUND: Gift from Mrs. Helen Hartley Jenkins, 1913-1914, in memory of her father, Marcellus Hartley, to found the Public Welfare Medal awarded for eminence in the application of science to the public welfare.	1,168
JOSEPH HENRY FUND: Contributions by Fairman Rogers, Joseph Patterson, George W. Childs, and others as an expression of their respect and esteem for Joseph Henry, for the establishment of a fund to assist meritorious investigators, especially in the direction of original research.	39,740
HUNSAKER FUND: Gift of Mr. and Mrs. J. C. Hunsaker in 1964 to found an Academy award in the field of aeronautical engineering.	24,750
KOVALENKO FUND: Gift of Michael S. Kovalenko, 1948-1949, in memory of his wife, to found the Jessie Stevenson Kovalenko Gold Medal for meritorious research in medical sciences.	43,741
MARSH FUND: Bequest of Othniel Charles Marsh, a member of the Academy (1909), to promote original research in the natural sciences.	10,000

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SCHEDULE 3-A
continued

GEORGE P. MERRILL FUND: Gift of Mrs. George P. Merrill in 1956, the income from which is to be used for studies of meteors, meteorites, and space.	$ 10,000
MICROBIOLOGY AWARD: Gift of the Foundation for Microbiology for an award of $5,000 every two years to be known as the Foundation for Microbiology Award in Microbiology.	10,000
MOLECULAR BIOLOGY AWARD: Funds contributed by the U.S. Steel Foundation for an annual award of $5,000 for scientific research by a relatively young investigator in the field of molecular biology or other scientific field selected by the Academy.	60,900
MURRAY FUND: Gift of the late Sir John Murray in 1911 to found the Alexander Agassiz Gold Medal in honor of a former member and president of the Academy, to be awarded for original contributions to the science of oceanography.	6,000
PRADEL FUND: A bequest of Jules Pradel in 1947 to be applied to work on the human central nervous system and allied subjects.	16,392
H. P. ROBERTSON LECTURESHIP FUND: Contributions by friends of H. P. Robertson, Foreign Secretary of the Academy at the time of his death (1962), to establish a lectureship under which distinguished scientists would be invited from anywhere in the world to present lectures to be known as the Robertson Memorial Lecture of the National Academy of Sciences.	20,325
SLIPHER TRUST FUND: Bequest of V. M. Slipher, a member of the Academy, to be used for research in astronomy or for any other purpose as directed by the officers of the Academy.	6,923
SMITH FUND: Gift of Mrs. J. Lawrence Smith in 1884, in memory of her husband, a former member of the Academy, to found the J. Lawrence Smith Gold Medal to be awarded for important investigations of meteoric bodies and to assist, by grants of money, research concerning such objects.	8,000
THOMPSON FUND: Gift of Mrs. Mary Clark Thompson, in 1919, for a gold medal of appropriate design, to be known as the Mary Clark Thompson Gold Medal, to be awarded for important services to geology and paleontology.	10,000

SCHEDULE 3-A
continued

TROLAND FUND: Bequest of Leonard T. Troland to be known as the Troland Foundation for Research in Psychophysics. The income to be expended with a view to the actual advancement of scientific knowledge within the field of psychophysics.	$ 212,000
WALCOTT FUND: Gift of Mrs. Mary Vaux Walcott in 1928, in honor of her husband, a former member and president of the Academy, for the award of medals and honoraria to persons, the results of whose published researches, explorations, and discoveries in pre-Cambrian or Cambrian life and history shall be judged most meritorious; the award to be known as the Charles Doolittle Walcott Medal.	5,000
G. K. WARREN FUND: Gift of Miss Emily B. Warren, 1966, in memory of her father, a member of the Academy, the income to be used for an award to be known as the G. K. Warren Prize in any field of science.	15,000
WATSON FUND: Bequest of James Craig Watson, a member of the Academy (1874), for the promotion of astronomical sciences through the award of the Watson Gold Medal and grants of money in aid of research.	25,000
ZWORYKIN FUND: Gift of the RCA Corporation to support the V. K. Zworykin award of the National Academy of Engineering for outstanding achievements in the field of electronic engineering in the service of mankind.	5,000

SCHEDULE 4

Expenditures from Current Funds

FOR THE YEAR ENDED JUNE 30, 1973

CURRENT GENERAL FUNDS

NATIONAL ACADEMY OF SCIENCES

Program Administration		
Executive Office	$ 923,337	
Office of the Foreign Secretary	165,494	
Membership Activities	57,801	
	$1,146,632	
General Administration		
Office of the Business Manager	$ 248,542	
Operations and Maintenance of Buildings and Grounds	589,445	
Rental and Operation of Joseph Henry Building—NAS	1,088,939	
Rental and Operation of Joseph Henry Building—OTHER	372,833	
Rental and Operation of Other Outside Space	184,466	
Depreciation of Equipment	154,300	
Building Use Charge	115,406	
Office of General Services	77,132	
Receiving, Stockroom, and Mail Service	160,182	
Security Office	47,745	
Telephone Service	171,390	
Office of Comptroller	132,366	
Accounting Office	449,467	
Financial Advisory Service	21,592	
Personnel Office	185,560	
Health Services	30,181	
Office of Information	272,019	
President's Allowance	29,404	
Reference Library	104,518	
Staff Benefits	127,875	
Forum Planning Office	46,105	
Food Service	70,610	
	$4,680,077	
Dissemination of Information and Publication Activities		
Printing and Duplicating Service	$ 64,561	
Publications	878,954	
	$ 943,515	
TOTAL NATIONAL ACADEMY OF SCIENCES		$6,770,224

SCHEDULE 4
continued

CURRENT GENERAL FUNDS—continued

NATIONAL ACADEMY OF ENGINEERING

Program Administration

Council	$ 9,254	
Executive Office	384,770	
Meetings and Conferences	8,710	
International Activities	12,989	
Membership Services	21,510	
Program Planning and Development	9,259	
Project Committee	5,007	
Engineering Manpower Policy	13,098	
	$ 464,597	
TOTAL NATIONAL ACADEMY OF ENGINEERING		$ 464,597

NATIONAL RESEARCH COUNCIL

Program Administration

Divisions:		
Assembly of Behavioral and Social Sciences	$ 108,574	
Biology and Agriculture	83,839	
Chemistry and Chemical Technology	68,282	
Earth Sciences	82,379	
Engineering	107,415	
Mathematical Sciences	37,659	
Medical Sciences	90,319	
Physical Sciences	83,168	
Office of Scientific Personnel	107,863	
Commission on Natural Resources	25,662	
	$ 795,160	
TOTAL NATIONAL RESEARCH COUNCIL		$ 795,160

SCHEDULE 4
continued

INSTITUTE OF MEDICINE		
Program Administration		
Institute of Medicine	$ 506,309	
TOTAL INSTITUTE OF MEDICINE		$ 506,309
General Expenses Allocated as Indirect Costs to Grants and Contracts		(6,516,608)
TOTAL CURRENT GENERAL FUNDS		$2,019,682

CURRENT RESTRICTED FUNDS

Government-Financed Activities

NATIONAL ACADEMY OF SCIENCES		
Advisory and Research Activities		
Committee on Science and Public Policy (NSF)	$ 92,928	
Materials Science and Engineering Survey (NSF)	74,539	
	$ 167,467	
TOTAL NATIONAL ACADEMY OF SCIENCES		$ 167,467
NATIONAL ACADEMY OF ENGINEERING		
Advisory and Research Activities		
Committee on Transportation (TRANSPORTATION)	$ 138,953	
Study of Goals for Manned Undersea Science and Technology (COMMERCE)	45,043	
Integrated Utility Systems (HUD)	91,310	
Study of National Science Foundation Incentive Program Experimental Research and Development (NSF)	59,546	
Computer Science in Electrical Engineering Courses (NSF)	6,208	
Marine Board (NAVY)	134,897	
Aeronautics and Space Engineering Board (NASA)	125,680	

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS—continued
Government-Financed Activities—continued
NATIONAL ACADEMY OF ENGINEERING—continued
Advisory and Research Activities—continued

Issues in Educational Technology (HEW)	$ 38,200	
Space Applications Board (NASA)	68,095	
Advisory Committee to the Bureau of Mines (INTERIOR)	70,738	
Study of Operational Safety in Offshore Resource Development (INTERIOR)	14,672	
Study of Priorities for Research Applied to National Needs (NSF)	262,058	
Committee on Power Plant Siting (NSF)	9,690	
Committee on Public Engineering Policy (NSF)	107,174	
Development of Computing Systems for Use in Chemistry Engineering Education (NSF)	36,008	
Committee on Interplay of Engineering with Biology and Medicine (HEW-NASA)	121,662	
Committee on Telecommunications (HUD-EXEC OFC PRES)	94,651	
Various Projects (LESS THAN $5,000 EACH)	9,789	
	$1,434,374	
Conferences and Symposia		
Symposium on Transportation and the Prospects for Improved Efficiency (NSF)	$ 35,163	
Panel on International Decade of Ocean Exploration (NSF)	7,425	
Various Projects (LESS THAN $5,000 EACH)	3,264	
	$ 45,852	
TOTAL NATIONAL ACADEMY OF ENGINEERING		$ 1,480,226

NATIONAL RESEARCH COUNCIL

ASSEMBLY OF BEHAVIORAL AND SOCIAL SCIENCES

Advisory and Research Activities

Assessment of Manpower Training Evaluation (LABOR)	$ 123,115	

SCHEDULE 4
continued

Committee on Vision and on Hearing, Bioacoustics, and Biomechanics (NAVY)	$ 158,570	
Advisory Committee on Child Development (HEW)		
Committee on Federal Agency Evaluation Research (EXEC OFC PRES)	46,836	
Panel on the Impact of Information on Drug Use and Misuse (HEW)	84,751	
Various Projects (LESS THAN $5,000 EACH)	62,317	
	17,405	
	$ 492,994	
Conferences and Symposia		
Various Projects (LESS THAN $5,000 EACH)	$ 6,426	
TOTAL DIVISION OF BEHAVIORAL SCIENCES		$ 499,420

DIVISION OF BIOLOGY AND AGRICULTURE

Advisory and Research Activities		
Animal Nutrient Requirement Series (AGRICULTURE)	$ 6,961	
Committee on Photobiology (NSF)	6,056	
Study of South American Primates (ARMY)	65,200	
Laboratory Animal Standards (HEW)	13,635	
Committee on Maternal and Child Health Nutritional Guidelines (HEW)	25,421	
Committee on Aquatic Food Resources (COMMERCE)	20,054	
Committee on the Effects of Military Use of Herbicides (ARMY)	772,880	
Survey of Safety of Food Chemicals Generally Recognized as Safe (HEW)	28,229	
Committee on National Nutrition Survey (HEW)	9,704	
Food Additives Codex (HEW)	44,696	
Factorial Evaluation of Human Nutrient Requirements (HEW)	40,506	
Committee on the Study of African Agricultural Research Capabilities (AID)	47,752	
Committee on International Nutrition (AID)	33,003	
U.S. Advisory Committee on Foot and Mouth Disease (AID)	5,866	
Committee on Genetic Vulnerability of Major Food Crops (AGRICULTURE)	5,256	
U.S. Committee on the International Biological Program (NSF)	141,511	

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS–continued
Government-Financed Activities–continued
NATIONAL RESEARCH COUNCIL–continued
DIVISION OF BIOLOGY AND AGRICULTURE–continued
Advisory and Research Activities–continued

Review of Saccharin (HEW)	$ 7,260	
Institute of Laboratory Animal Resources (AGRICULTURE-HEW-NAVY-AEC-NSF-VA)	181,463	
Various Projects (LESS THAN $5,000 EACH)	3,576	
	$1,459,029	
Conferences and Symposia		
Conference on Laboratory Animal Resources (HEW)	$ 32,838	
VI International Congress on Photobiology (NSF)	5,769	
Various Projects (LESS THAN $5,000 EACH)	4,895	
	$ 43,502	
TOTAL DIVISION OF BIOLOGY AND AGRICULTURE		$ 1,502,531

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY

Advisory and Research Activities

Protocol Evaluation and Development for Toxicological Assessment of Environmental Pollutants (EPA)	$ 88,743
Toxicology Assessment of Fuel Additives and Their Combustion Products (EPA)	7,650
Biochemical Nomenclature (HEW)	26,717
National Laboratory for Theoretical Chemistry (NSF)	9,171
Advisory Board on Numerical Data (COMMERCE)	54,299
Advisory Committee on Hazardous Materials (TRANSPORTATION-COAST GUARD)	133,888
Radioactive Waste Management Plan and Program (AEC)	67,605
Committee on Data for Science and Technology of the International Council of Scientific Unions (NSF)	29,550
Advisory Center on Toxicology (AGRICULTURE-NAVY-EPA)	143,489
U.S. National Committee of the International Union of Crystallography (NSF)	6,351
	$ 567,463

SCHEDULE 4
continued

Conferences and Symposia

IX General Assembly and Congress of the International Union of Crystallography (ARMY-NAVY-NASA)	$ 22,643	
Conference on Critical Evaluation of Chemical and Physical Structural Information (NSF)	11,195	
Various Projects (LESS THAN $5,000 EACH)	2,658	
	$ 36,496	
TOTAL DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY		$ 603,959

DIVISION OF EARTH SCIENCES

Advisory and Research Activities

*Advisory Committee to NOAA (COMMERCE)	$ 94,118
Committee on Oceanography (NAVY-NSF)	199,664
Workshop on Need for National Policy for Use of Underground Space (NSF)	5,667
U.S. National Committee on Tunneling Technology (INTERIOR)	84,321
Committee on Mineral Resources and the Environment (INTERIOR)	61,131
Ocean Science Freedom Studies (NSF)	18,254
Study on Orientations in Geochemistry (NSF)	24,021
Committee on Remote Sensing Programs and Earth Resource Surveys (NSF-INTERIOR)	98,272
Workshop on Inputs Fates and Effects of Petroleum in Marine Environment (EPA-NAVY-TRANSPORTATION)	27,880
U.S. National Committee for Geochemistry (NSF)	70,229
U.S. National Committee for the International Hydrological Decade (NSF)	142,768
U.S. National Committee for Rock Mechanics (ARMY)	46,615
Committee on Seismology (NSF-INTERIOR-AEC-COMMERCE-ARMY-NASA)	27,220
Committee on the Alaska Earthquake (NSF-INTERIOR-HUD)	14,931
Workshop on Dynamics of the Mid-Atlantic Ridge (NSF)	14,847
Publication of Great Alaska Earthquake Series (NSF)	100,000
Various Projects (LESS THAN $5,000 EACH)	5,732
	$1,035,670

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS—continued
Government-Financed Activities—continued
NATIONAL RESEARCH COUNCIL—continued
DIVISION OF EARTH SCIENCES—continued

Conferences and Symposia

III Congress of the International Society of Rock Mechanics (NSF-INTERIOR)	$ 24,480	
TOTAL DIVISION OF EARTH SCIENCES		$ 1,060,150

DIVISION OF ENGINEERING

Advisory and Research Activities

Study and Report on Passenger Travel Demand Forecasting (TRANSPORTATION)	$ 32,753
Study and Report on Highways and Air Quality (EPA)	31,890
Building Research Advisory Board to the Federal Construction Council (COMMERCE-AEC-HEW-ARMY-NAVY-INTERIOR-GSA-VA-NASA)	153,909
Development and Use of Standardized Subsystems for Buildings (COMMERCE)	127,589
Highway Research Board Maritime Research Information Service (COMMERCE)	212,183
Advisory Board on Military Personnel Supplies (ARMY)	121,947
Advisory Committee on Data Processing Systems for Anti-Ballistic Missile (ARMY)	8,725
U.S. National Committee for International Institute of Refrigeration (COMMERCE-NSF-AGRICULTURE-INTERIOR)	11,641
Short- and Long-Term Emergency Housing Alternatives after Disasters (EXEC OFC PRES)	52,989
Studies of Fire Loads and Live Loads in Buildings (GSA)	19,471
Advisory Services on Gears and Pinions for Artillery (ARMY)	8,474
Transportation Research Information Systems (TRANSPORTATION)	72,058
Advisory Service on Treatment and Disposal of High Energy Material (NAVY)	48,276
*Study and Technical Evaluation of Coal Gasification Research (INTERIOR)	78,540

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

Highway Research Board—Railway Research Information Service (TRANSPORTATION)	$ 133,835
Maritime Transportation Research Board (NAVY)	301,081
Ship Hull Research Committee (NAVY)	82,806
*Committee on Pollution Abatement and Control (HEW)	22,386
Committee on Solid Wastes Research (HEW-NSF)	78,603
Advisory Committee on Federal Housing Administration Technical Studies (HUD)	16,825
Highway Research Board (TRANSPORTATION)	514,023
Highway Research Board—Transportation Research Information Service (TRANSPORTATION)	52,756
International Information Service to National Highway Safety Bureau (TRANSPORTATION)	14,177
Advisory Service on Procedure for Bonding Rubber to Metal (NAVY)	6,098
National Cooperative Highway Research Program (TRANSPORTATION-COMMERCE)	3,622,508
Transportation Noise Abatement Advisory Services (TRANSPORTATION)	129,919
Committee on Motor Vehicle Emissions (EPA)	380,091
*Committee on Natural Disasters (NSF)	29,157
Committee on Fire Research (COMMERCE-NSF-AGRICULTURE)	51,358
U.S. National Committee on the International Council on Building Research (COMMERCE-NSF-ARMY-HUD)	54,039
Advisory Services on Materials Research and Development (COMMERCE-NASA)	43,909
National Materials Advisory Board (ARMY-NAVY-GSA-NASA-COMMERCE)	443,025
Various Projects (LESS THAN $5,000 EACH)	12
	$6,957,053

Conferences and Symposia

Conference on Solid Waste Management in Buildings (HUD-NSF-EPA)	$ 40,388
II International Conference on Permafrost (NSF-ARMY)	78,233
Conference Workshop on Soil Erosion (NSF)	6,887
Conference on Urban Transportation (TRANSPORTATION)	9,888
XIII International Congress of the International Institute of Refrigeration (NSF)	8,213

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS–continued
Government-Financed Activities–continued
NATIONAL RESEARCH COUNCIL–continued
DIVISION OF ENGINEERING–continued
Conference and Symposia–continued

Conference on Citizen Participation in Transportation Planning (TRANSPORTATION)	$ 12,357	
Various Projects (LESS THAN $5,000 EACH)	3,862	
	$ 159,828	
TOTAL DIVISION OF ENGINEERING		$ 7,116,881

DIVISION OF MATHEMATICAL SCIENCES

Conferences and Symposia

Various Projects (LESS THAN $5,000 EACH)	$ 161	
TOTAL DIVISION OF MATHEMATICAL SCIENCES		$ 161

DIVISION OF MEDICAL SCIENCES

Advisory and Research Activities

Medical Advisory Committees (ARMY)	$ 103,624	
Committee on Phototherapy in the Newborn (HEW)	50,368	
Committee on Prosthetics Research and Development (HEW-VA)	200,533	
Clinical Evaluation in Prosthetics and Orthotics (HEW)	194,916	
Committee on Problems of Drug Dependence (HEW-JUSTICE)	109,573	
Committee on Viral Hepatitis (HEW)	19,807	
Committee on the Toxicology Information Project (HEW)	28,530	
Evaluation of Effects of National Pituitary Agency on Field of Endocrinology (HEW)	8,690	
Evaluation of Research Impact on Discoveries in Neuro Diseases (HEW)	91,797	
Review of Food and Drug Administration's Position on DMSO (HEW)	40,764	
Committee on the Study of Inborn Errors of Metabolism (NSF)	53,661	
Follow-Up Agency Amyotsophic Lateral Sclerosis (HEW)	34,569	
Study of Synthetic Substitutes of Morphine (JUSTICE)	9,453	
Evaluation of Data on Children's Hazards from Lead in Paints (HEW)	7,223	

SCHEDULE 4
continued

Advisory Committee to Environmental Protection Agency (HEW)	$ 53,863	
Workshop on Dermatopharmocology (HEW)	5,214	
Drug Research Board (HEW)	78,376	
National Halothane Study (HEW)	279,605	
Multiple Sclerosis Epidemiology U.S. Veteran Population (HEW)	57,176	
Medical Follow-Up Studies—Veterans' Medical Problems (HEW-VA)	367,291	
National Institutes of Health Advisory Committees (HEW)	22,392	
Medical Follow-Up Agency Study of Etiology of Cancer in Veterans (HEW)	104,769	
Follow-Up Agency Medical Studies on Veterans Twins (HEW)	88,921	
Committee on Emergency Medical Service (HEW)	14,709	
Atomic Bomb Casualty Commission (AEC)	6,171,132	
Committee on Prosthetic-Orthotic Education (VA-HEW)	123,709	
Research Impact on Useful Discoveries in Mental Health (HEW)	10,581	
U.S. National Committee of the International Union of Physiological Sciences (HEW-NSF)	5,291	
Committee on Biologic Effects of Environmental Pollutants (EPA)	254,744	
ICSP-WHO International Reference Center (HEW)	151,781	
Various Projects (LESS THAN $5,000 EACH)	13,906	
	$8,756,968	
Conferences and Symposia		
Conference of Carcinogenesis Testing in the Development of New Drugs (HEW)	$ 15,260	
Conference on Contraceptive Drugs (HEW)	14,944	
Various Projects (LESS THAN $5,000 EACH)	3,830	
	$ 34,034	
TOTAL DIVISION OF MEDICAL SCIENCES		$ 8,791,002
DIVISION OF PHYSICAL SCIENCES		
Advisory and Research Activities		
Support of the International Union of Radio Science (NSF)	$ 20,000	
Committee on the DOT Climatic Impact Assessment Program (TRANSPORTATION)	73,999	
*Advisory Committee to the National Bureau of Standards (COMMERCE)	137,206	
Advisory Committee to Air Force Systems Command (AIR FORCE)	84,417	

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS–continued
Government-Financed Activities–continued
NATIONAL RESEARCH COUNCIL–continued
DIVISION OF PHYSICAL SCIENCES–continued
Advisory and Research Activities–continued

Advisory Committee to Army Research Office (ARMY)	$ 49,738	
Assessment of Land Mine Detection and Neutralization Research and Development (ARMY)	67,296	
Defense Science Board Summer Study (ARMY)	45,006	
Committee on Undersea Warfare (NAVY)	161,503	
Mine Advisory Committee (NAVY)	58,249	
Space Science Board (NASA)	291,322	
Committee on Atmospheric Sciences (NSF)	24,368	
Committee on Polar Research (NSF)	172,785	
Committee on Radio Frequency Requirements for Scientific Research (NSF)	25,180	
Geophysics Research Board (NSF)	166,760	
U.S. Committee for the Global Atmospheric Research Program (NSF)	136,030	
Support of U.S. National Committee for the International Astronomical Union and International Union of Theoretical and Applied Mechanics (NSF)	23,235	
Physics Survey Committee (NSF-AEC-NASA-NAVY)	50,703	
Committee on Nuclear Science (NSF-AEC-NASA)	425,317	
Astrometric Research in Southern Hemisphere (NSF-NASA)	25,750	
Various Projects (LESS THAN $5,000 EACH)	346	
	$2,039,210	
Conferences and Symposia		
XI General Assembly of International Union of Pure and Applied Physics (NSF-AEC)	$ 35,581	
XIII General Assembly and Congress of the International Union of Theoretical and Applied Mechanics (NSF-NAVY-NASA)	38,655	
IX General Assembly and Congress for the International Commission for Optics (NASA)	23,398	
XV General Assembly of the International Astronomical Union (NSF)	36,599	
Various Projects (LESS THAN $5,000 EACH)	2	
	$ 134,235	
TOTAL DIVISION OF PHYSICAL SCIENCES		$ 2,173,445

SCHEDULE 4
continued

OFFICE OF THE FOREIGN SECRETARY

Advisory and Research Activities

Commission on Scholarly Communications (STATE)	$ 14,188	
Study of Problems of Advanced Societies (NSF)	20,679	
U.S.-Argentine Cooperative Science Program (AID)	13,655	
Advisory Board on International Relations (STATE)	14,719	
Board on Science and Technology for International Development (AID)	792,696	
Science Organization Development Board (AID)	19,856	
International Organizations and Programs (NSF)	342,128	
U.S. National Committee for the International Federation of Documentation (NSF)	52,398	
Advisory Committee on USSR and Eastern Europe (NSF)	1,027,838	
ICSU Abstracting Board (NSF)	12,734	
Institute for Applied Systems Analysis (NSF)	1,280,027	
Indonesian Workshop on Natural Resources Planning and Management (AID)	28,878	
Committee on Scholarly Communication with People's Republic of China (NSF)	229,193	
Various Projects (LESS THAN $5,000 EACH)	3,330	
	$3,852,319	
Conferences and Symposia		
Joint Symposia on Scientific Policy (NSF)	$ 8,029	
International Seminars on Population Policy Analysis (AID)	74,855	
	$ 82,884	
Fellowships and Other Support of Scholars		
U.S.-Brazil Program for Postgraduate Research in Chemistry (NSF-AID)	$ 220,732	
TOTAL OFFICE OF THE FOREIGN SECRETARY		$ 4,155,935

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS—continued
Government-Financed Activities—continued
NATIONAL RESEARCH COUNCIL—continued

OFFICE OF SCIENTIFIC PERSONNEL

Advisory and Research Activities

Board on Human Resources (FDN. ON ARTS AND HUMANITIES)	$ 23,160
NIGMS Research Training Grant Program (HEW)	43,257
National Board on Graduate Education (NSF-HEW)	29,792
Doctorate Survey Program (NSF)	395,203
Biomedical Manpower Study (HEW)	133,463
Study of Science Development Program (NSF)	12,437
	$ 637,312

Fellowships and Other Support of Scholars

Agricultural Research Service Postdoctoral Research Associateships (AGRICULTURE)	$ 8,819
National Bureau of Standards Research Associateships (COMMERCE)	8,163
Air Force Systems Command Postdoctoral Research Associateships (AIR FORCE)	768,139
Army Materials and Mechanics Research Center Postdoctoral Research Associateships (ARMY)	70,324
Natick Visiting Scientists Program (ARMY)	187,796
National Oceanic and Atmospheric Administration Resident Research Associateship Program (COMMERCE)	437,404
Naval Electronic Laboratories Postdoctoral Research Associateships (ARMY)	41,663
Picatinny Arsenal Research Associateships (ARMY)	85,066
Bureau of Medicine and Surgery Postdoctoral Research Associateships (NAVY)	8,488
Naval Ordnance Laboratory Postdoctoral Research Associateships (NAVY)	7,973
Naval Postgraduate School Postdoctoral Research Associateships (NAVY)	8,512
International Atomic Energy Agency Training Program (AEC)	106,387

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SCHEDULE 4
continued

Naval Undersea Research and Development Center Postdoctoral Research Associateships (NAVY)	$ 9,767	
Naval Weapons Center Postdoctoral Research Associateships (NAVY)	447,314	
Bureau of Mines Postdoctoral Research Associateships (INTERIOR)	7,585	
U.S. Geological Survey Postdoctoral Research Associateships (INTERIOR)	8,428	
Committee on International Exchange of Persons (STATE)	1,523,645	
International Atomic Energy Agency Training Program (AID)	200,070	
NASA Research Associateships (NASA)	3,730,492	
Graduate Fellowship Program (NSF)	306,779	
Smithsonian Institution Visiting Research Associateships (SMITHSONIAN INSTITUTION)	45,943	
	$8,018,757	
TOTAL OFFICE OF SCIENTIFIC PERSONNEL		$ 8,656,069

OTHER

Advisory and Research Activities

Assessment of Computer Science Industry in Japan (COMMERCE)	$ 7,995	
Study of Environmental Problems (NSF-COMMERCE-FAA-STATE)	152,721	
Advisory Committee on Civil Defense (ARMY)	87,123	
*Advisory Assistance to Department of Housing and Urban Development (HUD)	427,952	
Advisory Committee to the Office of Emergency Planning (EXEC OFC PRES)	90,129	
*Environmental Studies Board Water Quality Criteria Study (EPA)	63,600	
Study on Problems of Pest Control (AGRICULTURE)	25,179	
Various Projects (LESS THAN $5,000 EACH)	1,852	
	$ 856,551	

Conferences and Symposia

Conference on Principle of Protocols for Evaluating Chemicals in Environment (EPA)	$ 72,330	
TOTAL OTHER		$ 928,881

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS—continued
Government-Financed Activities—continued

INSTITUTE OF MEDICINE

Advisory and Research Activities

Advisory Service in Reviewing the National Cancer Program Plan (HEW)	$ 5,577	
Study of Educational Costs in the Health Professions (HEW)	817,932	
Methodology for Evaluation of Ambulatory Health Service (HEW)	28,677	
National Committee on Human Value Issues in Health Care (HEW)	56,477	
	$ 908,663	

Conferences and Symposia

Conference on Interrelationships of Educational Program with Health Profession (HEW)	$ 50,092	
Seminar on Selected Issues in Mandated Health Insurance (HEW)	10,025	
	$ 60,117	
TOTAL INSTITUTE OF MEDICINE		$ 968,780
TOTAL GOVERNMENT-FINANCED ACTIVITIES		$38,104,907

Privately Financed Activities

NATIONAL ACADEMY OF SCIENCES

Advisory and Research Activities

Programs of Meetings and Conferences (VARIOUS)	$ 15,651
Awards and Prizes (VARIOUS)	90,639
Various Projects (LESS THAN $5,000 EACH)	4,167
	$ 110,457

SCHEDULE 4
continued

Conferences and Symposia		
Forum (NAS)	$ 45,125	
Fellowships and Other Support of Scholars		
Staff Fellowship Program (ALFRED P. SLOAN FDN.)	$ 12,788	
TOTAL NATIONAL ACADEMY OF SCIENCES		$ 168,370
NATIONAL ACADEMY OF ENGINEERING		
Advisory and Research Activities		
Committee on Engineering Education (M.I.T.)	$ 55,285	
NAE Committee on Power Plant Siting (VARIOUS)	5,562	
U.S. National Committee for Environmental Center on Oceanic Resources (VARIOUS)	8,804	
Various Projects (LESS THAN $5,000 EACH)	415	
	$ 70,066	
Conferences and Symposia		
Minority Participation in the Engineering Profession (IBM CORPORATION-OLIN CORPORATION)	$ 38,818	
Various Projects (LESS THAN $5,000 EACH)	596	
	$ 39,414	
TOTAL NATIONAL ACADEMY OF ENGINEERING		$ 109,480
NATIONAL RESEARCH COUNCIL		
ASSEMBLY OF BEHAVIORAL AND SOCIAL SCIENCES		
Advisory and Research Activities		
Various Projects (LESS THAN $5,000 EACH)	$ 2,190	
TOTAL DIVISION OF BEHAVIORAL SCIENCES		$ 2,190

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS—continued
Privately Financed Activities—continued
NATIONAL RESEARCH COUNCIL—continued

DIVISION OF BIOLOGY AND AGRICULTURE

Advisory and Research Activities

Food Additives Codex (VARIOUS)	$ 28,553	
Food and Nutrition Board (VARIOUS)	100,498	
Agriculture Board (MONSANTO FUND-FORD FDN.)	27,336	
Committee on Food Protection (VARIOUS)	11,341	
Agricultural Research Institute (VARIOUS)	17,440	
Institute of Laboratory Animal Resources (AMERICAN CANCER SOCIETY-VARIOUS)	22,919	
Study of Effects of Herbicides (NAS)	29,642	
Study of Agricultural Products Efficiency (ROCKEFELLER FDN.)	37,635	
Various Projects (LESS THAN $5,000 EACH)	8,607	
	$ 283,971	

Conferences and Symposia

Various Projects (LESS THAN $5,000 EACH)	$ 2,203	
TOTAL DIVISION OF BIOLOGY AND AGRICULTURE		$ 286,174

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY

Advisory and Research Activities

Various Projects (LESS THAN $5,000 EACH)	$ 1,582	

Conferences and Symposia

U.S. National Committee of International Union of Pure and Applied Chemistry (VARIOUS)	$ 23,749	
Various Projects (LESS THAN $5,000 EACH)	1,270	
	$ 25,019	
TOTAL DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY		$ 26,601

SCHEDULE 4
continued

DIVISION OF EARTH SCIENCES		
Advisory and Research Activities		
Various Projects (LESS THAN $5,000 EACH)	$ 3,407	
Dissemination of Information and Publication Activities		
Publication of Great Alaska Earthquake Series (VARIOUS)	$ 91,329	
Less: Transfer Expense to Government Fund	(100,000)	
	$ (8,671)	
TOTAL DIVISION OF EARTH SCIENCES		$ (5,264)
DIVISION OF ENGINEERING		
Advisory and Research Activities		
Committee on Motor Vehicles (NAS)	$ 7,721	
Highway Research Board (VARIOUS STATE GOVERNMENTS AND OTHERS)	1,525,179	
Building Research Advisory Board (VARIOUS)	80,130	
Various Projects (LESS THAN $5,000 EACH)	6,601	
	$1,619,631	
Conferences and Symposia		
U.S. National Committee for the International Institute of Refrigeration Congress (VARIOUS)	$ 39,475	
Conference on Electrical Insulation (VARIOUS)	42,524	
Various Projects (LESS THAN $5,000 EACH)	6,928	
	$ 88,927	
TOTAL DIVISION OF ENGINEERING		$1,708,558
DIVISION OF MATHEMATICAL SCIENCES		
Advisory and Research Activities		
Committee on National Statistics (RUSSELL SAGE FDN.)	$ 33,879	
Various Projects (LESS THAN $5,000 EACH)	382	
	$ 34,261	
TOTAL DIVISION OF MATHEMATICAL SCIENCES		$ 34,261

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS–continued
Privately Financed Activities–continued
NATIONAL RESEARCH COUNCIL–continued

DIVISION OF MEDICAL SCIENCES

Advisory and Research Activities

Emergency Medical Communication Systems (ROBERT W. JOHNSON FDN.)	$ 7,317	
Committee on Radiological Research (JAMES PICKER FDN.-OLOL MEMORIAL HOSPITAL)	285,840	
Committee on Problems of Drug Dependence (VARIOUS)	165,927	
Study of Body Build and Mortality of World War II Veterans (AMERICAN MEDICAL ASSOC.)	17,933	
National Committee of the International Union against Cancer (VARIOUS)	5,219	
Various Projects (LESS THAN $5,000 EACH)	5,940	
	$ 488,176	

Conferences and Symposia

Conference on Bioavailability of Drugs (VARIOUS)	$ 9,456	
II International Symposium on Microsomes and Drug Oxidation (VARIOUS)	14,923	
Various Projects (LESS THAN $5,000 EACH)	2,756	
	$ 27,135	
TOTAL DIVISION OF MEDICAL SCIENCES		$ 515,311

DIVISION OF PHYSICAL SCIENCES

Advisory and Research Activities

Various Projects (LESS THAN $5,000 EACH)	$ 4,271	

Conferences and Symposia

XIV General Assembly of the International Union of Pure and Applied Physics (VARIOUS)	$ 34,990	
Various Projects (LESS THAN $5,000 EACH)	4,180	
	$ 39,170	
TOTAL DIVISION OF PHYSICAL SCIENCES		$ 43,441

SCHEDULE 4
continued

OFFICE OF THE FOREIGN SECRETARY

Advisory and Research Activities

International Foundation for Science (ROCKEFELLER FDN.)	$ 6,144	
Science Cooperative Program with Republic of China (ROCKEFELLER FDN.)	13,581	
Programs in International Science Cooperation (FORD FDN.)	24,320	
Biological Research in Latin America (FORD FDN.)	19,223	
Various Projects (LESS THAN $5,000 EACH)	4,669	
	$ 67,937	
Conferences and Symposia		
Various Projects (LESS THAN $5,000 EACH)	$ 1,269	
Dissemination of Information and Publication Activities		
The Copernicus Quinquecentennial in 1973 Volume (ROCKEFELLER FDN.)	$ 20,418	
TOTAL OFFICE OF THE FOREIGN SECRETARY		$ 89,624

OFFICE OF SCIENTIFIC PERSONNEL

Advisory and Research Activities

National Board on Graduate Education (A. W. MELLON FDN.-	$ 122,486	
CARNEGIE CORP. OF N.Y.-VARIOUS)	96,465	
Board on Human Resources (RUSSELL SAGE FDN.)	1,648	
Various Projects (LESS THAN $5,000 EACH)	$ 220,599	
Conferences and Symposia		
Various Projects (LESS THAN $5,000 EACH)	$ 2,181	
Fellowships and Other Support of Scholars		
International Atomic Energy Agency Fellows Type I (VARIOUS)	$ 5,575	
Various Projects (LESS THAN $5,000 EACH)	1,066	
	$ 6,641	
TOTAL OFFICE OF SCIENTIFIC PERSONNEL		$ 229,421

SCHEDULE 4
continued

CURRENT RESTRICTED FUNDS—continued
Privately Financed Activities—continued
NATIONAL RESEARCH COUNCIL—continued

OTHER

Advisory and Research Activities

Computer Science and Engineering Board (VARIOUS)	$ 31,383	
*Environmental Studies Board (KELLOGG FDN.-SCAIFE FAMILY CHARITABLE TRUSTS)	388,368	
Various Projects (LESS THAN $5,000 EACH)	1,398	
	$ 421,149	

Conferences and Symposia

Conference on Scientific Information (VARIOUS)	$ 5,119	
TOTAL OTHER		$ 426,268

INSTITUTE OF MEDICINE

Advisory and Research Activities

Computer Based Exam for Clinical Competence of Candidate Physician (NATIONAL BOARD MEDICAL EXAM.)	$ 8,069
Study of Contrasts in Health Status (ASSOC. FOR THE AID OF CRIPPLED CHILDREN-CARNEGIE CORP. OF N.Y.)	168,834
Various Projects (LESS THAN $5,000 EACH)	91
	$ 176,994

Conferences and Symposia

Official Visit of Chinese Physicians (ROCKEFELLER FDN.-CARNEGIE CORP. OF N.Y.-KETTERING FDN.)	$ 80,762
Various Projects (LESS THAN $5,000 EACH)	3,639
	$ 84,401

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

Fellowships and Other Support of Scholars		
Fellowships in Health Policy (ROBERT W. JOHNSON FDN.)	$ 11,521	
TOTAL INSTITUTE OF MEDICINE		$ 272,916
TOTAL PRIVATELY FINANCED ACTIVITIES		$3,907,351

REPORT OF THE TREASURER

FISCAL YEAR 1974

Treasurer's Statement

To the Council of the National Academy of Sciences:

The financial statements and schedules that follow reflect the financial condition of the National Academy of Sciences, including the National Academy of Engineering, the Institute of Medicine, and the National Research Council, as of June 30, 1974, and the results of operations during the fiscal year ended on that date.

INVESTMENTS

Consolidated Fund—Schedules 1, 1-A, and 1-B

The investments of the Consolidated Fund of the Corporation, not including short-term investments of working capital funds, are summarized by classes of investment as follows:

	JUNE 30, 1974			
	BOOK VALUE (COST)	MARKET VALUE	PERCENT[a]	INCOME
Convertible Bonds and Notes	$ 100,000	$ 90,000	.45	$ 4,902
Other Bonds and Notes	2,070,761	1,875,782	9.40	167,062
Common Stocks	14,320,876	15,659,235	78.44	184,117
Cash, Cash Equivalents, Securities Receivables and Payables	2,337,546	2,337,546	11.71	272,975
Total	$18,829,183	$19,962,563	100.00	$629,056

[a]Of market value.

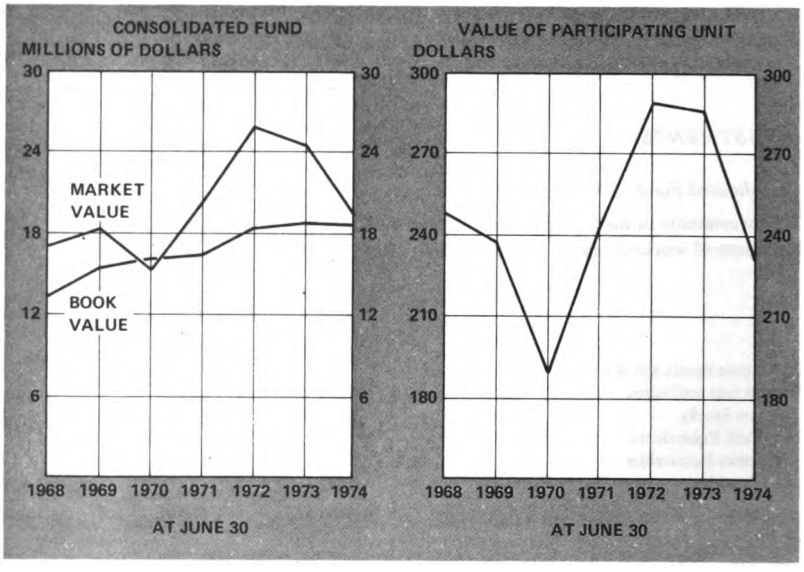
During 1973–1974 the distribution of holdings by major classes of investment changed from the levels as of a year ago. The book value of fixed-income securities decreased slightly, but the percentage of investments in common stocks increased compared to last year. Cash and cash equivalents on hand decreased sharply compared to last year.

The book value of investments at June 30, 1974, was $128,792 greater than at the end of the previous year. The principal items contributing to this change were receipts of $20,000 for U.S. Steel Award in Molecular Biology, $2,488 for the Slipher Fund, $20,000 for the Eddy Memorial Award Fund, $10,465 for F. L. Hunt Fund, $17,500 for the President's Deferred Compensation, $40,000 for the Carnegie Fund, a loss of $34,822 on sales of securities, and investment of $53,161 from earned income on trust accounts.

The market value of the investments owned was 106.00% of cost on June 30, 1974, compared with 131.93% at the end of the previous fiscal year. During the past year, the income on the average market value of all investments was at the rate of 3.15%, or about the same rate last year.

The funds participating in the Consolidated Fund are summarized in Schedule 3.

Pooled investments in the Consolidated Fund are administered like an open-end investment trust: Equities of the funds in the pool are expressed in terms of participating capital units. Each participating capital unit was assigned a value of $100 as of July 1, 1953; the value had decreased to $230.07 by June 30, 1974, from the value of $286.56, or 19.7%, as of the end of the last fiscal year.



The Morgan Guaranty Trust Company of New York continued to act as Investment Counsel and Custodian of Securities.

In addition to the securities held in the Consolidated Fund there were, from time to time during the year, other funds on deposit for Short-Term Investments at various banks from which additional income of $455,236 was earned.

Termination Allowance Trust Fund—Schedules 2 and 2A

In accordance with the labor laws of the Japanese Government, the Academy is liable for termination compensation to Japanese nationals who are employed by the Atomic Bomb Casualty Commission (ABCC) which is an activity of the Academy sponsored by the United States Government. The accrued liability is payable upon termination of employment.

In June 1972, the United States Government funded the amount of the liability for the termination compensation and agreed to fund annually any increase in the liability. These funds earned interest and dividends amounting to $153,706 and sustained a net capital loss of $321,395 during this reporting period.

The investments of the Termination Allowance Trust Fund are summarized as follows:

	JUNE 30, 1974			
	BOOK VALUE (COST)	MARKET VALUE	PERCENT*	INCOME
Cash, Cash Savings, and Receivables	$ 264,627	$ 264,627	4.88	$ 10,399
Cash Equivalents	2,841,000	2,841,000	52.38	112,724
Common Stock	3,170,306	2,318,110	42.74	30,583
Total	$6,275,933	$5,423,737	100.00	$153,706

*Of market value.

OPERATIONS

Exhibit B is a summary statement of income and expenses and changes in fund balances in the broad traditional classes of current funds, trust and endowment funds, and plant funds.

Activities conducted in response to requests of the United States Government are financed through cost reimbursement contracts. As expenses are incurred, bills are submitted to the

Federal Government agencies for reimbursement. The payments received from the Federal Government are therefore equal to the expenses incurred for those government-sponsored activities. On the other hand, activities supported by private, nonfederal agencies are usually financed by grants and agreements which provide for the funds to be paid to the Academy in lump sum or fixed incremental payments in advance of the expenses being incurred. These funds are available for expenditure on these projects during the current year and frequently also in subsequent years. Accordingly, the item of Deferred Income on the balance sheet of $1,674,943 represents those funds on hand at the close of the year which were available for later expenditure for specific activities under private grants and agreements. The amount received from private and nonfederal sources and used in the current year was $3,895,547.

The total operating expenses for the fiscal year amounted to $47,654,504. Of this amount, approximately $1,443,000, or 3%, was spent on activities designated as "classified" under the government security regulations.

The operation of the Joseph Henry Building for the fiscal year resulted in a gain on operations of $2,217. However, as the result of recommended audit adjustments of prior years' operations of $75,211, a net reduction in the Joseph Henry Building fund balance of $72,994 is reflected in the financial statements. Included in the costs of operation is an amount for the annual amortization costs of the improvements built into the building for use of both the commercial tenants and the Academy. The value of leasehold improvements remaining unamortized as of the end of the year was $597,847. The cost of the office space occupied by the Academy activities was $6.96 per square foot, including maintenance and utilities.

The following provide additional financial information on the operations during 1973–1974:

(a) In Table I below the sources of income used under contracts and grants for current purposes are summarized by agencies and organizations; and

(b) Table II below lists total current expenses by functional categories.

(c) Schedule 4 of this report reflects (1) expenditures from the current general funds in support of the two Academies, the Institute of Medicine, the National Research Council, other offices and services, and the physical plant; (2) expenditures from current restricted funds, the sources of which were agencies of the U.S. Government; and (3) expenditures from current restricted funds, the sources of which were private foundations, industrial concerns, state governments, and individuals. In (2) and (3) the major activities and principal sources of funds are indicated.

TABLE I

CURRENT FUNDS

Income by Source

U.S. GOVERNMENT AGENCIES (GRANTS AND CONTRACTS)

Department of Agriculture	$ 188,835
Department of Commerce	934,128
Department of Defense	
Department of the Air Force	1,022,260
Department of the Army	1,627,928
Department of the Navy	2,038,508
Department of Health, Education, and Welfare	4,708,625
Department of Housing and Urban Development	639,043
Department of the Interior	394,437
Department of Justice	52,268
Department of Labor	170,913
Department of State	2,033,839
Department of Transportation	4,643,277
Department of Treasury	13,380
U.S. Senate	269,401
Library of Congress	10,609
Executive Office of the President	505,902
Agency for International Development	1,176,564
Atomic Energy Commission	6,708,315
Environmental Protection Agency	850,926
General Services Administration	500,073
National Aeronautics and Space Administration	4,484,011
National Foundation on Arts and Humanities	48,233
National Science Foundation	6,996,178
Smithsonian Institution	23,340
Veterans Administration	664,833
Total	$40,705,826

TABLE I
continued

PRIVATE AND NONFEDERAL SOURCES (GRANTS, CONTRACTS, AND CONTRIBUTIONS)

Income Deferred from Fiscal Year 1973	$1,702,440	
Less: Grants Receivable from Fiscal Year 1973	68,776	$1,633,664
Income Received Current Fiscal Year		
Alcoa Foundation	$ 32,500	
American Bureau of Shipping	30,000	
American Cancer Society	23,824	
American Physiological Society	14,015	
American Telephone & Telegraph Co.	20,000	
Atlantic Richfield Company	20,000	
Baer Foundation	12,500	
Bechtel Corporation	21,500	
C. H. Boehringer Sohn	15,000	
Commonwealth Fund	35,000	
E. I. DuPont de Nemours & Company	21,000	
Electric Power Institute	10,000	
Exxon Corporation	21,500	
Ford Foundation	349,601	
General Electric Foundation	48,500	
Hoffman LaRoche, Inc.	24,000	
Holcomb Research Institute	10,000	
IBM Corporation	45,282	
International Foundation	11,395	
Kaiser Foundation	25,000	
Kellogg Foundation	100,000	
C. F. Kettering Foundation	33,423	
Eli Lilly & Company	22,588	
Mallinckrodt Foundation	10,500	
McDonnell Aero Foundation	20,000	
A. W. Mellon Foundation	150,000	
Merck and Co., Inc.	26,000	
Miles Laboratories	12,000	
Mrs. Paul's Kitchens, Inc.	25,000	
Olin Corporation	10,500	
James Picker Foundation	529,000	
Pfizer, Inc.	14,500	
Population Council	30,000	
RCA Corporation	25,000	

TABLE I
continued

Income Received Current Fiscal Year (continued)		
Rockefeller Foundation	46,950	
Rosenstiel Foundation	10,000	
D. Runyon-Winchell Cancer Fund	10,500	
Russell Sage Foundation	25,000	
Scaife Family Foundation	15,000	
Alfred P. Sloan Foundation	117,498	
Sterling Winthrop Research Institute	15,000	
Tinker Foundation	10,000	
Union Carbide Corporation	28,000	
United States Steel Corporation	13,000	
United States Steel Foundation	20,000	
University of Pennsylvania	18,000	
Various State Governments	1,581,200	
Wyeth Laboratories	17,250	
Miscellaneous (less than $10,000 per donor)	429,798	$4,156,324
Grants Receivable June 30, 1974		145,959
Total Available for Current Fiscal Year		5,935,947
Income Applied to Current Fiscal Year		4,511,816
Deferred to Future Periods		$1,424,131

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TABLE II

ALL CURRENT FUNDS

Expenses by Functional Categories

Program Administration	$ 3,742,549
General Administration	5,037,380
Advisory and Research Activities	29,954,312
Conferences and Symposia	521,463
Fellowships and Other Support of Scholars	7,066,796
Dissemination of Information and Publication Activities	1,332,004
Total	$47,654,504

Expenditures for all current purposes (excluding transactions of a capital nature in the Trust and Endowment Funds and in the Plant Funds) during the past ten years are represented in the chart on page 11.

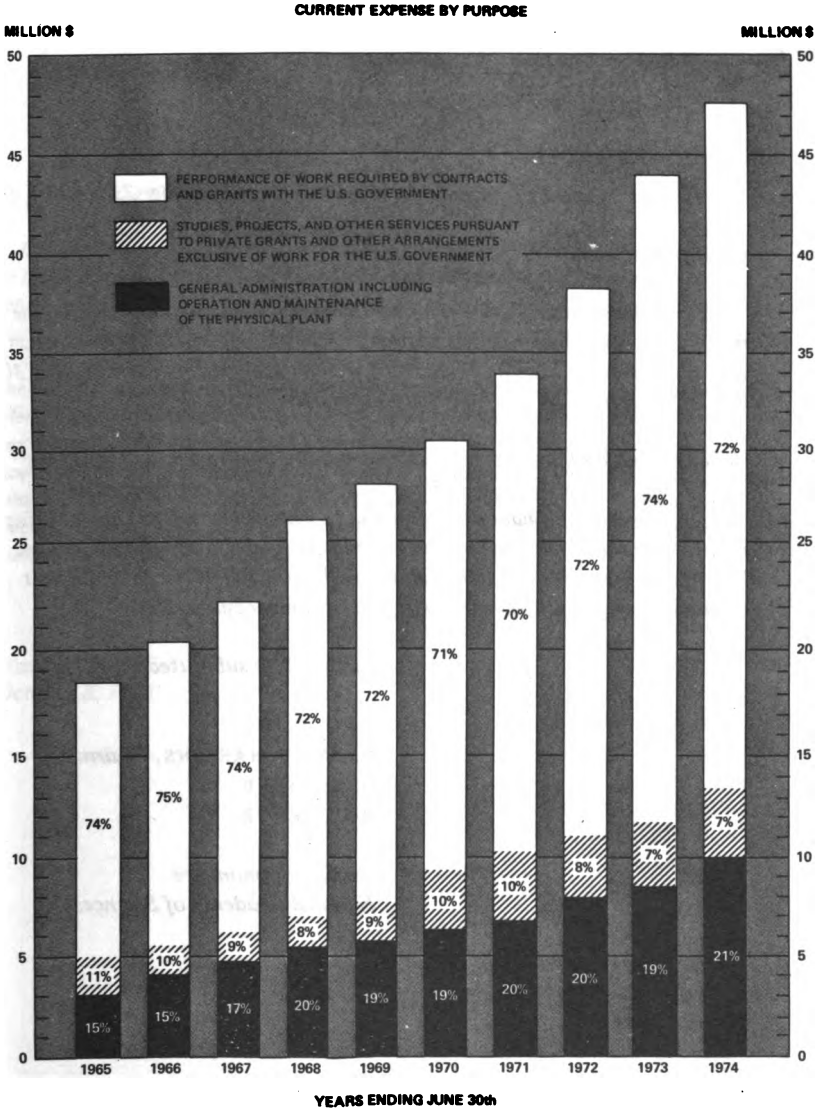
TRUST FUNDS

During the year there were additions to the Trust and Endowment Funds as follows:

(a) a gift of $2,488 from V. M. Slipher to be used for specific purposes.
(b) a gift of $20,000 from the U.S. Steel Foundation to be used for specific purposes.
(c) a bequest of $10,465 from the estate of Franklin Livingston Hunt to be used for specific purposes.
(d) contributions of $20,000 made in memory of Nathan B. Eddy to be used for specific purposes.

Respectfully submitted,

E. R. PIORE, *Treasurer*



Report of the Auditing Committee

October 23, 1974

Dear Dr. Handler:

In accordance with Bylaw V-7 of the National Academy of Sciences, the firm of Price Waterhouse & Co., Washington, D.C., was retained to make an audit of the accounts of the Treasurer for the fiscal year that ended June 30, 1974, and to report to the Auditing Committee.

The independent accountants have completed their examination of the financial statements and have submitted their report, a copy of which is attached, concerning financial statements to which they refer. The Auditing Committee has reviewed the report and recommends its acceptance as compliance with the governing bylaw and that the opinion of the independent accountants be published with the report of the Treasurer.

Respectfully submitted,

CARYL P. HASKINS, *Chairman*
H. S. YODER
ROY HERTZ

Auditing Committee
National Academy of Sciences

Dr. Philip Handler, President
National Academy of Sciences
Washington, D.C.

Report of Independent Accountants

To the Auditing Committee of the National Academy of Sciences

In our opinion, the accompanying balance sheets (Exhibit A), the related statements of income, expenses and changes in fund balances (Exhibit B), and the investments schedules (Schedules 1, 1-A, 1-B, 2 and 2-A) present fairly the financial position of the National Academy of Sciences (including the National Academy of Engineering, the National Research Council, and the Institute of Medicine) at June 30, 1974 and 1973, the income, expenses and changes in fund balances for the years then ended, and the supplementary information on investments, in conformity with generally accepted accounting principles consistently applied. Our examinations of these statements were made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances, including at June 30, 1974 and 1973, confirmation of investments by direct correspondence with the custodian.

PRICE WATERHOUSE & CO.

Washington, D.C.
October 8, 1974

Balance Sheets

	JUNE 30 1974	JUNE 30 1973
ASSETS		
Current Assets		
Cash	$ 1,393,469	$ 129,847
Certificates of deposit and short-term investments, at cost which approximates market	5,110,000	4,193,766
Accounts receivable–U.S. Government	3,445,578	4,406,722
Employee loans receivable (Note 4)	598,988	524,285
Other current receivables	600,027	618,931
Accrued interest on investments	277,311	169,917
Inventories of publications and supplies, at the lower of cost (average basis) or market	520,856	611,852
Prepaid expenses and other	77,650	127,936
Total Current Assets	12,023,879	10,783,256
Investments in Marketable Securities, at cost (approximate market value $19,900,017 in 1974 and $24,670,208 in 1973–Schedule 1)	18,766,637	18,699,395
Property and Equipment, at cost (Notes 2 and 3)		
Land	266,971	266,971
Buildings and improvements	8,541,838	8,445,827
Leasehold improvements, less accumulated amortization of $301,347 in 1974 and $245,887 in 1973	613,816	617,714
Furniture and equipment, less reserve for replacements of $712,484 in 1974 and $587,465 in 1973	1,859,910	1,774,474
EDP equipment, less accumulated depreciation of $53,478 in 1974 and $12,874 in 1973	364,932	405,536
	11,647,467	11,510,522
Termination Allowance Trust Fund (See Contra-Note 4)		
Cash and investments (Schedule 2)	6,275,933	5,137,028
Receivable from U.S. Government	208,365	729,940
	6,484,298	5,866,968
Total Assets	$48,922,281	$46,860,141

EXHIBIT A

	JUNE 30 1974	JUNE 30 1973
LIABILITIES AND FUND BALANCES		
Current Liabilities		
Accounts payable and accrued expenses	$ 2,602,973	$ 2,631,461
Accrued annual leave and employee benefits (Note 7)	1,233,476	933,720
Advances on U.S. Government contracts (Note 2)	1,563,839	910,516
Deferred income from grants (Note 2)	1,674,943	1,947,711
Total Current Liabilities	7,075,231	6,423,408
Note Payable (Note 3)	364,932	405,536
Termination Allowance Liability (Note 4)	6,484,298	5,866,968
Commitments (Note 6)	–	–
Fund Balances (Exhibit B)		
General funds	2,245,906	2,428,199
Restricted funds–		
Government	–	–
Private	3,007,447	2,362,005
Trust and endowment funds	18,687,640	18,591,816
Plant funds	11,056,827	10,782,209
	34,997,820	34,164,229
Total Liabilities and Fund Balances	$48,922,281	$46,860,141

Statements of Income, Expenses, and Changes in Fund Balances

FOR THE YEARS ENDED JUNE 30, 1974 AND 1973

	CURRENT FUNDS	RESTRICTED FUNDS
	GENERAL FUNDS	GOVERNMENT
INCOME		
Grants, contracts, and contributions (Notes 2 and 5)	$ 583,002	$40,552,120
Publication sales	1,177,207	–
Investment interest and dividends	491,764	153,706
Interest on certificates of deposit and short-term investments	234,048	–
Dues	31,938	–
Rental income	205,815	–
Other	15,278	–
	2,739,052	40,705,826
EXPENSES		
Personal services–		
Salaries, wages, and related benefits	5,778,465	15,003,562
Fees and other	251,415	945,774
Travel	343,444	3,088,993
Expenses allocated to rental areas	278,810	–
Other operating expenses	3,337,680	2,536,300
General expenses allocated as indirect costs to grants and contracts (1973–$6,516,608) (Note 5)	(7,535,857)	6,609,051
Subcontracts	–	3,854,451
Grants and fellowships	19,337	8,667,104
Government equipment and other property	–	591
	2,473,294	40,705,826
EXCESS OF INCOME	265,758	–
OTHER		
Net (loss) gain on sale of securities	–	–
Interfund transfers	(178,110)	–
Equipment acquired from current funds	(269,941)	–
FUND BALANCES, BEGINNING OF YEAR	2,428,199	–
FUND BALANCES, END OF YEAR	$2,245,906	$ –

EXHIBIT B

PRIVATE	TRUST AND ENDOWMENT FUNDS	PLANT FUNDS	TOTAL	YEAR ENDED JUNE 30, 1973 TOTAL
$3,895,547	$ 76,947	$	$45,107,616	$41,288,266
306,525	–		1,483,732	1,460,226
137,293	–	–	782,763	741,522
221,188	–	–	455,236	239,562
253,920	–	–	285,858	273,478
–	–	–	205,815	353,862
180,104	–	6,515	201,897	214,406
4,994,577	76,947	6,515	48,522,917	44,571,322
1,302,324	–	–	22,084,351	19,613,099
220,037	–	–	1,417,226	1,209,292
409,473	–	–	3,841,910	3,801,151
–	–	–	278,810	372,833
697,958	–	5,025	6,576,963	5,730,589
926,806	–	–	–	–
96,363	–	–	3,950,814	4,136,298
817,398	–	–	9,503,839	9,084,366
–	–	–	591	7,835
4,470,359	–	5,025	47,654,504	43,955,463
524,218	76,947	1,490	868,413	615,859
(538)	(34,284)	–	(34,822)	1,185,325
124,949	53,161	–	–	–
(3,187)	–	273,128	–	–
2,362,005	18,591,816	10,782,209	34,164,229	32,363,045
$3,007,447	$18,687,640	$11,056,827	$34,997,820	$34,164,229

NOTES TO FINANCIAL STATEMENTS
June 30, 1974 and 1973

NOTE 1 ORGANIZATION

The National Academy of Sciences was formed under a charter that was passed as an Act of Incorporation by the United States Congress and signed into law on March 3, 1863. The Academy operates as a private, co-optative society of distinguished scholars in scientific or engineering research, dedicated to the furtherance of science and its use for the general welfare. The Academy is exempt from federal income taxes under Section 501(c)(3) of the Internal Revenue Code.

NOTE 2 SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of Accounting

The accounts of the Academy include the National Academy of Engineering, the Institute of Medicine, and the National Research Council, all of which are related organizations of the Academy. The financial statements of the Academy have been prepared on the accrual basis of accounting, except that depreciation on the building is not recorded.

In order to ensure observance of limitations and restrictions placed on the use of the resources available to the Academy, the accounts of the Academy are maintained in accordance with the principles of "fund accounting." Under this procedure resources designated or available for various purposes are classified for accounting purposes into separate funds. Separate accounts are maintained for each fund; however, in the accompanying financial statements, funds that have similar characteristics have been combined.

The unrestricted income of the Academy is accounted for in the General Fund. The income and expenses relating to activities performed under contracts with governments are accounted for in the Government Restricted Fund. Grants, contributions and other restricted resources received from private individuals or organizations are accounted for in the Private Restricted Fund. The Trust and Endowment Fund includes gifts and bequests accepted by the Academy with the understanding that the principal and income be utilized in accordance with the terms of the gifts or bequests. Gains or losses arising from the disposition of investments are considered part of the principal of the investments and are accounted for in the Trust and Endowment Fund. The Plant Fund includes the Academy's property and equipment and the unexpended resources which have been specified for the acquisition of property and equipment.

Contracts and Grants

A significant portion of the Academy's activities is performed under cost-reimbursable contracts with the U.S. Government. It is the policy of the Academy to record income on these contracts as costs are incurred. Accordingly, funds received in advance of contract performance are recorded as advances on U.S. Government contracts in the Academy's balance sheets.

Activities supported by individuals or private organizations are generally financed by grants which frequently require the refund of any unexpended funds upon completion of the project. The policy of the Academy is to record grant income as costs are incurred if such refunds are required. Accordingly, funds received in advance of grant performance are recorded as deferred income in the Academy's balance sheets. Income from private grants that do not require such refunds and other private restricted fund income is recorded in the year of receipt.

Translation of Currencies

The assets and liabilities of the Atomic Bomb Casualty Commission (ABCC) included in the Government Restricted Fund in the accompanying financial statements have been translated into U.S. dollars at approximate market rates of exchange prevailing at the dates of the balance sheets. Income and expenses of the ABCC have been translated generally at the free rates of exchange prevailing at each month end. It is the policy of the Academy to record exchange gains or losses when incurred. The revaluation in February, 1973, of the Japanese yen in relation to the United States dollar resulted in an increase of the termination compensation liability and an exchange loss of approximately $691,000. During fiscal year 1974 there were no significant exchange gains or losses. (See Note 4 to the financial statements.)

Property, Equipment, and Depreciation

Property and equipment are stated at cost. Major improvements are capitalized while routine replacements, maintenance, and repairs are charged to expense. A reserve for replacement of furniture and equipment is provided over a ten-year life and leasehold improvements in the Joseph Henry Building are amortized over the remaining life of the lease.

The Academy does not provide for depreciation of its buildings since it intends to obtain funds for their replacement, when required, from contributions. The major building owned by the Academy (cost of $8,300,000) is located at 2101 Constitution Avenue, Washington, D.C., and has been officially declared as a national landmark of the United States.

NOTE 3 PROPERTY, EQUIPMENT, AND DEPRECIATION

The additions to the reserve for replacement of equipment during fiscal years 1974 and 1973 were $163,167 and $154,300, respectively. Amortization of leasehold improvements for fiscal years 1974 and 1973 amounted to $55,460 and $48,393, respectively.

During fiscal year 1973 the Academy acquired an IBM 370/135 computer at a cost of $418,410. The Academy executed a 7½ percent 8 year loan from a bank to finance the purchase. The loan is secured by the computer. Depreciation of the equipment is being computed over a period of 8 years and amounted to $40,604 and $12, 874 in fiscal years 1974 and 1973, respectively.

The Academy is the custodian of certain property and equipment that is owned by the U.S. Government and is furnished to the Academy for work under government contracts. The cost of these assets which is not reflected in the accompanying balance sheets approximated $3,343,000 and $3,322,000 at June 30, 1974 and 1973, respectively.

NOTE 4 ATOMIC BOMB CASUALTY COMMISSION

The Atomic Bomb Casualty Commission (ABCC) is an activity of the Academy located in Japan and is operated under cost reimbursement contracts with the United States Atomic Energy Commission and the Department of Health, Education and Welfare. For the fiscal years ended June 30, 1974 and 1973, the costs associated with operating the ABCC amounted to approximately $7,030,000 and $6,170,000 respectively. The Academy is presently involved in negotiations with the Atomic Energy Commission and the Japanese Government for the establishment of a successor organization to operate the ABCC. Management of the Academy expects that such an organization will be established in 1975 and will be organized under the laws of Japan.

In accordance with a labor agreement, the Academy is liable for termination compensation to Japanese nationals who are employed by the ABCC. In June 1972, the Atomic Energy Commission began funding the amount of the liability for the termination compensation and formally agreed to fund annually any increase in the liability. The amounts funded by the Atomic Energy Commission have been recorded in the Termination Allowance Trust Fund which is shown in the accompanying balance sheets.

In accordance with the same labor agreement the Academy has established an Employee Loan Fund which is available to employees of the ABCC. Loans from this fund are limited to and secured by the employee's vested interest in the termination compensation reserve.

The ultimate disposition of the assets and settlement of the liabilities of the ABCC activity cannot be specifically determined at the present time and will be decided in connection with the negotiations referred to above.

NOTE 5 GOVERNMENT CONTRACTS

The costs associated with U.S. Government contracts are subject to audit by the Defense Contract Audit Agency (DCAA), which has completed its examinations through June 30, 1972. Costs incurred during fiscal years 1973 and 1974 are currently being examined by the DCAA and in the opinion of management of the Academy, no significant adjustments are expected.

NOTE 6 COMMITMENTS

The Academy leases an office building from the George Washington University under an agreement that expires in 1987. Under the terms of this agreement the Academy is committed to pay annual rentals of $710,000 and all of the taxes, insurance and maintenance on the building. Portions of the building not immediately required for Academy usage are sublet to commercial and other tenants.

NOTE 7 PENSION PLAN

The Academy has a contributory pension plan covering substantially all of its employees. Effective July 1, 1973, the Academy amended the plan, and, as a result, certain employees who retire with more than 20 years service are entitled to a minimum annuity benefit as defined by the amended plan. The amendment to the plan created an unfunded past service liability of approximately $1,745,000 as determined by an actuarial valuation. The Academy's policy is to fund accrued pension expense. Total pension expense for the years ended June 30, 1974 and 1973, approximated $1,684,000 and $1,229,000 respectively, including in 1974 the amortization of $125,000 of past service cost over 25 years.

Consolidated Fund

	BALANCE JUNE 30, 1973 (AT COST)	ADDITIONS (AT COST)
FIXED INCOME SECURITIES (Schedule 1-A)		
Cash Equivalents	$ 4,014,000	$23,571,000
Convertible Bonds and Notes	100,000	–
Other Bonds and Notes	2,222,136	–
Total Fixed Income Securities	6,336,136	23,571,000
COMMON STOCK (Schedule 1-B)	12,363,259	6,321,249
Total Investments	18,699,395	$29,892,249
Uninvested Cash	996	
Net Payable for Securities Transactions	--	
TOTAL CONSOLIDATED INVESTMENT FUND	$18,700,391	
Less: Investment Advisory Fees		

SCHEDULE 1

SALES AND REDEMPTIONS		BALANCE JUNE 30, 1974 (AT COST)	QUOTED MARKET JUNE 30, 1974	INVESTMENT INCOME YEAR ENDED JUNE 30, 1974
PROCEEDS	NET GAIN OR (LOSS)			
$25,310,000	$ –	$ 2,275,000	$ 2,275,000	$312,417
–	–	100,000	90,000	4,902
142,750	(8,625)	2,070,761	1,875,782	167,062
25,452,750	(8,625)	4,445,761	4,240,782	484,381
4,337,435	(26,197)	14,320,876	15,659,235	184,117
$29,790,185	$(34,822)	18,766,637	19,900,017	668,498
		92,413	92,413	
		(29,867)	(29,867)	
		$18,829,183	$19,962,563	
				(39,442)
				$629,056

Fixed Income Securities—Consolidated Fund

JUNE 30, 1974

	INTEREST RATE	MATURITY	PRINCIPAL AMOUNT	COST	QUOTED MARKET
CASH EQUIVALENTS (Commercial Paper and Certificates of Deposit)					
Atlantic Richfield Company	9.466%	Demand	$ 150,000	$ 150,000	$ 150,000
Chase Manhattan Bank	11.15%	7/12/74	680,000	680,000	680,000
Continental Illinois National Bank & Trust Co. of Chicago	11.40%	8/19/74	1,000,000	1,000,000	1,000,000
General Electric Company	9.424%	Demand	217,000	217,000	217,000
International Harvester Credit Corporation	9.424%	Demand	163,000	163,000	163,000
Westinghouse Electric Corp.	9.561%	Demand	65,000	65,000	65,000
TOTAL CASH EQUIVALENTS			$2,275,000	$2,275,000	$2,275,000

SCHEDULE 1-A

	INTEREST RATE	MATURITY	PRINCIPAL AMOUNT	COST	QUOTED MARKET
CONVERTIBLE BOND					
Consolidated Freightways, Inc.	4.875%	1992	$ 100,000	$ 100,000	$ 90,000
TOTAL			$ 100,000	$ 100,000	$ 90,000
OTHER BONDS AND NOTES					
Adcor Realty Corporation	4.75%	1987	$ 69,000	$ 69,000	$ 48,128
Adcor Realty Corporation	5.25%	1987	52,000	52,000	40,950
Alcan Aluminum Corp.	4.75%	1984	173,000	173,000	133,643
American Telephone & Telegraph Company	8.75%	2000	200,000	195,250	195,750
Chesebrough-Ponds, Inc.	5.00%	1976	30,000	30,000	28,500
Columbia Broadcasting System	5.50%	1991	152,000	152,000	114,760
General Telephone Co.	9.25%	1999	100,000	101,000	95,750
Halliburton Company	7.95%	1995	250,000	250,656	225,000
Houston Natural Gas Corp.	9.375%	1990	210,000	210,105	199,763
Natural Gas Pipeline Co. of America	9.50%	1990	200,000	197,750	192,250
NCNB Corporation	8.40%	1995	250,000	250,000	235,000
Norfolk and Western Railway	5.50%	1981	140,000	140,000	122,850
Weyerhauser Company	8.625%	2000	250,000	250,000	243,438
TOTAL OTHER BONDS AND NOTES			$2,076,000	$2,070,761	$1,875,782

Common Stocks—Consolidated Fund

JUNE 30, 1974

	NUMBER OF SHARES	COST	QUOTED MARKET
Air Products & Chemicals, Inc.	10,030	$ 525,552	$ 525,321
Alcon Laboratories, Inc.	1,600	41,138	35,800
American Home Products Corp.	17,100	674,658	688,275
Arizona Bank Phoenix	5,750	199,888	119,313
Baker Oil Tools, Inc.	7,800	215,257	198,900
Betz Laboratories, Inc.	1,000	20,069	33,750
Black & Decker Mfg. Co.	10,000	353,723	345,000
Charles River Breeding Labs, Inc.	1,500	46,365	35,250
Chemed Corporation	2,000	40,000	37,000
Citicorp	12,000	445,558	372,000
Coca-Cola Company	5,000	496,808	540,000
DeKalb AG Research	600	26,350	20,100
Deluxe Check Printers, Inc.	1,000	35,750	26,500
Dow Chemical Company	10,000	576,449	653,750
Eastman Kodak Company	5,000	190,408	519,375
Economics Lab, Inc.	10,000	469,287	328,750
Emery Air Freight Corp.	4,000	198,174	215,500
Eli Lilly and Company	9,500	251,695	742,188
First Alabama Bancshares, Inc.	7,800	238,538	187,200
First International Bancshares, Inc.	10,000	542,282	386,250
General Binding Corp.	1,000	33,950	25,000
General Electric Company	10,000	552,204	492,500
Government Employees Life Insurance Co.	1,050	43,675	27,825
Halliburton Company	3,000	229,258	425,625
International Business Machines Corp.	4,750	471,369	1,010,563
International Flavors & Fragrances, Inc.	20,000	529,218	697,500
Johnson & Johnson	5,000	613,116	566,250
Lawson Products, Inc.	1,000	19,000	23,000
Loctite Corporation	1,500	44,813	40,875
Mary Kay Cosmetics, Inc.	1,600	45,800	38,400
McDonald's Corporation	9,500	538,268	454,813
Millipore Corporation	750	41,725	29,625
Minnesota Mining & Mfg. Co.	5,000	353,411	367,500
National Chemsearch Corp.	11,400	370,331	495,900
New England Nuclear Corp.	500	29,574	14,688
Polaroid Corporation	7,000	618,553	240,625
Procter & Gamble Company	6,700	364,965	668,325
Puritan Bennett Corp.	1,000	49,650	29,500
Research Cottrell, Inc.	1,600	109,169	14,200
Sears Roebuck & Company	6,000	402,298	497,250
Schering-Plough Corp.	9,200	601,334	602,600

SCHEDULE 1-B

	NUMBER OF SHARES	COST	QUOTED MARKET
Joseph Schlitz Brewing Company	10,000	$ 511,911	$ 452,500
Schlumberger, Ltd.	4,000	150,580	393,500
Simplicity Pattern Co., Inc.	5,000	149,402	66,875
Snap-On-Tools Corp.	1,000	56,750	35,000
S. S. Kresge Company	15,000	540,607	510,000
Sybron Corporation	20,000	608,376	362,500
Wal Mart Stores, Inc.	1,500	27,869	29,250
Wallace Business Forms, Inc.	2,000	40,091	42,500
Walt Disney Productions	7,752	270,345	335,274
Waste Management, Inc.	9,400	251,183	83,425
Xerox Corporation	5,000	64,132	575,625
TOTAL COMMON STOCKS		$14,320,876	$15,659,235

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Termination Allowance Trust Fund

	BALANCE JUNE 30, 1973 (AT COST)	ADDITIONS (AT COST)
Cash–Savings	$ 167,591	$ 184,400
Cash Equivalents (Schedule 2-A)	1,600,000	9,756,000
Common Stocks (Schedule 2-A)	3,310,689	1,099,058
Total Investments	5,078,280	$11,039,458
Uninvested Cash	280,762	
Net (Payable) Receivable from Securities Transactions	(238,379)	
Accrued Interest Receivable	16,365	
Total Investment Fund	$5,137,028	
Less: Investment Advisory Fees		

SCHEDULE 2

SALES AND REDEMPTIONS		BALANCE JUNE 30, 1974 (AT COST)	QUOTED MARKET JUNE 30, 1974	INVESTMENT INCOME YEAR ENDED JUNE 30, 1974
PROCEEDS	NET GAIN OR (LOSS)			
$ 247,602	$ –	$ 104,389	$ 104,389	$ 10,399
8,515,000	–	2,841,000	2,841,000	121,276
918,046	(321,395)	3,170,306	2,318,110	32,911
$9,680,648	$(321,395)	6,115,695	5,263,499	164,586
		141,891	141,891	
		2,661	2,661	
		15,686	15,686	
		$6,275,933	$5,423,737	
				(10,880)
				$153,706

Investments—Termination Allowance Trust Fund

JUNE 30, 1974

	INTEREST RATE	MATURITY	PRINCIPAL AMOUNT	COST	QUOTED MARKET
CASH EQUIVALENTS (Commercial Paper and Certificates of Deposit)					
Atlantic Richfield Co.	9.466%	Demand	$ 87,000	$ 87,000	$ 87,000
Chase Manhattan Bank	12.15%	8/27/74	500,000	500,000	500,000
Chemical Bank of New New York	10.75%	11/25/74	700,000	700,000	700,000
Chemical Bank of New York	11.00%	8/15/74	200,000	200,000	200,000
GTE Sylvania, Inc.	9.591%	Demand	26,000	26,000	26,000
Hamilton Federal Savings & Loan	8.75%	7/15/74	200,000	200,000	200,000
Hamilton Federal Savings & Loan	8.25%	10/8/74	319,000	319,000	319,000
Manufacturers Hanover Trust Co. of N.Y.	11.75%	8/23/74	500,000	500,000	500,000
Union Trust Company	10.63%	9/25/74	250,000	250,000	250,000
Westinghouse Electric Corp.	9.563%	Demand	59,000	59,000	59,000
Total Cash Equivalents			$2,841,000	$2,841,000	$2,841,000

SCHEDULE 2-A

COMMON STOCKS	NUMBER OF SHARES	COST	QUOTED MARKET
American Home Products Corp.	3,000	$ 115,875	$ 120,750
Baker Oil Tools, Inc.	2,500	84,882	63,639
Dow Chemical Company	2,000	116,341	130,750
Dun & Bradstreet Companies, Inc.	3,000	115,626	79,500
Eastman Kodak Company	1,000	136,150	103,875
Eli Lilly and Company	1,200	89,001	93,750
General Electric Company	1,500	82,303	73,875
Genuine Parts Company	4,000	133,414	120,500
Halliburton Company	500	86,658	70,938
International Business Machines Corp.	625	201,600	132,969
International Flavors & Fragrances, Inc.	3,000	136,667	104,625
McDonald's Corporation	2,000	127,162	95,750
Mercantile Stores Co., Inc.	1,600	125,088	69,600
Minnesota Mining & Mfg. Co.	1,000	70,987	73,500
National Chemsearch Corp.	2,400	108,418	104,400
Pickwick International, Inc.	3,120	135,017	37,440
Polaroid Corporation	1,500	183,528	51,563
Procter and Gamble Co.	1,000	101,586	99,750
Puritan Bennett Corp.	2,000	125,813	59,000
Ralston Purina Company	2,000	88,230	87,500
Sears Roebuck & Company	1,000	115,150	82,875
Schering-Plough Corp.	2,000	130,400	131,000
Joseph Schlitz Brewing Company	2,000	102,195	90,500
Snap-On-Tools Corp.	1,500	88,950	52,500
Walt Disney Productions	1,530	149,337	66,173
Waste Management, Inc.	3,300	100,155	29,288
Xerox Corporation	800	119,773	92,100
Total Common Stocks		$3,170,306	$2,318,110

Equity in Endowment, Trust and Restricted Funds

JUNE 30, 1974

	NUMBER OF PARTICIPATING CAPITAL UNITS (PCU)	CAPITAL CONTRIBUTION	ADDITION FROM EARNED INCOME
ENDOWMENT FUNDS (Income from which is for general purposes)			
Agassiz Fund	521.24	$ 50,000	$ –
Carnegie Endowment Fund	35,020.47	3,275,000	–
Commonwealth Fund	2,061.09	500,000	–
Ford Foundation Fund	20,706.79	5,000,000	–
Nealley Fund	204.49	19,556	–
Rockefeller Foundation Fund	4,252.60	1,000,000	–
Sloan Foundation Endowment Fund	4,254.14	1,000,000	–
General Endowment Fund	88.39	21,160	–
	67,109.21	10,865,716	–
TRUST FUNDS (Income from which is for specific purposes)			
Henryk Arctowski Fund	905.28	95,736	52,403
Bache Fund	640.55	60,000	41,500
Billings Fund	245.46	26,067	4,000
Blaauw Fund	536.45	71,299	33,201
John J. Carty Fund	298.58	25,000	10,000
Thomas L. Casey Endowment Fund	3,557.98	258,081	214,300
Comstock Fund	229.94	10,400	29,747
Arthur L. Day Fund	6,917.78	1,398,474	108,000
Draper Fund	141.53	6,000	11,000
Eddy Fund	85.27	20,000	–
Elliot Fund	84.20	8,000	–
Gibbs Fund	120.30	5,173	8,453
Gibbs Brothers Fund	126.21	24,000	2,600
Gould Fund	441.92	40,000	28,578
Hartley Fund	7.17	1,168	(1,107)
Joseph Henry Fund	591.95	39,740	33,024
Hunsaker Fund	150.25	24,750	7,700
Hunt Fund	39.20	10,465	–
Kovalenko Fund	387.89	43,741	7,000
Marsh Fund	201.97	10,000	8,700
George P. Merrill Fund	45.77	10,000	–
Murray Fund	112.77	6,000	5,500
Pradel Fund	164.40	16,392	14,908
H. P. Robertson Lectureship Fund	109.00	20,325	3,000
Slipher Fund	31.81	9,411	–
Smith Fund	252.29	8,000	41,000

SCHEDULE 3

REALIZED CAPITAL GAIN (LOSS)	TOTAL EQUITY IN CONSOLI-DATED FUND	SHORT-TERM INVEST-MENTS	CASH	TOTAL FUND EQUITY
$ 46,554	$ 96,554	$ –	$ –	$ 96,554
3,237,156	6,512,156	–	–	6,512,156
26,205	526,205	–	–	526,205
274,878	5,274,878	–	–	5,274,878
18,263	37,819	–	–	37,819
64,582	1,064,582	–	–	1,064,582
63,556	1,063,556	–	–	1,063,556
1,089	22,249	–	–	22,249
3,732,283	14,597,999	–	–	14,597,999
46,595	194,734	17,500	1,942	214,176
38,465	139,965	14,700	4,374	159,039
13,601	43,668	–	4,376	48,044
9,757	114,257	–	932	115,189
24,129	59,129	5,000	7,451	71,580
243,643	716,024	–	7,461	723,485
10,324	50,471	–	332	50,803
122,989	1,629,463	–	38,890	1,668,353
10,060	27,060	2,300	1,201	30,561
(234)	19,766	–	10,996	30,762
7,520	15,520	1,900	2,112	19,532
9,951	23,577	1,000	920	25,497
4,791	31,391	–	256	31,647
26,049	94,627	3,690	6,710	105,027
1,107	1,168	–	(2,323)	(1,155)
46,318	119,082	–	9,422	128,504
6,349	38,799	–	289	39,088
(296)	10,169	–	160	10,329
28,774	79,515	–	3,363	82,878
18,841	37,541	–	2,327	39,868
1,611	11,611	500	720	12,831
9,531	21,031	–	225	21,256
3,316	34,616	–	3,085	37,701
3,593	26,918	1,600	2,690	31,208
82	9,493	–	271	9,764
12,632	61,632	–	1,539	63,171

	NUMBER OF PARTICI-PATING CAPITAL UNITS (PCU)	CAPITAL CONTRI-BUTION	ADDITION FROM EARNED INCOME
TRUST FUNDS—continued (Income from which is for specific purposes)			
Thompson Fund	107.98	$ 10,000	$ 700
Troland Fund	748.45	212,000	–
U.S. Steel Award in Molecular Biology	287.72	80,900	–
Walcott Fund	52.12	5,000	–
G. K. Warren Fund	74.34	15,000	1,500
Watson Fund	361.02	25,000	19,400
Foundation for Microbiology Award	–	–	–
Applied Mathematics and Numerical Analysis Fund	–	–	–
Zworykin Fund	–	–	–
	18,057.55	2,596,122	685,107
RESTRICTED FUNDS			
Copernicus Fund	–	–	–
John A. Hutcheson Gift Fund	27.68	6,425	–
International Critical Tables	926.98	200,000	–
International Union of Physiological Sciences Congress	17.30	4,900	–
President's Deferred Compensation	157.33	41,250	–
International Union of Radio Science	42.43	10,000	–
Staff Retirement Fund	427.48	80,264	–
	1,599.20	342,839	–
Total Equity	86,765.96	$13,804,677	$685,107

Borrowed from the Carnegie Endowment Fund for leasehold improvements to Joseph Henry Building

Investments and Cash

Value of Participating Capital Unit:

June 30, 1973	$286.56
September 30, 1973	292.36
December 31, 1973	265.95
March 31, 1974	245.62
June 30, 1974	230.07

SCHEDULE 3
continued

REALIZED CAPITAL GAIN (LOSS)	TOTAL EQUITY IN CONSOLI-DATED FUND	SHORT-TERM INVEST-MENTS	CASH	TOTAL FUND EQUITY
$ 9,386	$ 20,086	$ –	$ 187	$ 20,273
17,706	229,706	–	11,080	240,786
805	81,705	–	8,580	90,285
4,655	9,655	1,800	903	12,358
2,543	19,043	–	623	19,666
25,345	69,745	4,600	5,565	79,910
–	–	5,500	460	5,960
–	–	22,800	2,266	25,066
–	–	4,500	525	5,025
759,938	4,041,167	87,390	139,910	4,268,467
–	–	125,000	11,483	136,483
351	6,776	–	76	6,852
16,060	216,060	140,000	11,823	367,883
333	5,233	–	280	5,513
812	42,062	–	1,296	43,358
1,032	11,032	5,000	9,619	25,651
8,590	88,854	120,200	1,358	210,412
27,178	370,017	390,200	35,935	796,152
$4,519,399	$19,009,183	$477,590	$175,845	$19,662,618
	(180,000)			
	$18,829,183			

Sources and Purposes of Trust and Endowment Funds

JUNE 30, 1974

A. Funds whose income may be used for general purposes:

AGASSIZ FUND: Bequest of Alexander Agassiz, a member of the Academy.	$ 50,000
CARNEGIE ENDOWMENT FUND: Balance of gift of $5,000,000 of the Carnegie Corporation of New York in 1919, for the purposes of the National Academy of Sciences-National Research Council, $1,725,000 of which has been used to cover the cost of the Academy building and the acquisition of other property.	3,275,000
COMMONWEALTH ENDOWMENT FUND: A grant of the Commonwealth Fund in 1968 for capital endowment of the Academy.	500,000
FORD FOUNDATION FUND: A grant of The Ford Foundation in 1967 to the National Academy of Sciences for capital endowment.	5,000,000
NEALLEY FUND: Bequest of George True Nealley in 1925 for the general purposes of the Academy.	19,556
ROCKEFELLER FOUNDATION FUND: A grant of The Rockefeller Foundation in 1967 to the National Academy of Sciences for general purposes.	1,000,000
SLOAN FOUNDATION ENDOWMENT FUND: A grant of $1,000,000 of the Alfred P. Sloan Foundation in 1968 for the general purposes of the Academy.	1,000,000
GENERAL ENDOWMENT FUND: Bequest of David Lloyd Fillman in 1970 for general purposes of the Academy.	21,160
RETIREMENT FUND: A fund established by the Academy prior to 1944 to provide for payment of annuities to staff members, upon retirement.	80,264

B. Funds whose income may be used for specifically designated purposes:

APPLIED MATHEMATICS AND NUMERICAL ANALYSIS FUND: Gift of the International Business Machines Corporation to support the NAS Award in Applied Mathematics and Numerical Analysis by an award of $5,000 approximately every three years.	22,800

SCHEDULE 3-A

HENRYK ARCTOWSKI FUND: Bequest of Jane Arctowska in 1958, in memory of her husband Henryk Arctowski, for the promotion and study of solar activity changes of short or long duration and their effects upon the ionosphere and terrestrial atmosphere.	$ 95,736
BACHE FUND: Bequest of Alexander Dallas Bache, a member of the Academy (1870), to aid researches in physical and natural sciences.	60,000
BILLINGS FUND: Bequest of Mrs. Mary Ann Palmer Draper (Mrs. Henry Draper) in 1915, to support the publication of the Proceedings of the Academy or for other purposes to be determined by the Academy.	26,067
BLAAUW FUND: Bequest of Marianne Blaauw in 1951 to establish the Edmond and Marianne Blaauw Fund to support research in the field of ophthalmology.	71,299
JOHN J. CARTY FUND: Gift of the American Telephone & Telegraph Company on November 13, 1930, in recognition of the distinguished achievements of John J. Carty, and as a lasting testimonial of the love and esteem in which he was held by his many thousands of associates in the Bell System; for a gold medal and award for noteworthy and distinguished accomplishments in any field of science.	25,000
THOMAS LINCOLN CASEY ENDOWMENT FUND: Bequest of Thomas L. Casey in 1954, as a memorial to his father, Thomas Lincoln Casey, to be used in the advancement of engineering in all its applications.	258,081
COMSTOCK FUND: Gift of General Cyrus B. Comstock, a member of the Academy (1907), to promote researches in electricity, magnetism, or radiant energy through the Comstock Prize to be awarded for notable investigations.	10,400
ARTHUR L. DAY FUND: A bequest of Arthur L. Day, a member of the National Academy of Sciences, for the purpose of advancing studies of the physics of the earth.	1,398,474
DRAPER FUND: Gift of Mrs. Henry Draper in 1883, in memory of her husband, a former member of the Academy, to found the Henry Draper Medal to be awarded for notable investigations in astronomical physics; the balance of income is applied to aid research in this science.	6,000

NATHAN B. EDDY MEMORIAL AWARD FUND: Contributions made in memory of Nathan B. Eddy for his work with the Committee on Problems of Drug Dependence. The funds are used for an award and medal for work in the field by an individual selected by the Committee.	$ 20,000
ELLIOT FUND: Gift of Margaret Henderson Elliot to found the Daniel Giraud Elliot Gold Medal and Honorarium for the most meritorious work on zoology or paleontology published in each year.	8,000
GIBBS FUND: Established by gift of Wolcott Gibbs, a member of the Academy (1892), and increased by a bequest of the late Morris Loeb in 1914 for the promotion of research in chemistry.	5,173
GIBBS BROTHERS FUND: Gift of William Francis Gibbs and Frederic H. Gibbs in 1963 to found The Gibbs Brothers Medal for outstanding contribution in the field of naval architecture and marine engineering.	24,000
GOULD FUND: Gift of Mrs. Alice Bache Gould in 1897 in memory of her father, a former member of the Academy, for the promotion of research in astronomy, and supplemented by a bequest of $20,000 from the estate of Alice Bache Gould received in 1954.	40,000
HARTLEY FUND: Gift from Mrs. Helen Hartley Jenkins, 1913–1914, in memory of her father, Marcellus Hartley, to found the Public Welfare Medal awarded for eminence in the application of science to the public welfare.	1,168
JOSEPH HENRY FUND: Contributions by Fairman Rogers, Joseph Patterson, George W. Childs, and others as an expression of their respect and esteem for Joseph Henry, for the establishment of a fund to assist meritorious investigators, especially in the direction of original research.	39,740
HUNSAKER FUND: Gift of Mr. and Mrs. J. C. Hunsaker in 1964 to found an Academy award in the field of aeronautical engineering.	24,750
FRANKLIN LIVINGSTON HUNT FUND: Bequest of Franklin Livingston Hunt for aid to research in physics, chemistry, and preventive medicine. A portion of the income may also be used from time to time to provide a medal to be known as the Franklin Livingston Hunt Medal for distinguished accomplishment in scientific research.	10,465

SCHEDULE 3-A
continued

KOVALENKO FUND: Gift of Michael S. Kovalenko, 1948–1949, in memory of his wife, to found the Jessie Stevenson Kovalenko Gold Medal for meritorious research in medical sciences.	$ 43,741
MARSH FUND: Bequest of Othniel Charles Marsh, a member of the Academy (1909), to promote original research in the natural sciences.	10,000
GEORGE P. MERRILL FUND: Gift of Mrs. George P. Merrill in 1956, the income from which is to be used for studies of meteors, meteorites, and space.	10,000
MICROBIOLOGY AWARD: Gift of the Foundation for Microbiology for an award of $5,000 every two years to be known as the Foundation for Microbiology Award in Microbiology.	10,000
MOLECULAR BIOLOGY AWARD: Funds contributed by the U.S. Steel Foundation for an annual award of $5,000 for scientific research by a relatively young investigator in the field of molecular biology or other scientific field selected by the Academy.	60,900
MURRAY FUND: Gift of the late Sir John Murray in 1911 to found the Alexander Agassiz Gold Medal in honor of a former member and president of the Academy, to be awarded for original contributions to the science of oceanography.	6,000
PRADEL FUND: A bequest of Jules Pradel in 1947 to be applied to work on the human central nervous system and allied subjects.	16,392
H. P. ROBERTSON LECTURESHIP FUND: Contributions by friends of H. P. Robertson, Foreign Secretary of the Academy at the time of his death (1962), to establish a lectureship under which distinguished scientists would be invited from anywhere in the world to present lectures to be known as the Robertson Memorial Lecture of the National Academy of Sciences.	20,325
SLIPHER TRUST FUND: Bequest of V. M. Slipher, a member of the Academy, to be used for research in astronomy or for any other purpose as directed by the officers of the Academy.	6,923
SMITH FUND: Gift of Mrs. J. Lawrence Smith in 1884, in memory of her husband, a former member of the Academy, to found the J. Lawrence Smith Gold Medal to be awarded for important investigations of meteoric bodies and to assist, by grants of money, research concerning such objects.	8,000

SCHEDULE 3-A
continued

THOMPSON FUND: Gift of Mrs. Mary Clark Thompson, in 1919, for a gold medal of appropriate design, to be known as the Mary Clark Thompson Gold Medal, to be awarded for important services to geology and paleontology.	10,000
TROLAND FUND: Bequest of Leonard T. Troland to be known as the Troland Foundation for Research in Psychophysics. The income to be expended with a view to the actual advancement of scientific knowledge within the field of psychophysics.	$ 212,000
WALCOTT FUND: Gift of Mrs. Mary Vaux Walcott in 1928, in honor of her husband, a former member and president of the Academy, for the award of medals and honoraria to persons, the results of whose published researches, explorations, and discoveries in pre-Cambrian or Cambrian life and history shall be judged most meritorious; the award to be known as the Charles Doolittle Walcott Medal.	5,000
G. K. WARREN FUND: Gift of Miss Emily B. Warren, 1966, in memory of her father, a member of the Academy, the income to be used for an award to be known as the G. K. Warren Prize in any field of science.	15,000
WATSON FUND: Bequest of James Craig Watson, a member of the Academy (1874), for the promotion of astronomical sciences through the award of the Watson Gold Medal and grants of money in aid of research.	25,000
ZWORYKIN FUND: Gift of the RCA Corporation to support the V. K. Zworykin award of the National Academy of Engineering for outstanding achievements in the field of electronic engineering in the service of mankind.	5,000

SCHEDULE 4

Expenditures from Current Funds

FOR THE YEAR ENDED JUNE 30, 1974

CURRENT GENERAL FUNDS

NATIONAL ACADEMY OF SCIENCES

Program Administration		
Executive Office	$ 952,432	
Office of the Foreign Secretary	138,585	
Membership Activities	82,173	
	$1,173,190	
General Administration		
Archives and Record Management	$ 96,217	
Office of the Business Manager	231,567	
Operations and Maintenance of Buildings and Grounds	588,749	
Rental and Operation of Joseph Henry Building—NAS	1,209,199	
Rental and Operation of Joseph Henry Building—OTHER	278,810	
Rental and Operation of Other Outside Space	132,392	
Depreciation of Equipment	163,167	
Building Use Charge	149,629	
Office of General Services	105,775	
Receiving, Stockroom, and Mail Service	171,279	
Security Office	44,693	
Telephone Service	200,318	
Office of Comptroller	118,368	
Accounting Office	522,053	
Personnel Office	229,868	
Health Services	31,910	
Office of Information	272,911	
President's Allowance	37,477	
Reference Library	121,471	
Staff Benefits	189,550	
Forum Planning Office	61,576	
Food Service	74,162	
	$5,031,141	
Dissemination of Information and Publication Activities		
Printing and Duplicating Service	$ 71,302	
Publications	1,201,773	
	$1,273,075	
TOTAL NATIONAL ACADEMY OF SCIENCES		$ 7,477,406

SCHEDULE 4
continued

NATIONAL ACADEMY OF ENGINEERING

Program Administration		
Council	$ 15,305	
Executive Office	414,400	
Meetings and Conferences	8,936	
International Activities	17,569	
Unallocated Funds	5,570	
Search Committee	21,366	
Engineering Manpower Policy	28,888	
	$ 512,034	
Advisory and Research		
Task Force on Energy	$ 6,653	
Board on Engineering Manpower and Educational Policy	4,338	
	$ 10,991	
Conferences and Symposia		
Transportation Symposium	$ 2,362	
TOTAL NATIONAL ACADEMY OF ENGINEERING		$ 525,387

NATIONAL RESEARCH COUNCIL

Program Administration		
Assembly of Behavioral and Social Sciences	$ 149,749	
Commission on Human Resources	133,146	
Division of Biology and Agriculture	82,206	
Division of Chemistry and Chemical Technology	67,638	
Division of Earth Sciences	84,829	
Division of Engineering	119,612	
Division of Mathematics	42,462	
Division of Medical Sciences	92,499	
Division of Physical Sciences	71,952	
Commission on Natural Resources	133,242	
Assembly of Life Sciences	135,440	
	$1,112,775	
TOTAL NATIONAL RESEARCH COUNCIL		$ 1,112,775

SCHEDULE 4
continued

INSTITUTE OF MEDICINE

Program Administration

Direction and Support	$ 503,607	
Council	34,315	
Membership Committee	18,850	
Program Committee	39,330	
Program Development	146,786	
Public Information and Reports	37,735	
Annual and Semi-Annual Meetings	12,607	
Commission on Biomedical Research	100,353	
	$ 893,583	
TOTAL INSTITUTE OF MEDICINE		$ 893,583
General Expenses Allocated as Indirect Costs to Grants and Contracts		(7,535,857)
TOTAL CURRENT GENERAL FUNDS		$ 2,473,294

CURRENT RESTRICTED FUNDS

Government-Financed Activities

NATIONAL ACADEMY OF SCIENCES

Advisory and Research Activities

Committee on Science and Public Policy (NSF)	$ 106,364	
Materials Science and Engineering Survey (NSF)	5,830	
Various Projects (less than $5,000 each)	86	
	$ 112,280	
TOTAL NATIONAL ACADEMY OF SCIENCES		$ 112,280

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SCHEDULE 4
continued

NATIONAL ACADEMY OF ENGINEERING

Advisory and Research Activities

Committee on Transportation (TRANSPORTATION)	$ 145,077
Integrated Utility Systems (HUD)	117,402
Study of National Science Foundation Incentive Program Experimental Research and Development (NSF)	65,334
Marine Board (NAVY)	190,330
Aeronautics and Space Engineering Board (NASA)	168,595
Simulation of Earthquake Effects on Structures (NSF)	42,254
Navy Environmental Protection Data Based Program (NAVY)	66,645
Bay Area Rapid Transportation Impact Committee (TRANSPORTATION)	26,140
Studies in Sea Floor Engineering (NSF)	15,304
Examination and Evaluation of Selected Government Technological Transfer Programs (NSF)	49,734
Forum on National Materials Policy (NSF-INTERIOR)	26,156
Space Applications Board (NASA)	148,863
Advisory Committee to the Bureau of Mines (INTERIOR)	9,881
Operational Safety in Marine Mining (INTERIOR)	25,397
Study of Priorities for Research Applied to National Needs (NSF)	49,156
Committee on Public Engineering Policy (NSF)	176,891
Development of Computing Systems for Use in Chemistry Engineering Education (NSF)	46,758
Committee on Telecommunications (HUD-EXEC OFC PRES)	105,467
Various Projects (less than $5,000 each)	12
	$1,475,396

Conferences and Symposia

Symposium on Application of Technology to Production in Service Sector of National Economy (NSF-HUD)	$ (3,652)
Committee on Transportation (TRANSPORTATION)	7,078
Panel on International Decade of Ocean Exploration (NSF)	5,208
Engineering Committee on Ocean Resources (NSF)	5,623
Various Projects (less than $5,000 each)	2,737
	$ 16,994

TOTAL NATIONAL ACADEMY OF ENGINEERING $ 1,492,390

SCHEDULE 4
continued

NATIONAL RESEARCH COUNCIL

ASSEMBLY OF BEHAVIORAL AND SOCIAL SCIENCES

Advisory and Research Activities

Assessment of Manpower Training Evaluation (LABOR)	$ 170,920	
Center on Vocational Education Research and Development (HEW)	28,049	
Study of Social Research and Development (NSF)	32,921	
Assessment of Biomedical Technology (NSF)	(2,411)	
Committee on Vision and on Hearing, Bioacoustics, and Biomechanics (NAVY)	175,452	
Advisory Committee on Child Development (HEW)	8,420	
Committee on Federal Agency Evaluation Research (EXEC OFC PRES)	28,561	
Panel on the Impact of Information on Drug Use and Misuse (HEW)	(15,225)	
Various Projects (less than $5,000 each)	143	
	$ 426,830	

Conferences and Symposia

XIV International Congress and Assembly of the Division of Historical Science (NSF)	$ 9,623	
Study Conference on Social and Behavioral Science (NSF)	13,251	
Various Projects (less than $5,000 each)	6	
	$ 22,880	
TOTAL ASSEMBLY OF BEHAVIORAL AND SOCIAL SCIENCES		$ 449,710

DIVISION OF BIOLOGY AND AGRICULTURE

Advisory and Research Activities

Study of South American Primates (ARMY)	$ 41,446
Laboratory Animal Standards (HEW)	10,258
Committee on Maternal and Child Health Nutritional Guidelines (HEW)	23,364

SCHEDULE 4
continued

Committee on Aquatic Food Resources (COMMERCE)	$ 17,565	
Committee on the Effects of Military Use of Herbicides (ARMY)	297,703	
Committee on National Nutrition Survey (HEW)	13,622	
Food Additives Codex (HEW)	37,705	
Committee on International Nutrition (AID)	48,599	
U.S. Committee on the International Biological Program (NSF)	132,351	
Population Dynamics of Yellowstone Grizzlies (INTERIOR)	22,259	
Latent Effects of Maladies and Infections (HEW)	18,587	
XVI Ornithological Congress Travel (NSF)	5,677	
Review of Saccharin (HEW)	18,574	
Institute of Laboratory Animal Resources (AGRICULTURE-HEW-NAVY-AEC-NSF-VA)	240,462	
Various Projects (less than $5,000 each)	10,489	
	$ 938,661	
Conferences and Symposia		
Conference on Laboratory Animal Resources (HEW)	$ 12,773	
Various Projects (less than $5,000 each)	1,231	
	$ 14,004	
TOTAL DIVISION OF BIOLOGY AND AGRICULTURE		$ 952,665

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY

Advisory and Research Activities		
Numerical Data Advisory Board (COMMERCE)	$ 68,774	
Protocol Evaluation and Development for Toxicological Assessment of Environmental Pollutants (EPA)	56,915	
Toxicology Assessment of Fuel Additives and Their Combustion Products (EPA)	59,799	
Biochemical Nomenclature (HEW)	33,393	
National Laboratory for Theoretical Chemistry (NSF)	7,319	
Advisory Committee on Hazardous Materials (TRANSPORTATION-COAST GUARD)	142,859	
Committee on Data for Science and Technology of the International Council of Scientific Unions (NSF)	31,255	
Advisory Center on Toxicology (NAVY-EPA)	149,290	

SCHEDULE 4
continued

Services on the Data Systems Program of the Office of Science Information Service (NSF)	$ 6,948	
Various Projects (less than $5,000 each)	2,333	
	$ 558,885	
Conferences and Symposia		
Various Projects (less than $5,000 each)	$ 1,523	
TOTAL DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY		$ 560,408

DIVISION OF EARTH SCIENCES

Advisory and Research Activities		
Tunneling Technology and Contracting Policies (NSF)	$ 141,646	
U.S. National Center for International Union of Quarternary Research (NSF-AIR FORCE)	19,635	
Evaluation of Tunneling Technology (NSF)	65,018	
Advisory Center for U.S. Geological Survey Space Program for Earth Observations (INTERIOR)	(6,669)	
Workshop on Need for National Policy for Use of Underground Space (NSF)	10,868	
U.S. National Committee on Tunneling Technology (INTERIOR)	16,701	
Study on Orientations in Geochemistry (NSF)	11,521	
U.S. National Committee for Geochemistry (NSF)	65,402	
U.S. National Committee for the International Hydrological Decade (NSF)	152,944	
U.S. National Committee for Rock Mechanics (ARMY-AEC-NSF-INTERIOR)	5,230	
Committee on Seismology (NSF-INTERIOR-AEC-COMMERCE-ARMY-NASA)	35,669	
Committee on the Alaska Earthquake (NSF-INTERIOR-HUD)	6,085	
Various Projects (less than $5,000 each)	2,836	
	$ 526,886	

SCHEDULE 4
continued

Conferences and Symposia

III Congress of the International Society of Rock Mechanics (NSF-INTERIOR-AEC-ARMY)	$ 90,802	
Various Projects (less than $5,000 each)	222	
	$ 91,024	
TOTAL DIVISION OF EARTH SCIENCES		$ 617,910

DIVISION OF ENGINEERING

Advisory and Research Activities

Study and Report on Passenger Travel Demand Forecasting (TRANSPORTATION)	$ 17,564
Study and Report on Highways and Air Quality (EPA)	6,455
Building Research Advisory Board to the Federal Construction Council (COMMERCE-AEC-HEW-ARMY-NAVY-INTERIOR-GSA-VA-NASA)	380,116
Development and Use of Standardized Subsystems for Buildings (COMMERCE)	9,583
Transportation Research Board Maritime Research Information Service (COMMERCE)	233,208
Advisory Board on Military Personnel Supplies (ARMY)	129,452
Studies of Fire Loads and Live Loads in Buildings (GSA)	402,306
Advisory Services on Gears and Pinions for Artillery (ARMY)	25,986
Transportation Research Information Systems (TRANSPORTATION)	142,643
*Study and Technical Evaluation of Coal Gasification Research (INTERIOR)	66,706
Feasibility Study of Building Investment Survey (NSF)	24,801
Research on Solar Energy for Heating and Cooling of Buildings (NSF)	26,480
Seminar on Models for Community Development (NSF)	9,009
Energy Performance Study Standards (TRANSPORTATION)	2,703
Fire Safety Aspects of Polymeric Materials (COMMERCE)	50,339
Study on Maintaining Research and Development Needs (TRANSPORTATION)	6,550
Study of Life Cycle of Industrial Materials (LIBRARY OF CONGRESS)	10,609

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

Advisory Survey on Assessment of Effectiveness of Technological Transfers thru Technical Data Package (ARMY)	$ 19,248	
Statewide Transportation Planning (TRANSPORTATION)	26,306	
Transportation Research Board—Railway Research Information Service (TRANSPORTATION)	181,244	
Maritime Transportation Research Board (NAVY)	309,945	
Ship Hull Research Committee (NAVY-COMMERCE-TRANSPORTATION)	81,352	
*Committee on Pollution Abatement and Control (HEW)	24,155	
Committee on Solid Wastes Research (HEW-NSF)	47,323	
Transportation Research Board (TRANSPORTATION)	626,630	
International Information Service to National Highway Safety Bureau (TRANSPORTATION)	15,055	
National Cooperative Highway Research Program (TRANSPORTATION-COMMERCE)	2,980,566	
Transportation Noise Abatement Advisory Services (TRANSPORTATION)	78,463	
Committee on Motor Vehicle Emissions (EPA)	393,232	
*Committee on Natural Disasters (NSF)	23,733	
Committee on Fire Research (COMMERCE-NSF-AGRICULTURE-ARMY)	75,974	
U.S. National Committee on the International Council on Building Research (COMMERCE-ARMY-HUD)	71,639	
National Materials Advisory Board (ARMY-NAVY-GSA-NASA)	500,784	
Various Projects (less than $5,000 each)	8,317	
	$7,008,476	
Conferences and Symposia		
Road Research Steering Center (TRANSPORTATION)	$ (122)	
Conference on Solid Waste Management in Buildings (HUD)	10,138	
II International Conference on Permafrost (NSF-ARMY)	20,933	
Conference Workshop on Soil Erosion (NSF)	(25)	
Conference on Citizen Participation in Transportation Planning (TRANSPORTATION)	25,073	
Various Projects (less than $5,000 each)	22	
	$ 56,019	
TOTAL DIVISION OF ENGINEERING		$ 7,064,495

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

DIVISION OF MATHEMATICAL SCIENCES

Advisory and Research Activities

Evaluation of National Crime Panel (JUSTICE)	$ 31,195	
1974 International Congress of Mathematicians (NSF)	15,514	
Various Projects (less than $5,000 each)	3,702	
	$ 50,411	

Conferences and Symposia

Congress of International Federation for Information Processing (NSF)	$ 44,883	
Various Projects (less than $5,000 each)	3,000	
	$ 47,883	
TOTAL DIVISION OF MATHEMATICAL SCIENCES		$ 98,294

DIVISION OF MEDICAL SCIENCES

Advisory and Research Activities

Medical Advisory Committees (ARMY)	$ 90,504
Committee on Phototherapy in the Newborn (HEW)	50,399
Committee on Prosthetics Research and Development (HEW-VA)	163,945
Clinical Evaluation in Prosthetics and Orthotics (HEW)	251,409
Committee on Problems of Drug Dependence (HEW-JUSTICE)	69,005
Committee on Viral Hepatitis (HEW)	12,656
Committee on the Toxicology Information Project (HEW)	42,300
Evaluation of Effects of National Pituitary Agency on the Field of Endocrinology (HEW)	47,274
Evaluation of Research Impact on Discoveries in Neural Diseases (HEW)	21,443
Committee on the Study of Inborn Errors of Metabolism (NSF)	106,546
Follow-Up Agency Amyotsophic Lateral Sclerosis (HEW)	41,643
Study of Synthetic Substitutes of Morphine (JUSTICE)	15,288
Evaluation of Data on Children's Hazards from Lead in Paints (HEW)	7,956
USNC for International Brain Research Organization (NSF)	5,005
Manpower Resources and Needs in the Basic Neurological and Communicative Sciences (HEW)	71,848

SCHEDULE 4
continued

Clinical Evaluation of Narcotic Antagonists (EXEC OFC PRES)	$ 172,734	
Ad Hoc Committee on Electronarcosis (HEW)	12,846	
Development and Production of a Human Malaria Vaccine (AID)	9,342	
Study of Exposure to Ionized Radiation (EPA)	9,509	
Appraisal of Manpower and Associated Health Care Resources (VA)	178,591	
Study on Drug Efficacy (HEW)	5,147	
Study of Childhood Cancer in Relation to Prenatal Irradiation (HEW)	28,324	
USNC for International Union against Cancer (HEW)	263,701	
Advisory Services to the Federal Radiation Council (HEW)	46,028	
Drug Research Board (HEW)	59,564	
National Halothane Study (HEW)	470,685	
Multiple Sclerosis Epidemiology U.S. Veteran Population (HEW)	30,717	
Medical Follow-Up Studies–Veterans Medical Problems (HEW-VA)	360,768	
Medical Follow-Up Agency Study of Etiology of Cancer in Veterans (HEW)	129,150	
Follow-Up Agency Medical Studies on Veterans' Twins (HEW)	62,616	
Atomic Bomb Casualty Commission (AEC)	6,884,718	
Committee on Prosthetic-Orthotic Education (VA-HEW)	192,438	
Research Impact on Useful Discoveries in Mental Health (HEW)	18,518	
U.S. National Committee of the International Union of Physiological Sciences (HEW-NSF)	16,072	
Committee on Biologic Effects of Environmental Pollutants (EPA)	271,847	
ICSP-WHO International Reference Center (HEW)	136,573	
Various Projects (less than $5,000 each)	12,336	
	$10,369,445	
Conferences and Symposia		
Workshop on Dermatopharmacology (HEW)	$ 7,250	
Various Projects (less than $5,000 each)	1,450	
	$ 8,700	
TOTAL DIVISION OF MEDICAL SCIENCES		$10,378,145

SCHEDULE 4
continued

DIVISION OF PHYSICAL SCIENCES

Advisory and Research Activities

Committee on the DOT Climatic Impact Assessment Program (TRANSPORTATION)	$ 149,417	
*Advisory Committee to the National Bureau of Standards (COMMERCE)	140,969	
Advisory Committee to Air Force Systems Command (AIR FORCE)	81,831	
Committee on Line Spectra of the Elements (NSF)	7,752	
Research Needs in Low Dose Radiation Exposure (AEC)	14,837	
Board on Naval Science and Technology (NAVY)	51,241	
Summer Study on Scientific Uses of Space Shuttle Transportation Systems (NASA)	113,877	
Advisory Committee to Army Research Office (ARMY)	53,882	
Assessment of Land Mine Detection and Neutralization Research and Development (ARMY)	16,309	
Committee on Undersea Warfare (NAVY)	363,200	
Mine Advisory Committee (NAVY)	(7,817)	
Space Science Board (NASA)	306,888	
Committee on Atmospheric Sciences (NSF)	39,440	
Committee on Polar Research (NSF)	158,134	
Committee on Radio Frequency Requirements for Scientific Research (NSF)	30,689	
Geophysics Research Board (NSF)	197,917	
U.S. Committee for the Global Atmospheric Research Program (NSF)	151,978	
Support of U.S. National Committee for the International Astronomical Union (NSF))	16,117	
Physics Survey Committee (NSF-AEC-NASA-NAVY)	7,937	
Committee on Nuclear Science (NSF-AEC)	319,192	
Astrometric Research in Southern Hemisphere (NSF-NASA)	109,586	
Various Projects (less than $5,000 each)	4,145	
	$2,327,521	
Conferences and Symposia		
Various Projects (less than $5,000 each)	$ 9,192	
TOTAL DIVISION OF PHYSICAL SCIENCES		$ 2,336,713

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

OFFICE OF THE FOREIGN SECRETARY

Advisory and Research Activities

Center on International Scientific and Technological Information Programs (NSF)	$ 42,230	
Biology and Utilization of Manatus (NSF)	9,431	
Role of Peace Corps in 1970's (EXEC OFC PRES)	47,588	
Center on Arid Lands of Subsaharan Africa (AID)	34,086	
Commission on Scholarly Communications (STATE)	195,300	
Study of Problems of Advanced Societies (NSF)	(7,549)	
U.S.-Argentine Cooperative Science Program (AID)	28,310	
Advisory Board on International Relations (STATE)	38,697	
Board on Science and Technology for International Development (AID)	705,049	
International Organizations and Programs (NSF)	401,398	
U.S. National Committee for the International Federation of Documentation (NSF)	7,631	
Advisory Committee on USSR and Eastern Europe (NSF)	1,160,130	
ICSU Abstracting Board (NSF)	5,770	
Institute for Applied Systems Analysis (NSF)	1,080,362	
Committee on Scholarly Communications with People's Republic of China (NSF)	291,882	
Various Projects (less than $5,000 each)	1,228	
	$4,041,543	

Conferences and Symposia

Board on Science and Technology for International Development (AID)	$ 20,307	
International Seminars on Population Policy Analysis (AID)	139,232	
Various Projects (less than $5,000 each)	19	
	$ 159,558	

Fellowships and Other Support of Scholars

Board on Science and Technology for International Development (AID)	$ 22,352	
U.S.-Brazil Program for Postgraduate Research in Chemistry (NSF-AID)	137,321	
	$ 159,673	
TOTAL OFFICE OF THE FOREIGN SECRETARY		$ 4,360,774

SCHEDULE 4
continued

OFFICE OF SCIENTIFIC PERSONNEL

Advisory and Research Activities

Study of Educational Costs in Health Profession (HEW)	$ 6,847
Development of a Computer Roster of Doctorates in Science and Engineering (NSF)	245,942
International Atomic Energy Agency Training Program (AEC)	272,942
Council of International Exchange of Scholars (STATE)	600,479
Board on Human Resources (FDN. ON ARTS AND HUMANITIES)	48,233
Doctorate Survey Program (NSF)	222,060
Biomedical Manpower Study (HEW)	155,621
Study of National Science Foundation (NSF)	175,830
	$1,727,954

Fellowships and Other Support of Scholars

National Bureau of Standards Research Associateships (COMMERCE)	$ 15,920
Air Force Systems Command Postdoctoral Research Associateships (AIR FORCE)	931,175
Army Materials and Mechanics Research Center Postdoctoral Research Associateships (ARMY)	38,776
Natick Visiting Scientists Program (ARMY)	183,401
National Oceanic and Atmospheric Administration Resident Research Associateship Program (COMMERCE)	341,449
Naval Electronic Laboratories Postdoctoral Research Associateships (ARMY)	29,910
Picatinny Arsenal Research Associateships (ARMY)	70,081
Bureau of Medicine and Surgery Postdoctoral Research Associateships (NAVY)	9,120
Naval Ordnance Laboratory Postdoctoral Research Associateships (NAVY)	8,541
International Atomic Energy Agency Training Program (AEC)	63,069
Study of Problems of Pest Control (AGRICULTURE)	9,547
Ballistic Research Laboratories–Resident Research Associateship Program (ARMY)	79,182
National Research Laboratory Postdoctoral Research Associateships (NAVY)	436,508
Naval Weapons Center Postdoctoral Research Associateships (NAVY)	8,256

SCHEDULE 4
continued

Bureau of Mines Postdoctoral Research Associateships (INTERIOR)	$ 8,749	
U.S. Geological Survey Postdoctoral Research Associateships (INTERIOR)	9,283	
Committee on International Exchange of Persons (STATE)	1,199,324	
NASA Research Associateships (NASA)	3,662,996	
Smithsonian Institution Visiting Research Associateships (SMITHSONIAN INSTITUTION)	23,443	
National Science Foundation Graduate Fellowship Program (NSF)	344,015	
Various Projects (less than $5,000 each)	833	
	$7,473,578	
TOTAL OFFICE OF SCIENTIFIC PERSONNEL		$ 9,201,532

COMMISSION ON NATURAL RESOURCES

Advisory and Research

Board on Agriculture

Study of African Agricultural Research Capabilities (AID)	$ 27,555
Committee on Animal Nutrition (HEW-AGRICULTURE)	33,337
United States Advisory Committee on Foot and Mouth Disease (AID)	10,941
Animal Nutrient Requirement Series (AGRICULTURE)	39,204
Various Projects (less than $5,000 each)	1,162
	$ 112,199

Board on Energy Studies

Waste Management (AEC)	$ 96,229
Return of Underground Coal Wastes to Mined Out Voids (NSF)	32,152
	$ 128,381

Environmental Studies Board

Health Effects of Air Pollutants (US SENATE)	$ 147,651
Cost Benefit Analysis of Air Pollutants (US SENATE)	121,749
National Commission on Water Quality (EXEC OFC PRES)	78,840
Study of Outer Continental Shelf (EXEC OFC PRES)	67,715
Environmental Studies Board (NSF)	30,946
Study of Problems of Pest Control (AGRICULTURE)	115,332

SCHEDULE 4

Environmental Quality Indicators Planning Study (EXEC OFC PRES)	$ 50,793
Various Projects (less than $5,000 each)	7,806
	$ 620,832
Board on Nonrenewable Resources	
Committee on Mineral Resources and the Environment (INTERIOR)	$ 125,155
Board on Ocean and Atmosphere	
Committee on Oceanography (NAVY)	$ 168,839
Ocean Science Freedom Studies (NSF)	47,399
Workshop on Inputs, Fates, and Effects of Petroleum in Marine Environment (EPA)	29,898
Man-Generated Material Inputs to Marine Environment (NSF-TRANSPORTATION-EPA)	107,607
Large Scale Oceanic Atmospheric Coupling (NSF)	39,999
Various Projects (less than $5,000 each)	7,344
	$ 401,086
Special Projects	
Advisory Committee on U.S. Geological Survey Space Program for Earth Observations (NSF-INTERIOR)	$ 90,572
	$1,478,225
Conferences and Symposia	
Board on Agriculture	
Workshop on Genetic Improvement of Protein in Cereals (NSF-AEC)	$ 21,810
Various Projects (less than $5,000 each)	849
	$ 22,659
Environmental Studies Board	
Conference on Principles of Protocols for Evaluating Chemicals in Environment (EPA)	$ (23,006)

SCHEDULE 4
continued

Board on Ocean and Atmosphere		
Workshop on Inputs, Fates, and Effects of Petroleum in Marine Environment (NAVY-TRANSPORTATION)	$ (12,989)	
Various Projects (less than $5,000 each)	1,837	
	$ (11,152)	
	$ (11,499)	
TOTAL COMMISSION ON NATURAL RESOURCES		$ 1,466,726

OTHER

Advisory and Research Activities		
Advisory Committee on Advisory Planning (COAST GUARD)	$ 13,380	
Public Policy Implication of Earthquake Predictions (HUD)	22,014	
Advisory Committee on Civil Defense (ARMY)	71,577	
*Advisory Assistance to Department of Housing and Urban Development (HUD)	157,094	
Advisory Committee to the Office of Emergency Planning (EXEC OFC PRES)	59,568	
Various Projects (less than $5,000 each)	33	
	$ 323,666	
TOTAL OTHER		$ 323,666

INSTITUTE OF MEDICINE

Advisory and Research Activities	
Social Security Studies (HEW)	$ 82,935
Conference on Regulations in Health Care Industry (HEW)	23,321
Review of Saccharin (HEW)	5,068
Study of Educational Costs in the Health Professions (HEW)	1,089,908
National Committee on Human Value Issues in Health Care (HEW)	87,528
Various Projects (less than $5,000 each)	3,486
	$1,292,246

*Administered jointly by the National Academy of Sciences and the National Academy of Engineering.

SCHEDULE 4
continued

Conferences and Symposia		
Conference on Carcinogenesis Testing in Development of New Drugs (HEW)	$ (132)	
Conference on Interrelationships of Educational Programs with Health Profession (HEW)	(1,996)	
	$ (2,128)	
TOTAL INSTITUTE OF MEDICINE		$ 1,290,118
TOTAL GOVERNMENT-FINANCED ACTIVITIES		$40,705,826

Privately Financed Activities

NATIONAL ACADEMY OF SCIENCES

Program Administration	
Copernicus Quinquecentennial Dinner (VARIOUS)	$ 35,426
Ad Hoc Committee on Scientific and Technological Advice to Federal Government (NAS)	26,530
Various Projects (less than $5,000 each)	385
	$ 62,341
General Administration	
Various Projects (less than $5,000 each)	$ 1,210
Advisory and Research Activities	
Awards and Prizes (VARIOUS)	$ 92,786
Various Projects (less than $5,000 each)	8,596
	$ 101,382
Conferences and Symposia	
Forum (NAS)	$ 56,061
Fellowships and Other Support of Scholars	
Staff Fellowship Program (ALFRED P. SLOAN FDN.)	$ 174,327

SCHEDULE 4
continued

Dissemination of Information and Publication Activities		
Letter Agreement with Norman Metzger (U.S. STEEL FDN.)	$ 6,535	
TOTAL NATIONAL ACADEMY OF SCIENCES		$ 401,856
NATIONAL ACADEMY OF ENGINEERING		
Advisory and Research Activities		
Programs on Minorities in Engineering Profession (VARIOUS)	$ 78,696	
Commission on Engineering Education (VARIOUS)	53,258	
U.S. National Committee for Environmental Center on Oceanic Resources (VARIOUS)	7,973	
Various Projects (less than $5,000 each)	5,658	
	$ 145,585	
Conferences and Symposia		
Minority Participation in the Engineering Profession (IBM CORPORATION-OLIN CORPORATION)	$ 12,336	
Various Projects (less than $5,000 each)	3,757	
	$ 16,093	
TOTAL NATIONAL ACADEMY OF ENGINEERING		$ 161,678
NATIONAL RESEARCH COUNCIL		
ASSEMBLY OF BEHAVIORAL AND SOCIAL SCIENCES		
Advisory and Research Activities		
Manpower Revenue Sharing Evaluation (FORD FDN.)	$ 42,293	
Division of Behavioral Sciences Reserve Fund (VARIOUS)	14,728	
	$ 57,021	
Conferences and Symposia		
Various Projects (less than $5,000 each)	$ 3,542	
TOTAL ASSEMBLY OF BEHAVIORAL SCIENCES		$ 60,563

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SCHEDULE 4
continued

DIVISION OF BIOLOGY AND AGRICULTURE

Advisory and Research Activities

Food and Nutrition Board (VARIOUS)	$ 101,456	
Institute of Laboratory Animal Resources (AMERICAN CANCER SOCIETY-VARIOUS)	19,867	
Various Projects (less than $5,000 each)	(3,090)	
	$ 118,233	
Conferences and Symposia		
Various Projects (less than $5,000 each)	$ 2,720	
TOTAL DIVISION OF BIOLOGY AND AGRICULTURE		$ 120,953

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY

Advisory and Research Activities		
Various Projects (less than $5,000 each)	$ 1,741	
Conferences and Symposia		
U.S. National Committee of International Union of Pure and Applied Chemistry (VARIOUS)	$ 39,945	
Various Projects (less than $5,000 each)	1,106	
	$ 41,051	
TOTAL DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY		$ 42,792

DIVISION OF EARTH SCIENCES

Advisory and Research Activities		
Tunneling Technology Newsletter (ASSOC. OF GENERAL CONTRACTORS OF AMERICA)	$ 5,848	
Various Projects (less than $5,000 each)	8,596	
	$ 14,444	

SCHEDULE 4
continued

Conferences and Symposia		
USNC International Hydrological Decade (VARIOUS)	$ 10,572	
III Congress for International Society for Rock Mechanics (VARIOUS)	18,705	
	$ 29,277	
Dissemination of Information and Publication Activities		
Publication of Great Alaska Earthquake Series (VARIOUS)	$ 22,996	
TOTAL DIVISION OF EARTH SCIENCES		$ 66,717
DIVISION OF ENGINEERING		
Advisory and Research Activities		
Center on Fire Research (FIRE EQUIPMENT MANUF. ASSOC.)	$ 14,678	
Ship Hull Research Center (AMERICAN BUREAU OF SHIPPING)	10,161	
Transportation Research Board (VARIOUS STATE GOVERNMENTS AND OTHERS)	1,688,993	
Building Research Advisory Board (VARIOUS)	89,280	
Various Projects (less than $5,000 each)	9,380	
	$1,812,492	
Conferences and Symposia		
II International Conference on Permafrost (VARIOUS)	$ 8,589	
U.S. National Committee for the International Institute of Refrigeration Congress (VARIOUS)	(6,595)	
Conference on Electrical Insulation (VARIOUS)	38,157	
Various Projects (less than $5,000 each)	(118)	
	$ 40,033	
Dissemination of Information and Publication Activities		
NCHRP Progress Publication (VARIOUS)	$ 36,508	
TOTAL DIVISION OF ENGINEERING		$ 1,889,033

SCHEDULE 4
continued

DIVISION OF MATHEMATICAL SCIENCES

Advisory and Research Activities

Committee on National Statistics (RUSSELL SAGE FDN.)	$ 50,786	
Various Projects (less than $5,000 each)	2,351	
	$ 53,137	

Conferences and Symposia

Various Projects (less than $5,000 each)	$ 5,758	
TOTAL DIVISION OF MATHEMATICAL SCIENCES		$ 58,895

DIVISION OF MEDICAL SCIENCES

Advisory and Research Activities

Twin Registry Study (UNIV. OF PENNSYLVANIA)	$ 34,356	
Emergency Medical Communication Systems (ROBERT W. JOHNSON FDN.)	208,690	
Committee on Radiological Research (JAMES PICKER FDN.-OLOL MEMORIAL HOSPITAL)	408,470	
Committee on Problems of Drug Dependence (VARIOUS)	293,480	
National Committee of the International Union Against Cancer (VARIOUS)	12,570	
Various Projects (less than $5,000 each)	9,270	
	$ 966,836	

Conferences and Symposia

International Congress on Adverse Reaction Report Systems (AMERICAN PHYSIOLOGICAL SOCIETY)	$ 13,980	
Various Projects (less than $5,000 each)	4,323	
	$ 18,303	
TOTAL DIVISION OF MEDICAL SCIENCES		$ 985,139

SCHEDULE 4
continued

DIVISION OF PHYSICAL SCIENCES		
Advisory and Research Activities		
Various Projects (less than $5,000 each)	$ 437	
Conferences and Symposia		
XIV General Assembly of the International Union of Pure and Applied Physics (VARIOUS)	$ 5,565	
Various Projects (less than $5,000 each)	2,515	
	$ 8,080	
TOTAL DIVISION OF PHYSICAL SCIENCES		$ 8,517
OFFICE OF THE FOREIGN SECRETARY		
Advisory and Research Activities		
Development of Agriculture in Semi-Arid Region of Brazil (MIGON FINEP)	$ 16,644	
International Foundation for Science (ROCKEFELLER FDN.)	10,399	
Science Cooperative Program with Republic of China (ROCKEFELLER FDN.)	29,213	
Programs in International Science Cooperation (FORD FDN.)	(9,052)	
Biological Research In Latin America (FORD FDN.)	7,765	
Various Projects (less than $5,000 each)	6,056	
	$ 61,025	
Conferences and Symposia		
Symposium on Physiological and General Aspects of Reproduction (FORD FDN.)	$ 10,151	
Various Projects (less than $5,000 each)	20	
	$ 10,171	
Fellowships and Other Support of Scholars		
U.S. Brazil Program for Postgraduate Research in Chemistry (ATLANTIC RICHFIELD)	$ 27,354	
Committee on Scholarly Communication with the Peoples Republic of China (CHARLES KETTERING FDN.)	10,000	
	$ 37,354	

SCHEDULE 4
continued

Dissemination of Information and Publication Activities		
The Copernicus Quinquecentennial in 1973 Volume (ROCKEFELLER FDN.)	$ 9,495	
TOTAL OFFICE OF THE FOREIGN SECRETARY		$ 118,045
OFFICE OF SCIENTIFIC PERSONNEL		
Advisory and Research Activities		
Analytical Report on Federal Policy Alternatives (CARNEGIE CORP.)	$ 26,255	
National Board on Graduate Education (A. W. MELLON FDN.-CARNEGIE CORP. OF N.Y.-VARIOUS)	147,369	
Board on Human Resources (RUSSELL SAGE FDN.)	6,835	
Various Projects (less than $5,000 each)	1,956	
	$ 182,415	
Conferences and Symposia		
Various Projects (less than $5,000 each)	$ 1,762	
Fellowships and Other Support of Scholars		
National Board on Graduate Education (FORD FDN.)	$ 17,199	
Fellowships in Health Policy (R. W. JOHNSON)	29,562	
Various Projects (less than $5,000 each)	988	
	$ 47,749	
TOTAL OFFICE OF SCIENTIFIC PERSONNEL		$ 231,92
COMMISSION ON NATURAL RESOURCES		
Advisory and Research Activities		
Board on Agriculture		
Agriculture Board (ROCKEFELLER FDN.-FORD FDN.)	$ 15,468	
Study of Agriculture Production Efficiency (ROCKEFELLER FDN.)	10,762	
Various Projects (less than $5,000 each)	8,078	
	$ 34,308	

SCHEDULE 4
continued

Environmental Studies Board		
Committee on International Environmental Programs (HOLCOMB RESEARCH INSTITUTE)	$ 10,000	
Environmental Studies Board (FORD FDN.-KELLOGG FDN.-SCAIFE FAMILY FDN.)	142,580	
	$ 152,580	
Board on Nonrenewable Resources		
Committee on Mineral Resources and the Environment (POPULATION COUNCIL)	$ 13,192	
Board on Ocean and Atmosphere		
Workshop on Inputs, Fates, and Effects of Petroleum in Marine Environment (ROCKEFELLER FDN.-AMERICAN CHEMICAL SOCIETY)	$ 11,476	
Various Projects (less than $5,000 each)	766	
	$ 12,242	
TOTAL COMMISSION ON NATURAL RESOURCES		$ 212,322
OTHER		
Advisory and Research Activities		
Various Projects (less than $5,000 each)	$ 241	
TOTAL OTHER		$ 241
INSTITUTE OF MEDICINE		
Advisory and Research Activities		
Study of Contrasts in Health Status (ASSOC. FOR THE AID OF CRIPPLED CHILDREN-CARNEGIE CORP. OF N.Y.)	$ 22,842	
Various Projects (less than $5,000 each)	2,023	
	$ 24,865	

SCHEDULE 4
continued

Fellowships and Other Support of Scholars		
Fellowships in Health Policy (ROBERT W. JOHNSON FDN.)	$ 86,816	
TOTAL INSTITUTE OF MEDICINE		$ 111,681
TOTAL PRIVATELY FINANCED ACTIVITIES		$ 4,470,358

APPENDIX VI

PUBLICATIONS, FISCAL YEARS 1973–1974

SELECTED BIBLIOGRAPHY

The following listing of NAS–NAE–IoM–NRC documents is representative of the publications of the overall organization; it is not a comprehensive listing of all reports published during the years 1973–74. Not included are the numerous technical reports by the Highway Research Board, the Building Research Advisory Board, and the Maritime Transportation Research Board, nor the many contract reports and letter reports to government agencies. Except where otherwise indicated, reports in print may be obtained from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

Abatement of Particulate Emissions from Stationary Sources (COPAC–5). Prepared by the *Ad Hoc* Panel on Abatement of Particulate Emissions from Stationary Sources, Committee on Air Quality Management, Committees on Pollution Abatement and Control, Division of Engineering, National Research Council (National Academy of Engineering, 1972; 46 pp.; limited number of copies available from Committee on Air Quality Management).

Accommodating Utilities in Transportation Rights-of-Way. (Transportation Research Record 483). Transportation Research Board, National Research Council (Transportation Research Board, 1974; 28 pp.; ISBN 0–309–02269–X; $1.80; available from the board).

Accumulation of Nitrate. Committee on Nitrate Accumulation, Agricultural Board, Division of Biology and Agriculture, National Research Council (National Academy of Sciences, 1972; 106 pp.; ISBN 0–309–02038–7; $4.25).

The Administration's 1974 Budget: The Health Budget. A staff paper by Milton Turen and Ruth S. Hanft. Institute of Medicine (Institute of Medicine, May 1973; 38 pp.; limited number of copies available from the Institute).

The Administration's 1975 Budget: The Health Budget. A staff paper by Milton Turen. Institute of Medicine (Institute of Medicine, June 1974; 34 pp.; limited number of copies available from the Institute).

Advanced Concepts and Techniques in the Study of Snow and Ice Resources. An interdisciplinary symposium organized by the Work Group on Snow and Ice, the Work Group on Remote Sensing, and the Work Group on Nuclear techniques, of the U.S. National Committee for the International Hydrological Decade, Asilomar Conference Grounds, Monterey, Calif., December 2–6, 1973. Henry S. Santeford and James L. Smith, compilers. U.S. National Committee for the International Hydrological Decade; Division of Earth Sciences, National Research Council (National Academy of Sciences, 1974; 789 pp.; ISBN 0–309–02235–5; $11.00).

Air Quality and Automobile Emission Control. Volume 1: Summary Report. Report by the Coordinating Committee on Air Quality Studies, National Academy of Sciences-National Academy of Engineering, prepared for the Committee on Public Works, U.S. Senate, pursuant to S. Res. 135 (Committee on Public Works, U.S.

Senate; 93d Congress, 2d Session, September 1974; Committee print, 129 pp.; $1.40; available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402).

Allocating and Managing Manpower Resources (Transportation Research Record 480). Transportation Research Board, National Research Council (Transportation Research Board, 1974; 41 pp.; ISBN 0–309–02266–5, $1.80; available from the board).

Alternative Sources of Protein for Animal Production. Proceedings of a symposium held under joint sponsorship of the Committee on Animal Nutrition of the National Research Council and the American Society of Animal Science at the 1972 meeting of the society in Blacksburg, Va., July 31, 1972 (National Academy of Sciences, 1973; 183 pp.; ISBN 0–309–02114–6; $6.00).

America's Uncounted People. Report of the Advisory Committee on Problems of Census Enumeration, Division of Behavioral Sciences, National Research Council, Carole W. Parsons, ed. (National Academy of Sciences, 1972; 159 pp.; ISBN 0–309–02026–3; $7.25).

Analysis of HUD [U.S. Department of Housing and Urban Development] Operation Breakthrough Guide Criteria (Report Number 2–31). Prepared by a Special Advisory Committee of the Building Research Advisory Board, Division of Engineering, National Research Council (Building Research Advisory Board, 1973; 54 pp.; available from NTIS; PB 226 549; $3.50 paper, $1.45 microfiche).

Animal Disease Eradication: Evaluating Programs. Proceedings of a National Academy of Sciences workshop at the University of Wisconsin-Madison on the evaluation of national and international programs for the control or eradication of animal disease, Wisconsin Center, April 12–13, 1973. Planned by the Committee on Animal Health, of the Agricultural Board, Division of Biology and Agriculture, National Research Council (University of Wisconsin-Extension, Agricultural Bulletin Building, 1535 Observatory Drive, Madison, Wis. 53706; 43 pp.; $1.50 plus postage).

Animal Models for Biomedical Research V—Invertebrates. Intersociety symposium presented at the 57th Annual Meeting of the Federation of American Societies for Experimental Biology, Atlantic City, N.J., April 19, 1973. Sponsored by the American Society for Experimental Pathology; cosponsored by the Institute of Laboratory Animal Resources, of the National Research Council, and the American Physiological Society. *Federation Proceedings,* December 1973.

Annual Report: Fiscal Year 1968–69. National Academy of Sciences, National Academy of Engineering, National Research Council (U.S. Government Printing Office, 1972; 414 pp.; $2.00; available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402).

Application of Fracture Prevention Principles to Aircraft (NMAB–302). Report of the Committee on Application of Fracture Prevention Principles to Aircraft, National Materials Advisory Board, Division of Engineering, National Research Council (National Materials Advisory Board, February 1973; 260 pp.; available from NTIS; AD 764 513; $15.75 paper, $1.45 microfiche).

Application of Technology to Improve Productivity in the Service Sector of the National Economy. Summary Report and Recommendations based on a Symposium and Workshops held on the occasion of the Eighth Annual Meeting, November 1 and 2, 1971, at the National Academy of Engineering (National Academy of Engineering, 1973; 362 pp.; ISBN 0–309–02041–7; $7.50).

An Appraisal of Halogenated Fire Extinguishing Agents. Proceedings of a Symposium, April 11–12, 1972, held at National Academy of Sciences, Washington, D.C., and conducted by Committee on Fire Research, Division of Engineering, and Committee on Toxicology, Division of Chemistry and Chemical Technology, of the National

Research Council (National Academy of Sciences, 1972; 349 pp.; ISBN O–309–02111–1; $5.50).

Approaches to Natural Language. Proceedings of the 1970 Stanford Workshop on Grammar and Semantics, sponsored by the Committee on Basic Research in Education, of the National Academy of Sciences—National Research Council and National Academy of Education. K. J. J. Hintikka, J. M. E. Moravcsik, and P. Suppes, eds. (D. Reidel Publishing Co., Inc., 306 Dartmouth Street, Boston, Mass. 02116; 1973; 526 pp.; ISBN 90–277–0233–0; $18.00).

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Asphalt and Asphalt Mix Technology (Highway Research Record 468). Highway Research Board, National Research Council (Highway Research Board, 1973; 130 pp.; ISBN 0–309–0254–1; $4.00, available from Transportation Research Board).

Assessing Health Quality—The Case for Tracers. David M. Kessner, Carolyn E. Kale, and James Singer. Health Services Research Study, Institute of Medicine, National Academy of Sciences, *New England Journal of Medicine,* January 25, 1973; reprints available from Institute of Medicine.

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Astronomy and Astrophysics for the 1970's. Volume 1: Report of the Astronomy Survey Committee. Astronomy Survey Committee, Division of Physical Sciences, National Research Council (National Academy of Sciences, 1972; 136 pp.; ISBN 0–309–02029–8; $4.75).

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Atomic Spectroscopy Survey. Committee on Line Spectra of the Elements, Division of Physical Sciences, National Research Council (Committee on Line Spectra of the Elements, 1974; 71 pp.; available from the committee).

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Background Information on Lactose and Milk Intolerance. Statement of the Food and Nutrition Board, Division of Biology and Agriculture, National Research Council. Prepared by the Committee on International Nutrition Programs, Food and Nutrition Board (Food and Nutrition Board, May 1972; 4 pp.; available from the Food and Nutrition Board).

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