1958 Parliament of Science

Conducted in Washington, D.C., 15–17 March by the AAAS, it offered these recommendations on education and the support of science

The power of man through science is currently assuming a new order of magnitude. Power has always been sought avidly. Sometimes it has been used disastrously; often it has been used wisely. How the United States shall keep abreast of the developments in science and scientific technology; how it shall help avoid disaster; how it shall ensure that new knowledge (the age-old synonym for power) will be used for the benefit of mankind in general and its citizens in particular are among the most important questions before the American public today.

But the American public is disturbed, worried, and confused. We thought we were well in the lead, scientifically and technologically. Now, all of a sudden, this comfortable assumption is challenged. We are "behind." It isn't clear just what this statement means, or whether the serious versions of its possible meanings are in fact true. But there is no denying the general concern, and the almost frantic determination to "do something about it."

The concern and the determination are, we believe, justified. But it is imperative that we sort out our ideas, brush off as superficial certain spectacular but minor items, and try to see our problem in its true dimensions.

Not long after the discovery of fission, we began to sense the fact that man's impending control of atomic and nuclear power made possible, and indeed made inevitable, the beginning of a new age. As the still more vast potentialities of fusion were made available for destructive purposes, and as it became clear that these incredible forces would presently be tamed for nonmilitary use, the magnitude of our break with the past became visibly greater and greater.

We are just beginning to see that even these advances, tremendous as they are, constitute the signal, rather than the substance, of what is to come. Our successful probing into the nucleus of the atom is but an example of the clear fact that science is entering a new and accelerated stage of advancement, which will give to man the possibility of control over his environment, over himself, and over his destiny, which we have as yet only vaguely sensed. With prospects that are —just as they were in the case of nuclear energy—both marvelous and frightening, we are on the threshold of an equally revolutionary probing of the cell and of the mind.

Man is breaking with the past, its limitations and its safeguards. The prize is greater than ever before—so are the risks. The question is not, "Do we like this?" The question is, "What role do the people of the United States wish to play in the drama of the future?" We cannot hide. We must not relax. How can we play a noble part?

What concerns us here is far and away larger than any question about a satellite, or even about a battery of long-range guided missiles, although these dramatic devices have precipitated discussion and have produced a readiness to consider drastic action.

We are in fact saying that man is on the very edge of a new relation to the atom, to the cell, to himself, and to the universe in which he is set. Many forces have been active, but clearly it is science which has been chiefly instrumental in bringing about this new relation. The new relation will place new demands on all man's resources—especially on his capacity to handle this new power with wisdom, restraint, and decency.

This scientific revolution will totally dwarf the Industrial Revolution and the other historical instances of great social change. It will be more compelling, and will pose more urgent problems, because of both the pace and the magnitude of the changes which now impend.

What faces man is not, in any restricted sense, a scientific problem. The problem is one of the relation of science to public policy. Scientific issues are vitally and almost universally involved. The special knowledge of the scientist is necessary, to be sure; but that knowledge would be powerless or dangerous if it did not include all areas of science and if it were not effectively pooled with the contributions of humanists, statesmen, and philosophers and brought to the service of all segments of society.

What is to be done? Scientists certainly have no arrogant illusion that they have the answers. But they do want to help. They are, moreover, convinced that the time is overripe for a more understanding collaboration between their special profession and the rest of society.

Because it is urgent for scientists to organize their own thinking about the problems raised in the preceding paragraphs, and urgent for society to understand those problems and their implications, the American Association for the Advancement of Science convened this Parliament of Science.

The Terms of Reference

The members of this Parliament—over one hundred working scientists representing all fields and all parts of our country, selected as the result of a democratic procedure which involved nomination by the sections of the AAAS and its affiliated societies—have agreed that the more detailed and more specific recommendations of the Parliament should all be viewed within the general context provided by the following statements:

A) Although science leads to a vast number of practical and useful results, and although we have not the slightest wish to minimize the importance of these practical results, nevertheless we wish to emphasize that science is, at base and in reality, a response of man's intellectual curiosity to the order and beauty of the universe in which he finds himself. It is by no means the only response to that order and beauty, and hence science feels itself allied with, not opposed to, such other responses as the arts and humanistic studies.

B) The pursuit of knowledge is an activity of the human race, not an activity of political subdivisions. As citizens we recognize that the hard realities of the present world sometimes require, or at least seem to require, certain restrictions on the complete international freedom of basic research. But we earnestly think that these restrictions are often wrong and futile. Furthermore, we wish to place a special, positive emphasis upon the kinds of scientific problems—the kinds

of international cooperation in science—which capitalize upon our universal common interests as members of the human race, such as our common struggle against disease and hunger. Scientists of all nations are engaged in a common enterprise. They are urged to take leadership in international understanding and thus to make progress toward permanent peace.

C) Many of the important—and especially the broad—questions concerning science and society do not usefully permit categorical or permanent answers. It is therefore not to be expected that our answers will always be a firm or fixed "yes" or "no." It is essential that there be flexibility within which can operate the evolving human judgments on individual problems, and within which can be preserved the variety which is so great a source of strength in our national life.

D) The statements which a competent scientist makes about his own special field are based upon the facts available to him and his interpretation of those facts. They deserve the respect of society as scientific statements, and deserve also the understanding of society that new facts may be found and new interpretations made. The statements which any scientist makes about matters outside his field of scientific competence should neither gain nor suffer from the fact that the author is a scientist. Such statements should be judged on their own merits.

The problems that were considered at this Parliament of Science are in part scientific and in part they depend on a wide variety of other considerations. The members of the Parliament of Science were trying to serve in the joint capacity of scientist-citizens, and were trying, in the case of each individual question considered, to illuminate the scientific issues as much as possible with a minimum of confusion due to our inevitable, and we think proper, differences of opinion on the social issues.

E) Not only does each answer to a scientific question characteristically lead to a series of new scientific questions, but scientific advances—as we are all aware these days—also give new and difficult form to certain problems in the social, political, and moral fields. It is futile to suppose that society can avoid these problems. As scientists we are concerned with the discovery of new truth. As scientist-citizens we are concerned that the power which this new truth brings be used wisely and decently for the welfare of humanity as a whole.

The Board of Directors of the American Association for the Advancement of Science, in session on the day following conclusion of the Parliament of Science, voted to express its satisfaction with the Parliament as a method of expressing the collective judgment of a representative group of scientists on matters of public policy, and to commend the recommendations of the Parliament to the attention of all scientists.

F) The strengths and the weaknesses of our scientific and educational systems reflect strengths and weaknesses existing in our political and social environment. The way science is used depends upon the values of the community. The climate of opinion about intellectual activities influences the progress of science, the uses of science, and the kind of people who enter science.

G) The freedom we cherish is served and strengthened by science. Science must also share in this freedom. In the long run it is not possible to have vigorous and imaginative science unless society is willing to provide a total climate, within which scientists work, which assures freedom of choice of problems, freedom to travel, freedom to communicate, freedom to disagree. There appear to be no qualifications to the choice here posed: a full intellectual freedom for scientists, or a weak and declining science.

H) Although this Parliament of Science quite properly concentrated on problems of science and public policy, and although some of the recommendations are quite specific to science, it must be emphasized that science represents only one part of intellectual endeavor. Both public policy and the welfare of science require an educational system that is strong at all levels and in all fields of knowledge. Efforts to advance science at the expense of other fields of learning would harm all fields of learning and the society they serve.

Reports on Specific Topics

The Parliament of Science addressed itself to five main topics:

I. *The Support of Science.* Discussion leader, William V. Houston, president, Rice Institute. Recorder, Mina S. Rees, dean, Hunter College.

II. *Organization and Administration of Science in Government.* Discussion leader, W. Albert Noyes, Jr., dean, Graduate School, University of Rochester. Recorder, E. R. Piore, director of research, International Business Machines Corporation.

III. *Communication among Scientists and Communication of Scientific Ideas.* Discussion leader, J. Murray Luck, professor of biochemistry, Stanford University. Recorder, Mary I. Bunting, dean, Douglass College, Rutgers University.

IV. *The Selection, Guidance, and Assistance of Students.* Discussion leader, Henry Eyring, dean, Graduate School, University of Utah. Recorder, Harry C. Kelly, assistant director, National Science Foundation.

V. *The Improvement of Teaching and Education.* Discussion leader, George W. Beadle, chairman, Division of Biology, California Institute of Technology. Recorder, James F. Crow, professor of zoology and genetics, University of Wisconsin.

In addition to over one hundred scientists who attended the conference, a number of representatives of other professions, and activities (politics, business, law, religion, labor, mass media of communication, other academic professions, etc.) were invited to attend as regular working members of the meeting. The scientists particularly appreciate the interest of those who accepted the latter type of invitation. Although the public representation was not as large as had been hoped for, it was most encouraging and helpful.

Over sixty accredited observers, representing a wide variety of academic, industrial, governmental, and other research agencies, attended the sessions and contributed greatly by their presence and by their participation in the informal parts of the discussions.

After an opening, general session, the groups considering the five topics listed above met separately in at least two extended sessions. Their reports were then brought before two successive sessions of the entire Parliament. Since the five groups worked quite separately, their individual reports took somewhat different form. It has seemed neither necessary nor useful to bring them to a uniform format.

Reports of the five discussion groups were presented to the entire Parliament in an afternoon session on the second day and were voted on in a concluding session on the third day. Few votes were unanimous, but few departed greatly from unanimity. Items on which the vote was substantially split are identified, and the vote is given, in the following sections, each of which reports the recommenda-

tions of the Parliament on one of the five general topics considered. Some of the recommendations are addressed to scientists themselves; others are addressed to the Federal Government, to fund-granting agencies, to the press, or to the public.

Report of Section I, The Support of Science

The well-being of man, his health, and his security depend now as never before upon science, and society recognizes the value of science by these tangible results. If these useful results are to continue, it is imperative that science have a strong foundation of basic research, the untrammeled exploration of the universe and of man in the universe. If basic research is encouraged to grow steadily and healthily, useful results will inevitably follow.

Research must be supported in two ways: first, by general recognition that learning—all learning—is a high calling, to be respected; second, by money. But simply more money is not enough. Funds must be provided under conditions that encourage and support creativity. Support for basic research in universities must be provided in ways that maintain a system of diverse and free institutions and in ways that maintain within universities a balance between the research function and the interlocking teaching function. Universities should be models of freedom in our society where free inquiry and free expression in the arts and the humanities, as well as in the sciences, can go forward.

These objectives can be most effectively sought through a mixed private-governmental system of support designed to bring the diverse judgments of large numbers of wise people to bear on a continuing series of difficult and significant problems.

The main sources for the support of basic research are government, industry, foundations, and universities. Whatever the source of support for research in universities, it is important that this support be given in such a way as to (i) maintain the institution's autonomy; (ii) give freedom to the research worker to choose his own area of research, and provide flexibility to enable him to move from one problem to another as his results warrant or his interests shift; (iii) provide continuity, stability, and other conditions that enable research men to devote their time and energy to research.

(*Note*: The following recommendations apply particularly to universities. This emphasis resulted from the necessity of confining discussions to manageable scope; participants were well aware that much research is carried out in industry, government laboratories, museums, biological research stations, and other agencies that are not connected with universities, but did not have time to consider adequately the special problems of support of research in these agencies.)

Recommendations. 1) Science should be supported on a greatly expanded scale. In using these increased funds, science-supporting agencies, scientific societies, government and industrial laboratories, and universities are urged to find ways of recognizing and encouraging exceptional creative ability and significant productivity.

2) To attain a more productive balance among fields of science in this country, additional funds for large and expensive research undertakings in the biological and social sciences are imperative. Only in this way can the full opportunities arising from the balanced growth of science be realized.

We take particular note that one result of some recent applications of science has been the creation of hazards to human welfare which we are not yet able to understand or control, with the consequence that we are now handicapped by our ignorance concerning many biological questions which have taken on great urgency. Certain studies—for example, large-scale investigation of biological processes in controlled environments such as the genetic and pathological effects of long-continued but small radiation exposures—will require massive expenditures on a scale which has heretofore been restricted to certain aspects of the physical sciences.

3) If we are to increase our scientific efforts, universities as a whole must be strengthened. We favor unprogramed grants made on the basis of carefully devised plans, subject to review after a period of years, and available for the support of research and the training of graduate students in a designated area, rather than on a specific project. Research functions at such institutions cannot be separated from teaching functions.

4) It is essential to maintain and increase the diversity of sources of governmental and private support for basic research. Such diversity of sources provides a way to secure diversity of judgment and to maintain freedom.

5) We favor prompt and thorough consideration of the possibility of carrying out adjustments in the tax structure of the nation which would increase the amount, diversify the sources, and equalize the cost to contributors, both corporate and private, of the support of education and research. (*Note*: This recommendation was approved by a vote of approximately three to two. The proportion of negative votes was greater than that for any other recommendation. It was noted by the participants that a study of proposed tax changes was being conducted for the AAAS.)

6) Scientific development would be accelerated if a greater proportion of the total research and development funds were invested in basic research. In the anticipated period of rapid scientific advance, the demands of development make very clear the underlying need for increased emphasis on basic research in sciences and engineering.

7) In the appropriation of funds for the National Science Foundation, care should be exercised to ensure that the support of basic research is not subordinated to programs in support of education in the sciences.

Two points should be made: (i) The training of young research men is significantly advanced by their participation in research projects. Moreover, research grants increase the effectiveness of personnel needed not only for research, but also for teaching. (ii) A large expansion of the fellowship program imposes a financial burden on the universities. This needs to be compensated by grants to the universities covering the full cost, just as research grants should provide for full coverage of indirect costs.

8) The government has the responsibility for ensuring adequately broad support of research by stimulating other sources of support and supplementing them. We favor a decision at the highest levels of government which would establish a stable base in terms of which the core amount to be provided by the Federal Government may be predetermined, but may be subject to review and reappraisal at intervals. This is peculiarly needed in the support of research where effective use of funds requires assurance of continuity and stability.

9) In general, close and effective contact, both intellectual and geographic, should be maintained between research institutes and universities to assure maximum utilization of research facilities for the training of graduate students. But when there are obviously special needs of equipment and location, as in astronomy, research institutes separate from universities are justified.

10) The welfare of the sciences must not be secured at the expense of other segments of the university.

Report of Section II, Organization and Administration of Science in Government

Section II was assigned the very broad topic of "Organization and Administration of the Nation's Scientific Effort." This problem is so vast that the section felt that of necessity the topic had to be delimited in some way. Since planning on a national scale must be done mainly by the Federal Government, and since a large part of the financial support for research comes from Federal sources, the section addressed itself mainly to the problems of the Federal Government. Time did not permit consideration of the important roles of private agencies and of local and state governments.

When one speaks of broad-scale planning for the national organization for science, one must include not only a determination of the broad fields which should receive support but also the problem of proper utilization of the scientific manpower that will come in increasing numbers from the colleges and universities.

Recommendations. The actions taken by the group may be divided into the following headings:

A) A means of providing advice to the top-policy levels of government, as well as the planning for expenditure of large amounts of money and for the coordination of government research activities.

B) Contract and Civil Service laboratories.

C) Research laboratories and institutes.

D) The organization of research and development in the Department of Defense.

A) *Scientific Advice—Scientific Planning on the National Scale.* Science and technology have an impact on national policy both domestic and foreign. Science and technology are supported by the government both within government and outside of government. Furthermore, science and technology are utilized by government to perform its functions. Both functions require planning and coordination in the operational sense and in fact require planning on a national scale.

11) The group felt, in regard to the impact of science and technology on national policy, that this requires representation of science and technology at highest levels in government where such national policies are formulated. Such representation will also provide the necessary interpretation in the evolution of national policy for science and technology.

12) The present plan with Dr. J. R. Killian, Jr., as special assistant to the President does seem to furnish the necessary high-level representation, and we strongly endorse the continuation of such an arrangement.

13) The establishment of a department of science which would have jurisdiction over all scientific activities of the government is undesirable at this time because: (i) Many scientific activities of the government are integral parts of the missions of existing departments and should remain within those departments. (ii) To set up a department of science for basic research alone is undesirable since it would segregate exactly those parts of science least relevant to political issues and place them under the direction of a cabinet officer who is automatically and properly a political appointee.

14) We recognize and endorse the importance of the National Science Foundation in coordinating basic research among all agencies, both governmental and nongovernmental.

15) The role of the National Academy of Sciences–National Research Council as nongovernmental agencies through which advice to the government is rendered upon its request is strongly supported.

16) The group addressed itself only to the basic research aspects of science and technology. The various departments and agencies in government that support or perform research should continue to be free to engage in basic research as they recognize needs related to their operating responsibilities. As over-all funds for research increase, it will be necessary to do more planning and give closer scrutiny to national policy. By statute, the National Science Foundation has been given major responsibility for formulating national scientific policy. This function will become more important as the availability of funds increases. In addition to expanding the horizon of national planning, the NSF should encourage support for research in universities and research institutions. The procedures to be used in making funds available may require modification to give more flexibility to those performing the research. This can be accomplished by permitting the Foundation to use its judgment regarding allocation of appropriated funds, rather than by following the present procedure, in which the Bureau of the Budget and the Congress must give approval to specific items.

B) *Contract and Civil Service Laboratories.* The group discussed the general problem of research laboratories operated by contract, as for example under the Atomic Energy Commission, and those operated by the government under Civil Service. This dualism creates different salary scales and different modes of operation.

Both types of operation seem to have their proper place. Although some high-grade research laboratories are operated within the government framework, all suffer from the hampering influence of Civil Service personnel policies and regulations.

17) Basic research should be carried on in government laboratories, partly because basic research is often a necessary prerequisite to applied research and partly because some basic research will be necessary if personnel of high quality are to be secured and retained.

18) It is highly desirable to organize retirement plans, insurance benefits, etc., so that a given individual may transfer from university to government and vice versa in middle life without danger of losing such benefits. The same problem arises between universities and to some extent between both government and universities and industry.

C) *Research Laboratories and Institutes.* The group discussed at some length the need for new research laboratories and institutes. Separation of basic research from teaching is on the whole not advisable, although for specific problems it may from time to time be necessary to create new research institutes.

Agreement was reached on the following points:

19) An increase in the number of universities with strong research programs and training at the graduate level is highly desirable. In increasing the number, it is particularly important to widen the geographic distribution of such universities.

20) Increased staffs, with teaching loads so adjusted as to encourage research, are essential. Funds for capital expenditures for buildings and equipment must also be found.

21) Research centers should wherever possible be associated with the teaching function.

D) *Defense.* The group discussed at some length the problem of research in the Department of Defense. The problems which affect the type of research and the recruitment of personnel in defense establishments are numerous.

The group as a whole accepted the following points:

22) The structure of research and development in the Department of Defense should be subjected to continuous reexamination.

23) Able administration of research must be ensured, possibly by career officers who are not subject to frequent rotation but more probably by civilians who would be allowed to attain high administrative posts.

24) Decision between contract and civil-service operation was not made. Each probably will be necessary for certain specific problems, but government operation not by contract will be essential for many installations.

25) The following points should also be stressed: (i) Greater continuity of budgets is desirable. (ii) Greater responsibility for programing should be placed on operating agencies. (iii) Special agencies may be created for specific or crash programs.

Report of Section III, Communication among Scientists and Communication of Scientific Ideas

The problems of communication are considered under two headings: (i) communication among scientists and (ii) communication between scientists and the public.

The following recommendations are directed in some cases to scientists themselves, in other cases to the government, to fund-granting agencies, to the press, or to the general public.

The following propositions provide a basis for specific recommendations.

A) Communication among scientists and between scientists and the public is an essential part of research.

B) It is important that the findings and conclusions of the scientist be presented as effectively as possible to both groups.

C) Agencies supporting research have a responsibility to contribute to the cost of publication and to the cost of personal contact among scientists at local, national, and international levels. These two types of communication are important contributions to the development and use of new knowledge.

D) It is to the public interest that every effort be made to preserve and strengthen those freedoms which are universally recognized as essential to the pursuit of study, research, and communication.

Recommendations concerning Communication among Scientists. 26) It is recommended that scientists themselves improve the presentation of papers by use of clear, vigorous English with correct technical terms and nomenclature, and improve the quality of what is communicated by supporting critical and responsible editorial policies in scientific periodicals. To this end we urge more systematic attention to expository writing on the part of graduate students in science.

27) It is recommended that research-supporting agencies: (i) Provide financial support where it is needed to ensure that publication is not withheld because of lack of funds; (ii) Recognize that monographs, abstracts, indices, reviews, compendia, books, bibliographies, and proceedings of symposia are important means of communication and that scientists should be supported in their preparation. (iii) Encourage and support scientific meetings as an effective method for the exchange of information and the education of young scientists and the public, and small seminars (of sufficient duration for effective communication) as an essential method of communication among research scholars. (iv) Provide adequate support for research on new devices for recording, storing, and retrieving scientific information.

28) It is agreed that the emergence of Russian as an increasingly important language makes it essential to provide translating services and to encourage universities to offer instruction in this language.

Recommendations concerning Communication between Scientists and the Public. In the past, progress in scientific research has been paralleled by similar progress in communications between scientists and the public. This has been marked by a gratifying improvement in the relationships between many scientists and many science writers and a growing understanding by each of these groups of the problems and responsibilities faced by the other.

More significantly, this advance in communication has led to a growing appreciation and understanding of science by the public. In the past this has been desirable; today it is essential. Without public understanding of science in a democracy, neither democracy nor science can hope to survive.

Where do we stand now? The facts are more encouraging than many scientists realize. Recent data clearly indicate that news of science is already read widely by the public, that there is a firm demand by readers on all educational and economic levels for more science news, and that public understanding of the scientist and his work is becoming increasingly accurate and realistic.

These same data make it clear, however, that the problems of communication between scientists and the public have not been entirely solved. Further progress depends on increased participation of scientists in helping to clarify scientific achievements and their social consequences. This in turn requires the further understanding and acceptance by scientists of certain basic concepts of communication.

These are: (i) The work of the scientist is not truly completed until its significant results are communicated not merely to other scientists but to the public at large. (ii) In communication between scientists and the public, full use should be made of all media of public information. (iii) In developing communication between scientists and the public, the major role must be undertaken by science writers or other interpreters with professional training and standards. This does not absolve scientists of their responsibility to communicate directly with the public when they can do so. (iv) Scientists have not merely the right but the obligation to speak out against quacks, charlatans, and pseudoscientists. (v) Except when necessary for national security, governmental censorship and restrictions on the dissemination of information in science are destructive, wasteful, and intolerable in a democratic society.

Acceptance of these principles logically suggests the following specific actions for their prompt implementation.

29) Since there is an increasing need for skilled science communication, scientists and their organizations should assume part of the responsibility for training science writers in both government and private research facilities and universities. Specifically, the American Association for the Advancement of Science and other representative scientific organizations should cooperate formally with the National Association of Science Writers and other agencies now conducting such training programs. In addition, enabling legislation is recommended so that funds may be provided by such appropriate agencies as the National Science Foundation and the National Institutes of Health to assist in these training programs.

30) Scientists and their organizations

should join actively in the efforts of the American Society of Newspaper Editors, the American Bar Association, and other agencies now concerned with reducing governmental secrecy and protecting the public's right to know.

31) In addition to utilizing standard mass media of communication, individual scientists and their organizations should make increasing and experimental use of other means of contact between scientist and the public—in adult education programs, local discussion groups, and science fairs. Specifically, for example, the AAAS and the international scientific unions are urged to cooperate in the sponsorship of such appropriate ventures as the forthcoming World's Fair of Science.

32) In order to facilitate wise public decisions, scientific organizations have the responsibility to present, where possible, evaluations of available facts on controversial public problems involving the social consequences of their fields of activity. Science does not speak with a single voice; in many cases there will be divergence of opinion among scientists themselves. Yet it is desirable to reduce, not increase, public confusion. One recently attempted solution is the appointment by scientific organizations of expert committees to clarify for the public the evidence and the possible interpretations of its meaning. Other solutions must be sought.

Report of Section IV, The Selection, Guidance, and Assistance of Students

The advance of education is dependent upon support for faculty and institutions as well as for students.

We recognize the need for increased support for students in all fields of educational endeavor. Therefore funds must be provided not only for the support of students in mathematics, the natural sciences, and technology but also for those in the humanities and the social sciences.

All citizens should have an opportunity to become familiar with the processes, procedures, and findings of scientific endeavor. This requires education of all students to the full potential of their talent and motivation both during school years and thereafter.

Recommendations. 33) The Federal Government should not assume the entire burden of the expanding education program. It is essential that states and local communities and other agencies recognize their responsibilities in promoting and improving the entire educational effort.

34) Support and encouragement for high quality education in the sciences is needed at all levels of education.

35) Programs of counseling, guidance, identification, and motivation of talented students should be developed through the cooperative efforts of institutions of higher learning and elementary and secondary schools.

36) There is a serious shortage of counselors. We recommend that both "short term" and "regular" institutes for counselors and teachers be supported by grants from the Federal Government.

37) Testing for identification of abilities and for guidance should begin in the elementary school and should be a diversified and continuing process. Responsibility for testing rests with states and localities, but Federal support should be available, where necessary, to get such testing started.

If there are Federal scholarships, selection of recipients should be made at the state level, using tests as one factor.

38) At best a federal undergraduate scholarship program for high school seniors is only one facet of the necessary support of education. It carries within itself the danger of concealing other essential steps.

39) Scholarships and fellowships, the cost of which is defrayed from Federal funds, should be awarded solely on the basis of merit. In a federal scholarship program there should be no restriction upon choice of specialty by the student.

40) Fellowship programs in science should recognize the importance of complementary fellowships in the humanities and in the social sciences.

41) Fellowship and grant programs should be made realistic in terms of support to the fellows, their families, and the institutions they attend.

42) A satisfactory fellowship program depends upon the quality of teaching and on the institutional resources. This quality varies greatly in different institutions. Therefore, cooperation among educational institutions should be encouraged to develop their different strengths.

43) Students' interest and competence can be enhanced by a variety of means in addition to scholarships. For example: (i) Summer institutes in science, mathematics, social sciences, and the humanities for superior high school students should be organized and operated by colleges and universities. Desirable summer institutes for high school students can be provided through demonstration classes such as are now supported by the NSF at some institutes for teachers. Selection for a summer institute is one means of rewarding intellectual achievement and of motivating students toward scholarly activities. (ii) Schools and colleges should emphasize programs which permit gifted students to learn more and to benefit by each other's intelligence and by superior teaching. Offering college level work for superior high school students is one means to these ends. (iii) In addition to training the critical faculties of students, more emphasis should be laid on the development of the creative and imaginative capacities.

Report of Section V, Improvement of Teaching and Education

We believe that the primary goal of education should be the intellectual development of the individual. With its accelerating importance in our society, science has become an increasingly important part of general knowledge. We believe that scientific education is best fostered as a part of a general emphasis on intellectual activity and that the pressing need is for increased support of the social sciences and humanities as well as the natural sciences.

Curriculum. 44) *Science Teaching.* The teaching of science should give due emphasis to the nature of science itself. It should not be simply a collection of facts. It should show the way in which scientific conclusions are drawn by rational processes from observations and should emphasize the tentativeness of these conclusions. It should keep alive that curiosity and enthusiasm for learning which are so necessary for all intellectual pursuits.

45) *Research in Education.* We recommend the support of research designed to improve the methods of attaining the educational goals set forth in the two preceding paragraphs.

46) *College Entrance Requirements.* We believe that education in science, mathematics, and other subjects could be improved by generally raising university and college entrance requirements. This should be done in consultation with secondary schools so that the requirements can be based on mutual understanding.

47) *Special Schools.* We oppose the creation of a special "West Point of Science" or any federal educational institution devoted solely to science training.

48) *Students of Exceptional Ability.* We urge that efforts be made to recognize at an early age students with high intellectual competence and that opportunities be made available for them to receive education commensurate with their abilities.

49) *Languages.* In view of the crucial role that languages play in scientific communication, because of the great increase in international travel and communication and because of the ease with which languages are learned by the young, we urge that foreign-language instruction be made available to students in grade schools and be strengthened in high schools and colleges.

Teaching. 50) *Salaries and Recognition.* The urgent need to develop fully the intellectual resources of our nation requires a prompt and thorough recognition of the basic importance of education in our society. Our schools and colleges will be able to contribute fully to the solution of the problems that now confront us only if the improvement of the teaching profession is accorded a high priority among our major concerns. We must compensate teachers at levels which reflect the degree to which the destiny of the nation depends on teaching of the highest quality. Only through such a realistic approach can we hope to solve the quantitative and qualitative shortages which now seriously limit what schools and colleges are able to accomplish.

Preparation and Certification of Teachers in Elementary and Secondary Schools. 51) We recommend that the minimum requirements for academic subject courses for the certification of science teachers be raised to such a level that the teacher has a reasonable mastery of his subject.

52) We recommend the continuance and expansion of teacher training programs, such as those sponsored by the National Science Foundation. We urge state and local groups, both public and private, to lend their support, financial and otherwise, to programs that increase the subject-matter knowledge of people now teaching science.

53) We recommend that credit toward professional advancement be given to postgraduate work in academic subjects related to the teaching field even when these do not carry graduate credit or count toward a graduate degree.

54) We recommend that universities and colleges develop master's degree programs in sciences which are specifically designed to meet the needs of teachers.

55) We believe that in many cases it is possible to reduce the number of hours in professional education courses required for certification or graduation, and that the corresponding increase in opportunity for other courses would improve teaching effectiveness.

56) We recommend that certification requirements in the several states be revised to make it possible for a college or university to prepare teachers for any state, and to facilitate the movement of teachers from state to state.

57) We recommend that scientists and scientific organizations take the initiative in cooperating with various state and local groups concerned with primary, secondary, and college teaching.

58) *Merit Increases.* We believe that in principle merit salary increases are desirable. A carefully administered system of salary increases based in part on merit is one means of increasing the attractiveness of teaching careers for students of superior competence.

59) *Use of College and University Students in Teaching.* We believe that a potential reservoir of teaching talent lies in college and university students. We recommend that ways be found for using such students of special ability in various ways, such as in summer institutes for gifted secondary school students.

60) *Science Supervisors.* We recommend that in each state there be one or more scientifically qualified science consultants or supervisors in departments of public education or universities to have such functions as (i) representing science and scientists in the formation of educational policy; (ii) serving as a liaison between scientists and teachers; and (iii) collecting and distributing to teachers information helpful in science instruction.

Priorities. 61) It is the sense of this group that federal and other funds for improvement of science education be assigned priorities as follows: (i) improvement of education and encouragement of teachers by better salaries and opportunities for further learning; (ii) new construction, facilities, and equipment; (iii) scholarships.

General Conclusions

Under the auspices of the American Association for the Advancement of Science, a representative group of over 100 American scientists and public leaders met in Washington on 15–17 March 1958 to consider current and pressing problems of the support of science and the improvement of education. These problems in large measure have resulted, directly or indirectly, from the rapid expansion of scientific knowledge and its technological application. This Parliament of Science reached a number of conclusions which are set forth above. Underlying the specific conclusions are a much smaller number of general principles upon which the participants agreed.

1) Scientific endeavor is one phase of human intellectual effort; the degree to which it flourishes depends largely upon the extent to which intellectual effort generally is supported and encouraged.

2) Optimal progress in science requires increased support for basic research.

3) As funds for the support of science increase, it becomes increasingly necessary to formulate appropriate plans and procedures for the administration and correlation of the total scientific effort and to give closer scrutiny to national scientific policy.

4) In order that science may progress most effectively, and in order that science may be wisely used for the improvement of human welfare, scientists must have the maximum possible freedom to communicate with each other, both in person and by publication, and to communicate with the public.

5) Scientists are dedicated to the finding of new knowledge. As citizens, they have the responsibility to concern themselves with the social consequences of their scientific findings and to inform the public of the consequences they foresee.

6) The primary goal of education is the intellectual development of the individual. The primary need of education is to employ quality and to raise standards—of teachers, of curricula, and of what is expected of students.

7) In the assignment of funds to the improvement of education, first priority should go to improvements in curricula, teaching, and the status and salaries of teachers.

The Parliament of Science sponsored by the American Association for the Advancement of Science illustrates a way whereby scientists may appropriately consider the social consequences of their findings. Future conferences of a similar sort could further explore problems of science and public policy.