Annual Report of the Executive Officer

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1984, the 136th year of the AAAS, was one of continued vigor in the national scientific and engineering enterprise. While there was continued disarray in precollege education in the sciences and mathematics, public and industrial support of scientific research and development reached impressively high levels, and scientific journals were hard-pressed to keep pace with the output of the research system. At the midpoint of the decade, science and engineering are beneficiaries of a consensus conspicuously missing in other salient policy areas. In such a fortunate posture, the opportunities for the scientific community to employ its principal institutions in addressing emerging issues and dilemmas responsibly are not only clear but pressing. Through its journals, publications, meetings, and program initiatives, the AAAS can and does do its part.

At the year's end, the assets of the Association were sound. *Science*, the flagship of the AAAS, continued to anchor the well-being of the Association and to alert a worldwide audience to the progress of science and its evolving environment. *Science 84*, our general audience magazine of science and technology, again earned publishing honors and continued to attract a paid circulation of 700,000.

Links with our nearly 300 affiliated societies continued to be strengthened through joint activities extending to cooperative international programs, science policy projects, partnerships for science education and scientific freedom, and growing sponsorship of Congressional Fellows. The four Regional Divisions, including the newly initiated Caribbean Division, made tangible contributions to AAAS's geographical outreach and member participation. The willingness—even eagerness—of AAAS members to take a hand in the work of our standing committees—Science, Engineering, and Public Policy; Scientific Freedom and Responsibility; Opportunities in Science; Science, Arms Control, and National Security; Public Understanding of Science and Technology; Population, Resources, and Environment; Climate; Arid Lands; Finance and Investment—as well as the two Editorial Advisory Boards, the Committees on Council Affairs and Nominations, and the Section Steering Groups, is telling evidence as to the relevance of the Association agenda.

This upbeat review should not mask internal and external contingencies and unfinished business. On the internal side, the editorial achievements of *Science 84* (now *Science 85* and counting) have been sobered by a general decline of advertising revenues affecting most newly launched general magazines of science. Although *Science 84* has held its own, the situation has exerted a temporary strain on the operating budget. On another front, persisting postal rate increases coupled with dismaying increases in the prices of publishing materials have compelled us to raise member and subscriber dues, along with advertising rates. Dues increases, year after year, work against membership and circulation growth, and the circle is indeed vicious as well as relatively uncontrollable. We fight back through modernizing the publishing technology in cooperation with our printers and suppliers, but cost pressures have a way of outpacing savings.

Externally, the government's economic headaches leave in doubt the future course of public outlays for research and development. Whether the striking buildup of federal support for basic research can be sustained in the face of deficit reduction necessities is a very real question even though the Administration's commitment to science is beyond dispute. In the same vein, if some sciences should manage to be protected while critical areas of civil research and development—energy, the environment, agriculture, oceanography, aeronautics, and others—are targets for frugality, unhappy competition and scuffling could overtake us. The displacement impacts on core research and development of preemptive long-term military and space projects, in a context of prolonged budgetary rollbacks, have not been faced up to. Finally, the scientific enterprise is not out of danger from governmental controls on the open dissemination of information from unclassified research financed through federal contracts and grants. Overall, the good news associated with science and engineering has to be viewed with restraint.

At this writing, a changing of the guard is under way for our journal *Science*. In mid-1984, the Board of Directors persuaded Daniel E. Koshland, Jr., to accept the editorship upon the retirement, at the end of the year, of Philip H. Abelson after 22 years of exceptional service to AAAS and to science. While relinquishing the editor's chair, Dr. Abelson will not sever his ties with *Science* but will have a substantial role as deputy editor for engineering and applied sciences. It would be impossible to overstate the Board's satisfaction with this course of events, and it is hardly necessary to add that Dr. Koshland has the Board's unqualified support as he maps new editorial directions for the journal.

In the course of a busy and productive year, the Association has scored some noteworthy gains toward meeting the members' expectations. Selected highlights follow.

Science. Editor Abelson's aim to shape the content of the journal to future-oriented science took form in 1984 as four "special issues" devoted to Spacelab 1, Neurosciences, Instrumentation, and Materials Sciences. The 13 July issue included 36 Reports giving first results of observations made in the European-built Spacelab. The 21 September Neuroscience issue treated new results from recently developed techniques such as monoclonal antibodies. The Instrumentation issue of 19 October provided examples of new equipment that increases the sensitivity of measurement and makes feasible additional areas of research. The thrust of high technology is limited by the properties of materials, hence the special issue of 9 November sampled new developments including the effects on surfaces of laser and fast ion bombardment and the significant alterations in the interfaces among metallic crystals induced by the addition of small amounts of boron to metals.

In addition, *Science* in the first half of the year published most of the important research articles on acquired immune deficiency syndrome.

Science 84. Under Allen Hammond's

continued editorship, *Science 84* was again nominated for a National Magazine Award for general excellence, having won it twice in succession. The magazine reached its fifth anniversary, publishing its first "theme" issue, a 190-page overview of 20th-century science and technology.

International activities. Seventy affiliated scientific and engineering societies joined in the AAAS Consortium of Affiliates for International Programs, with the goal of intersociety cooperation and collaboration in international affairs. The focus in 1984 was on developing cooperative U.S.–Indian and U.S.–African initiatives. A number of the societies took part in a March planning workshop in Swaziland for sub-Saharan African scientific and engineering societies, and participated in a December African Regional Seminar in the Ivory Coast.

During 1984, the AAAS held six seminars for foreign science counselors and attachés posted in Washington, on topics that included science education, advances in immunology, and industry-government-university partnerships to advance engineering.

The Science, Engineering, and Diplomacy Fellowship program, supported by federal funding, enabled four Fellows to be selected from 65 applicants. The Fellows were assigned to bureaus in the Department of State and the Agency for International Development.

AAAS again took the initiative to staff a Continuing Committee of U.S. and foreign societies on the roles of scientific and engineering societies in development. A November meeting at the conference center of the Max-Planck Society near Munich had participants from North and South America, Europe, Africa, and Asia.

AAAS also serves as the secretariat for the Interciencia Association, a federation of associations of science in nine countries of the Western Hemisphere. Meetings were sponsored by the Interciencia Association in 1984 in New York City, Buenos Aires, Quirama, Colombia, and Mendoza, Argentina, with their primary focus on biological resources and biotechnology. Two new periodicals were launched, a biotechnology newsletter from Costa Rica and a biological resources bulletin from Bogotá.

The African Regional Seminar on the Role of Scientific and Engineering Societies for Development took place in Grand Bassam, Ivory Coast, in December, with more than 100 participants from sub-Saharan Africa, Europe, the United States, and international organizations. The seminar assessed opportunities for societies to contribute to development in Africa and formulated plans for pilot projects.

Bilateral cooperative programs of the AAAS in 1984 were primarily with the People's Republic of China, India, and the Federal Republic of Germany. Smaller but promising cooperative programs are being developed with Bangladesh, Sri Lanka, and Romania. Toward the close of the year, a working agreement was reached with the Hungarian Federation of Technical and Scientific Societies for cooperative exchanges.

The AAAS Committee on Climate undertook a peer review for the Department of Energy of 42 papers dealing with the issue of CO_2 effects, and is serving as the focus for collaborative efforts between U.S. and Indian societies to plan a 1986 international conference on climate and food.

A major new start began on a program on Population, Resources, and the Environment. It is an effort at examining scientific and policy issues at the intersections of these related areas. To lead this salient a new committee has been set up under the chairmanship of Dr. Roger Levien. At the year's end, AAAS was exploring possibilities for linking portions of this work with studies being undertaken at the Vienna-based International Institute of Applied Systems Analysis.

The international concerns of the AAAS extend, in a very serious way, to the vexing problems of arms control and national security. A major contribution to dialogue on these issues was the publication in *Science*, on the eve of Christmas 1983, of the multi-authored article on the "nuclear winter" effects of a limited weapons exchange. A Board-level committee of experts has supervised the preparation of a primer on verification in arms control agreements, which is to be published shortly. The committee sponsored a congressional seminar on verification in 1984, together with a series of well-attended symposia at the 1984 Annual Meeting. A substantial increase in the programs and activities of the committee will be initiated in 1985, with support from private foundations.

1984 was a banner year for publications and reports prepared under the auspices of the Committee on Arid Lands: (i) Cyrus McKell *et al.*, *Paradoxes of Western Energy Development: How Can We Maintain the Land and the People if We Develop* (Westview Press); (ii) Francis Conant *et al.*, Eds. *Resource Inventory and Baseline Study Methods for Developing Countries* (AAAS); and (iii) Lisbeth Levey, Ed., "Delegation Trip Report: Arid Lands in China" (AAAS).

The announced withdrawal of U.S. participation in Unesco clouds the future of present arrangements for international cooperation in science. While the Unesco venue has been a troubled and politicized one, it has served as a north-south bridge for science, the removal of which creates an array of problems and compels the substitution of alternative agreements.

Public-sector programs. For the ninth straight year, AAAS produced its unique special analysis and report on research and development in the federal budget, with robust support from participating affiliated societies. *AAAS Report IX: Research and Development, FY 1985*, was followed by a well-attended R&D Colloquium in Washington in March, and in December AAAS brought out its assessment of Congress's treatment of R&D budgets, *FY 1985 Congressional Action Report*. The reports and the colloquium now constitute the central core of AAAS's science policy research and reporting activities, under the guidance of the Committee on Science, Engineering, and Public Policy.

In addition, with sponsorship from the Environmental Protection Agency, AAAS followed up on a 2-year series of professional seminars on biotechnology by holding a workshop on EPA research plans related to biotechnology and the environment. A second seminar is planned for 1985 that will deal with environmental issues related to genetically altered viruses.

Assisted by the National Science Foundation, AAAS proceeded with a study of the effects on professional practice of educational programs in science, engineering, and public policy. AAAS also continued testifying to committees of the Senate and the House on legislative and funding issues. For the 12th year, the Congressional Science and Engineering Fellows Program kept its momentum, supported by 19 professional societies and the Office of Technology Assessment. Forty-two Fellows participated in 1983–1984. In addition, six Environmental Science and Engineering Fellows worked with EPA during the summer months on a striking range of environmental policy research problems. 1984 also was the tenth year of the Mass Media Science and Engineering Fellows Program, which placed 15 advanced students with mass media sites across the country. This unique program now is financed mainly by corporate sector contributions to the AAAS.

The AAAS–American Bar Association National Conference of Lawyers and Scientists continued to focus on interprofessional problems such as "Science and the Rules of Procedure" and "Release of Genetically Engineered Organisms: Law, Science, and Politics."

Public understanding of science. As scientific progress and technological innovation flood the society with opportunities, choices, and dilemmas, the AAAS takes seriously its responsibility to help explain "what's going on" to a public neither equipped nor accustomed to reading scientific and technical journals and magazines. By far the largest share of our operating expenses goes to publishing *Science 85*, which reaches 700,000 subscribers and newsstand buyers ten times a year and an estimated total readership of 1.5 million. But this is not the only communication tool we have.

The Annual Meeting, which migrates from one urban center to another from year to year, is an intense 5-day collage of more than 200 symposia running the gamut of fields, interdisciplinary research and development, and policy issues. It is an unmatched window on the American experience with science and technology—a window to the public and the nearly 700 science writers and other journalists who come to listen, question, and disseminate news and information. At the 1984 meeting in New York City, AAAS served this large contingent by providing advance information, setting up interviews, and scheduling press briefings. National Public Radio, funded by a private grant, gave in-depth coverage to the meeting.

AAAS likewise continued two radio programs in 1984. *Report on Science* is coproduced by AAAS and the CBS Radio Stations News Service and has an audience of some 5 million. In its fourth season, this program is a 90-second news feature with Allen Hammond, editor of *Science 85*, as host. A different program, *Focus*, is AAAS's 30-minute public affairs radio program carried on National Public Radio stations via NPR satellite. During 1984–1985 the program is being sent to an additional 150 public radio stations.

The quality and timeliness of media news and analysis is critical in improving public understanding of science and technology. The National Association of Science Writers and the Council for the Advancement of Science Writing are dedicated to the integrity and professionalism of science journalism, and the results are decidedly impressive. Each year the AAAS and the Westinghouse Educational Foundation make awards for excellence in science journalism in print, television, and radio categories, based on evaluations by independent judging committees of work nominated for the awards. We have found that excellence is an attribute of small-circulation publications as well as national dailies and news magazines, a fact that redounds to the credit of editors, publishers, and producers across the country.

Finally, in 1984 the AAAS developed a seminar program for university faculty on "Communicating About Science" and tested it with satisfying results at Ohio State University preparatory to extending it elsewhere. AAAS also joined with the Scientists' Institute for Public Information and the Association of American Universities in developing a Media Outreach Program involving media round tables on topics related to university research. This activity will be initiated in 1985.

External funds support. Because three-fourths of AAAS's resources from dues and subscriptions must be channeled into editing and publishing operations, which are dogged by inflation and rising postal rates, we depend increasingly on outside support for our programs and activities. Federal grants or contracts play an unquestionably helpful, but proportionately small, role consistent with AAAS's desire for policy independence. Foundation and corporate grants, supplemented by members' voluntary gifts, make up the difference. In 1984, some 48 grants and contributions came to over $1.6 million. In addition, the New York Annual Meeting Committee raised an unprecedented $216,000 for the meeting and post-meeting activities. Receipts from bequests exceeded $169,000.

The substantial private-sector assistance in 1984 has benefited AAAS programs in

- Science, Arms Control, and National Security
- Population, Resources, and Environment
- Precollege Science Education
- Mass Media Science and Engineering Fellowships
- Equity and Access for Minorities, Women, and the Disabled
- African Regional Seminar on the Role of Scientific and Engineering Societies in Development.

Scientific freedom and responsibility. The focuses of this set of program activi-

Table 1. Summary budget for 1985.

Major category of revenue	1985 revenue budget	Office/Center	AAAS funds	Direct grant and contract funds	1985 expense budget
Revenue (in thousands)			Expense (in thousands)		
Dues of annual members	$ 7,300	Executive Office	$ 1,366	$ 330	$ 1,696
Institutional subscriptions (*Science*)	2,080	Office of Administration	3,354		3,354
Science 85 circulation	9,467	Office of Comptroller	694		694
Advertising in *Science*	8,750	Office of Communications and Membership	1,511	21	1,532
Advertising in *Science 85*	5,407				
Grant and contract funds	3,728	Office of Development	107		107
Product sales	1,557	Office of Information Systems and Services	369		369
Investment income	1,500				
Annual meeting registration and exposition	343	Editorial Center—*Science*	11,392		11,392
		Editorial Center—*Science 85*	15,326		15,326
Contributions and other items	256	Meetings and Publications Center	1,057		1,057
		Programs Center	1,709	3,202	4,911
Subtotal—revenue	40,388	Contingency Reserve	250		250
Deficit—funded from reserves	300				
Total revenue	$40,688	Total expense	$37,135	$3,553	$40,688

ties in 1984 were upon national security and scientific communication, effects of secrecy on university research, and science and human rights.

- The AAAS Project on Scientific Communication and National Security, embracing efforts to monitor federal government activities in revising laws, regulations, and policy to restrict the flow of selected areas of U.S. technology and technical information overseas. An intersociety working group was organized to facilitate consensus and coordination of work to assess the effects of controls on scientific and educational activities. A chronology was issued documenting incidents where government restrictions have affected scientific and technical meetings or publications. AAAS initiated quarterly publication of the AAAS Bulletin *Scientific Freedom and National Security*, updating the status of pending statutory and administrative developments.
- With support from the National Science Foundation and the National Endowment for the Humanities, AAAS arranged a series of papers and regional seminars to examine the effects of secrecy and openness on the conduct of university research. The seminars were cosponsored by AAAS and science-and-society programs at the Massachusetts Institute of Technology, the Illinois Institute of Technology, Vanderbilt University, and the University of California, San Diego. Selected papers and commentaries are expected to be published in a special issue of *Science, Technology, and Human Values* in early 1985.
- The AAAS Clearinghouse on Science and Human Rights in conjunction with 40 AAAS-affiliated societies took up 148 cases of foreign scientists, engineers, and health professionals whose basic human rights had been violated or who had experienced governmental restrictions in their professional work. AAAS interceded on behalf of Andrei Sakharov and Anatolyi Koryagin, and the Clearinghouse monitored the status of Soviet scientists and engineers denied permission to emigrate.

In Central America, the Clearinghouse documented 18 cases of Guatemalan professionals who "disappeared" or were killed in 1983–1984. In El Salvador, the Clearinghouse and several medical societies made inquiries on behalf of Dina Rodriguez de Coto, a medical student who was detained with her family in 1983 and who was subsequently released from prison in 1984.

AAAS issued its *Report of a Fact-Finding Mission to the Philippines* in 1984 with the findings of a delegation sent to the Philippines in December 1983 to observe health and human rights conditions. The visit was sponsored by the AAAS, American College of Physicians, American Committee for Human Rights, American Nurses Association, American Public Health Association, and the Institute of Medicine of the National Academy of Sciences.

The preliminary report, *Medicolegal Aspects of the Investigation of the Human Remains of the "Disappeared" and the Identification of "Disappeared" Children in Argentina*, was issued, and the final report is near completion. This report contains findings and recommendations of a delegation to Argentina in 1984 to assist in identifying the remains of thousands of persons abducted and killed and later buried in unmarked graves from 1973 to 1983.

In other areas, the AAAS brought together representatives of 25 affiliated and nonaffiliated societies to review their roles in developing and implementing codes of ethics. The group reviewed guidelines for misconduct investigations, adjudication procedures, criteria for reviewing complaints involving charges of unprofessional conduct, and the development of new codes of ethics.

Opportunities in Science. AAAS's Office of Opportunities in Science seeks improvements in the participation in science by minorities, women, and the disabled. It has developed several networks with which it works actively: the National Network of Minority Women in Science; the Resource Group of Disabled Scientists and Engineers; and MESH-WORK, a network of minority mathematics, engineering, science, and health organizations. The Office also has vigorous and effective contact with federal agencies, notably the National Science Foundation, NASA, Department of Education, Smithsonian Institution, and WISE, an organization of women in science and engineering employed by the federal government. The methods used by AAAS include developing resources, providing direct referral services, and making presentations on behalf of minority, women, and disabled scientists.

In 1984, the Committee on Opportunities in Science established a task group on Technology, Education, Employment, and Equity out of concern that the introduction of technology in schools and the workplace has a differential and often negative impact on minorities, women, and the disabled. On the same theme, the Project on the Handicapped in Science works with the National Science Foundation toward assisting disabled persons to achieve higher levels of employment and education.

With Ford Foundation support, the Office is building the base of knowledge on minorities in mathematics. It is also working with AAAS Section A (Mathematics) to draw the mathematics community into efforts to increase minorities' participation and achievement.

Through the Office of Opportunities in Science, AAAS organized a delegation of disabled scientists and engineers to make presentations and exhibit technologies at the Second International Symposium on Design for Disabled Persons, held in Israel in late 1984. Likewise, a briefing was given on minorities in science for a delegation of scientists from the South-Central Institute for National Minorities in the People's Republic of China.

Science education. The AAAS has committed itself to a decade-long drive to raise the quality of precollege science and mathematics education, recognizing that the decentralized structure of education coupled with the conflicting claims on resources allocation make the problems difficult to address and resolve.

In 1984, AAAS's *Science Resources for Schools Project*, funded by Standard Oil of Ohio, developed and delivered packets of lively, activity-oriented science materials to middle schools in eight states on a five-times-per-year schedule. The participating states were Colorado, Ohio, North Carolina, Florida, Oregon, Pennsylvania, Texas, and Washington.

The *Challenge of the Unknown Project*, funded by Phillips Petroleum, is focused to help teachers capture student's interest in mathematics and problem-solving. It is structured around seven 20-minute films for middle-grade students and teachers. The films will be available to schools in the spring of 1985.

Although these two projects have been described with few words, they are challenging to conceive, produce, and launch, and AAAS's Office of Science and Technology Education has had its work cut out. It is also significant that the multimillion-dollar project costs are being met by two public-spirited petroleum companies that have recognized the criticality of the precollege education situation and have done something about it.

In the spring of 1984, the Carnegie Corporation generously funded AAAS to undertake the first 3 years of a 5-year project on school science and technology. This project is for an annual AAAS Colloquium on the status of science,

mathematics, and technology education which is expected to draw together leaders in government, industry, and education in assessing public and private responsibilities and strategies for school science and technology.

Following up on the New York Annual Meeting of the AAAS, in conjunction with the New York Academy of Sciences, eight science seminars for secondary school teachers were held, based on symposia from the annual meeting. More than 300 teachers responded, and each seminar was oversubscribed. Not all the news of precollege science education is doleful, and the best hope rests in motivated teachers.

Books from the AAAS. Three new books are in the process of publication, based on articles in *Science*. First in line is *Biotechnology and Biological Frontiers*. Next to come is *Neuroscience*. Later in 1985, *Astronomy and Astrophysics* will be published.

From *Science 84*, three more books have been, or will be, published. *Newton at the Bat*, based on the sports science columns, and *A Passion to Know*, based on profiles of scientists, appeared in 1984. *Songs From an Unsung World*, consisting of science poetry, is due early in 1985.

Other AAAS books, deriving from AAAS programs and activities, are also forthcoming. *Science as Intellectual Property* by Dorothy Nelkin was published in 1984 by Macmillan. *Science and Creation*, edited by Robert Hanson, and *The Recombinant DNA Controversy*, edited by Raymond A. Zilinskas and Burke K. Zimmerman, are due from Macmillan in the spring of 1985. *Scientists and Journalists*, edited by Sharon Dunwoody, Sharon Friedman, and Carol Rogers, will come from Macmillan later in 1985. *The Breaking of Minds and Bodies*, edited by Eric Stover and Elena Nightingale, is to be published for AAAS by W. H. Freeman, while *Verification and Arms Control*, edited by Richard Scribner, William Metz, and Theodore Ralston, will be published by Birkhauser-Boston. *Biotechnology and the Environment*, edited by Albert Teich, Morris A. Levin, and Jill H. Pace, will be published by the AAAS.

Regional Divisions. To the three Regional Divisions (Arctic, Pacific, and Southwestern and Rocky Mountain) that have provided geographic outreach for decades, the AAAS Council in 1984 added a fourth. The new Caribbean Division includes all the islands and countries in or bordering on the Caribbean Sea, including Mexico's Yucatán Peninsula. The Association welcomes the initiative by its members in the Caribbean region.

The Arctic Division held its annual meeting in Anchorage, and 150 papers were presented. A highlight was the symposium organized with the American Meteorological Society on "Meteorology and Oceanography of the North American High Latitudes." The Alaskan legislature funded a symposium on "Arctic Air Pollution," attended by villagers from remote areas. The Division applauded the action of Congress in adopting the Arctic Research Policy Act which the President signed in July.

The Pacific Division met in June at San Francisco State University with sizable attendance including a delegation from the People's Republic of China. Over 400 papers were presented in 25 symposia and contributed paper sessions, and Linus Pauling gave the Distinguished Members' address. The Division continued with preparation of volumes on *Late Cenozoic History of the Pacific Northwest* and *Phanerozoic Diversity*, complementing last year's publication of *Patterns of Evolution of Galápagos Organisms*. In press is a symposium volume titled *Biological Consequences of Mount St. Helen's Explosive Eruptions*.

The Southwestern and Rocky Mountain Division, with a membership of 13,650, held its annual meeting at Texas Tech University, addressed by Gerard Piel, AAAS president-elect. The John Wesley Powell Memorial Lecture was given by Mary K. Seeley of the Namib Desert Ecological Research Unit, on "New Science in an Old Desert." In all, 225 papers were presented in the Division's 13 Sections. The Division has five symposium volumes in preparation from its last three annual meetings.

The four Regional Divisions operate under bylaws approved by the AAAS Council, but are self-governing and are expected to shape and carry out agendas suitable to their regions. In addition, however, they are valuable sources of member feedback to the parent Association, and the diligence and creativity of their leadership have been admirable.

As this is written, on the eve of the second half of the decade, the advancement of science is unmistakable. The discovery process is on course, and its contributions to technology come thick and fast. As the national political system seizes upon the goal of restoring and sustaining U.S. technological competitiveness, while at the same time it seeks to enhance military and space assets while keeping new knowledge from benefiting adversaries, we need to remind policy-makers that American scientific and technological prowess is grounded upon an infrastructure of education, basic research, and openness, and that its renewal and replenishment ought to be the first priority in any agenda built on propositions of national interest.

In an era where science and racing technological drive occupy unaccustomed centrality in both the public sector and the market economy, it might seem ungracious to observe that scale and mass do not constitute ideal ends of the discovery process. Carried too far, scale can obscure the aims of science's search while excesses of mass can impose a heavy tax upon flexibility and the unimpeded marketplace of ideas. What bears thinking about is whether some of the forces presently in motion are leading in these directions and what, in time, may come of it. The platforms of AAAS are sturdy enough to bear the weight of this and other inquiries germane to the advancement of science.