Meetings

Science and the Future: American and British Associations Meet

Twenty-nine scientists invited by the American and the British Associations for the Advancement of Science* met from 13 to 19 April in the cubistic red building of the National Center for Atmospheric Research, on a mesa overlooking Boulder, Colo. The group examined problems and issues that are likely to influence the course of science in the coming years. They used these discussions as a basis for a consideration of future responsibilities of associations for the advancement of science. In order to enlarge the perspective from which these questions were examined, the conference included several specially invited scientists from countries other than those of the host associations.

A sense of deep concern over the changing attitude of the public and of scientists themselves toward science and technology pervaded the meeting. There was more stock-taking than crystal-gazing, more thoughtful meditation about the present than brainstorming about the future.

Continuing advances in knowledge can be expected in the next few decades, but it was generally agreed that, for the purposes of the conference, the specific nature of these advances would be less important than the changes expected or sought in the organizational arrangements and the social and economic conditions involved. The relatively small fraction of the total world scientific effort that now comes from India, China, and the underdeveloped countries will probably increase. Although that increase will be small in the near future, the trend raises questions about the increasing mobility of scientists and the future of traditional forms of communication through papers, journals, and meetings. Moreover, the trend will complicate—but make more necessary—the creation of internationally satisfactory solutions to the problems of organizing, storing, and utilizing a rapidly increasing fund of information.

Both on these points and also on the questions of technological development, the future seems to depend on how social institutions are changed. There was disagreement about how ready the social sciences are to provide dependable and widely useful knowledge about how to change social institutions and customs. However, some members felt that the social sciences are on the verge of a takeoff, and that an intensive exploration of the rigidities, bureaucratic barriers, and social and institutional deterrents to innovation and to the greater and faster constructive utilization of new knowledge would be useful.

It was generally agreed that, in the developed countries, the rate of growth of science and technology is slowing and it is near the inflection point of the curve of expansion. The increase of 15 percent per annum in the support of basic science now needed to match inflationary costs and to equip and support the growing scientific manpower clearly cannot continue for more than a few more doubling times of 4.7 years without consuming the entire gross national product. Other factors that will limit, or at least modify, scientific growth are the sheer volume of scientific information, the ever-increasing specialization of the modern scientist, the rapid rate of educational obsolescence, and a disproportion between the promises of the scientists and their realizations. Other factors are a lack of coupling of science to human needs (for example, the United States, while having the very best in medical resources, ranks 15th among the nations of the world with respect to infant mortality), an inefficient, trickle-down mode of communication between academic and applied science, and, last but not least, the resistance of the public to further increases in expenditure.

It is becoming increasingly clear to the public that the mere capacity to manipulate the world by no means ensures that this will be done for the net benefit of mankind. The long-term, negative, unanticipated side effects of the introduction of insufficiently tested technological developments into the social and political economy have adversely influenced the image of science and technology in the United States. Direct experience with the discontent of students, who so often reflect in anticipatory fashion the trends in the public mind, suggests that science in the United States no longer gives many individuals a satisfyingly coherent and unified picture of the world. The apparent collusion between some technologists and the military-industrial complex in the United States has raised grave doubts about the motivations of technologists, and even of scientists, although it appears clear that there has been little direct collaboration between university scientists and the military. Concomitantly, there is a growth of antirational activities, as witnessed, for example, by the increasing interest in astrology; in the United States, there are 10,000 persons who make a living in this activity, while there are only 2000 professional astronomers!

The situation with regard to science in the developing countries is entirely different. The 33 "more developed" countries include only 31 percent of the world population but spend 97 percent of the total expenditure for research and development and possess 91 percent of the qualified scientists and engineers. Even though some of the aforementioned growth-limiting factors affect primarily the relatively few people working in the "scientific desert," there has not developed in those parts of the world an antagonism of society

* Participants from the BAAS were: Ian H. Cox, N. L. Falcon, Dennis Gabor, J. H. Humphrey, Kenneth Hutton, Kathleen Lonsdale, and Henry D. Turner. Participants from the AAAS were: Philip H. Abelson, Lewis M. Branscomb, Edward U. Condon, James D. Ebert, H. Bentley Glass, William T. Kabisch, Robert Morison, Mina Rees, Walter Orr Roberts, Jack P. Ruina, Carl Sagan, Athelstan Spilhaus, and Dael Wolfle. Additional participants were Stevan Dedijer, Sweden; J. T. Gunther, New Guinea; A. F. Gurnett-Smith, Australia; J. O'Neil Lewis, Trinidad; Marcos Moshinsky, Mexico; Marcel Roche, Venezuela; O. M. Solandt, Canada; Hugo Thiemann, Switzerland; and V. A. Venikov, U.S.S.R.

toward science; the attitude is either one of indifference, as in the past, or of definite enthusiasm for science and technology.

Continuous growth of the gross national product was denied by some as representing an essential sign of health, and most thought that growth should be better controlled and directed. On the other hand, it was argued that growth is a built-in aspiration of human beings and that an increase in the gross national product augments freedom of choice and the possibilities for self-expression. One participant described his own "private Utopia" as being one where there would be smaller populations, less growth, more respect for intellectual and artistic development, and less consumption.

Science continues to be the greatest triumph of human imagination, and, although its applications may have given rise to many failures, the dignity of man has been increased by the many choices for self-realization that technology has afforded him. It was generally agreed, however, that the trend from now on should be toward less absolute freedom and *laissez faire* than in the past. The proposition that scientific priorities need to be determined implies that society already has some goal, however broadly conceived. A broadly acceptable goal would be "to give all human beings maximum possibility for constructive self-realization." This implies that the self-destruction of human society must be avoided. Designs of national goals in science and technology should be formulated in consultation with scientists, and these goals should be directed toward human needs. A full-scale study of the relation of growth in science to technological improvement, population size, and rate of population increase clearly seems needed, and the creation of an agency to forecast as early as possible the effect of technological changes on society might be indicated. A research strategy at the national level, in both developing and developed nations, with model building and better coordination between the different areas of pure and applied science would be useful.

In the design of stricter strategies for science in the face of increasingly limited funds, decisions based on policy rather than on conflicting pressures and interests must be used. Pure science, that is, research not directed toward preconceived technological aims, must be carried out, in both advanced and developing countries, as part of the cultural creative life of society because pure science is often the source of unforeseen technological advances. The choice of which individuals to support in this activity should be the responsibility of the scientific community, once the global sum dedicated to pure science has been decided upon. These choices should not be determined by national technological goals.

The bulk of the moneys allotted to research should support work applicable to human needs, according to predetermined strategies. A conscious and penetrating attempt should be made to avoid directions likely to produce markedly negative side effects. The AAAS and the BAAS should assume responsibility for sharpening the issues and putting them before the public and before those in the government who must make the final decisions. The role of the associations, in that sense, should be primarily that of explaining, in terms which the government and the people can understand, what are the foreseeable consequences of different technological applications, and of indicating, when necessary, what further research and analysis is needed in order to foresee the consequences better. The associations could act chiefly through the appointment of committees to analyze the issues and to develop the facts and formulate recommendations which, while not binding upon the associations as a whole, would yet serve to influence decisions.

Further improvement in education as a means of bettering the present situation was emphasized. Continuing education throughout life, such as the Japanese are now providing for teachers, was advocated. The narrowness of specialization should be reduced, and generalists with Montaigne's *tête bien faite* rather than *tête bien pleine* should be produced, who reflect an emphasis on methods rather than on the content of science. More courses on the relation between science and various aspects of society should be offered in the university. Moreover, Ph.D.'s should be trained in problem-solving methods rather than in narrow specialized techniques.

The public should be made to understand, through organizations such as the Russian *Znanie*, that the future of mankind depends largely on scientific knowledge and that efforts to interest the youths of the countries should be intensified.

For those of us in the developing countries who still cherish unequivocally and ingenuously the idea that science and technology are the great hope for bridging the gap between our countries and the more advanced ones, the generally dark thoughts spoken at this conference came almost as a total surprise. We are nowhere near the plateau of expenditure in science. While more advanced countries spend sums of the order of 3 percent of their gross national product, we invest in science no more than 0.1 to 0.2 percent. Also, the more advanced countries, because of their long tradition and because of the solidity of their present position in science, can stop and meditate on the need for further growth. Those of us in the developing countries can hardly afford to do this. On the other hand, the present soul-searching attitude will be useful in forcing everyone to better formulate his policy for science and to make science more relevant to national needs.

Organizations such as the BAAS and the AAAS must decide how they can best contribute to the achievement of the various goals that were put forward. As the conference considered that responsibility, there seemed to be general agreement on three points:

1) The advanced and wealthy countries must give greater aid to the developing and poorer ones. As part of this assistance, associations for the advancement of science should seek means to help, and sometimes to help create, similar organizations in the newer countries.

2) The associations should seek means that would make it possible for government leaders and others who help to determine public policy to understand the probable long- and short-range consequences of technological development, so that technology may better serve the long-range interests of society.

3) Although many ideas and recommendations were expressed during the week's discussion, the conference adopted no formal recommendations or statements of position. All of the discussion was intended as advice to the governing bodies of the associations represented. Those bodies will have to decide on the future programs of the associations they serve.

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