

F. A. S. NEWSLETTER

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----- to provide information and to stimulate discussion. Not to be attributed as official FAS policy unless specifically so indicated.

Should FAS Issue A Statement on Vietnam?

For more than two years, Vietnam has been the number one problem for Americans. To many members of FAS it has seemed to overshadow everything with which FAS has been concerned in the past. Whether or not FAS should address itself to this subject was first discussed at the Council meeting in April 1965. About half of the Council members advocated making a statement while the other half felt that the subject was not appropriate for the Federation. Finally, a statement was adopted which urged that the local military objectives in Vietnam should not be permitted to interfere with achieving agreements on arms control and disarmament. Statements of a similar nature were affirmed at subsequent Council meetings in February and April 1966.

A special meeting of the Council to discuss Vietnam was held in New York City on Sept. 16-17. Papers by Jay Orear, Lincoln Wolfenstein, Halton Arp and Anatol Rapaport were circulated before the meeting. Probably all those participating in the discussion were strongly critical of the Administration's deep involvement. But two long sessions failed to achieve agreement on a policy for FAS. And it was agreed that the Council should not commit the Federation to an active role in the Vietnam debate without giving the membership an opportunity to express an opinion. On the one hand, it may be argued that FAS has been effective because it has dealt with issues which involve specifically scientific and technical expertise. On the other hand, it appears to many that the Vietnam involvement is so great that it permeates everything which concerns the Federation.

The Council appointed a drafting committee to compose a statement which would strongly commit the Federation on the Vietnam issue. A version of this draft is printed below and comments are solicited. They should be addressed to Chairman Marvin Kalkstein, FAS, 2025 Eye St., N.W., Washington, D. C. 20006.

DRAFT STATEMENT

After many months of hesitation, the Federation of American Scientists has come to the conclusion that it must speak out on the war in Vietnam, beyond its obvious implications for the spread and the proliferation of weapons of mass destruction. For two decades, we have endeavored primarily to contribute to the peace and security of mankind, and to its material and spiritual well-being, whatever specialized training and skills were to be found within an organization composed of natural and social scientists and engineers. We have participated in the discussion of public policies in these areas as responsible citizens but as an organization only insofar as scientists might have special knowledge or special concern. We have considered it inappropriate to take public positions on questions where specialized competence or concern of scientists as scientists was irrelevant.

For some time, the war in South East Asia has given rise to collateral issues on which the Federation of American

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Biomedical Research Policy: The Harris Seminar

Senator Fred R. Harris, Chairman of the Senate Subcommittee on Government Research, arranged a conference in Oklahoma City on October 24-27, on the theme of "Research in the Service of Man." The immediate stimulus for the conference appears to have been President Johnson's concern, expressed last June 15th, that biomedical knowledge was not being applied effectively enough to "reducing deaths and disabilities . . ." Some 29 papers were presented at the conference. Following is most of D. S. Greenberg's report, entitled "Biomedical Policy: LBJ's Query Leads to an Illuminating Conference," which appeared in *Science*, 4 November 1966.

. . . If any themes emerged from among the 29 papers that were presented during the conference, they were these:

1) Federal policymakers recognize the value as well as the peculiar vulnerabilities of basic research, and they want to protect it from severe budgetary fluctuations and demands for rapid payoff.

2) However, the rationale for federal support of biomedical research is the prevention and alleviation of suffering, and, therefore, greater attention and resources must be devoted to efforts that directly help the sick.

3) Since resources cannot be obtained for investigating or exploiting every reasonable possibility in research and treatment, choices will have to be made, and these choices may involve decisions to support applied research efforts at the expense, in terms of manpower, facilities, and money, of basic research.

This line of thought, which was in one way or another reflected in the papers of many government as well as non-government participants, was perhaps best expressed by William D. Carey, assistant director of the Bureau of the Budget, who stated:

Today we have a strong base of medical research, supported conspicuously by Government. . . I know of nobody who wants to start taking this enterprise apart, and I believe it will continue to prosper. At the same time, there is no certainty that it will be the exuberant growth industry that it has been. Public policy is starting to look at the field of health as a universe, with medical research sharing the health dollars along with the development of new training institutions, innovations in health services, improved information systems, and effective applied research.

These are the dynamics that are now emerging so clearly. It is unrealistic to suppose that Government's attitude toward health in its modern dimension can be essentially neutral and limited to grinding out appropriations for research, training, and facilities. It must concern itself with goals and objectives. . . It must make choices as to balance in its health investment. . . I would be surprised if Government does not choose to allot an increasing share of its growing health investment toward more deliberate exploitation of medical knowledge, assigning it a higher priority than heretofore. . . As I look ahead, the scene will be one of transition. In

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Scientists has had stated positions, and we have issued a number of statements bearing on these issues. They have included statements on chemical and biological warfare, and on escalation, including in particular technological escalation. We have called attention to the war's impact on international negotiations concerning a non-proliferation treaty and other measures of arms control; but we have avoided facing the issue of the war itself.

For the past year and a half, the United States involvement in the Vietnam war has avalanched. What had been a relatively modest contribution of manpower has turned into a first-class military enterprise, which engages a large part of our active military forces, which dominates the international relations of the United States, and which looms large in its domestic life. It has become unrealistic if not impossible to consider public policy in almost all areas of FAS concern without facing the war. This is why we must take a formal position, reluctant as we may be to break with a tradition established in two decades of organizational activity.

As we understand the objectives of the United States in Vietnam, it is to "prove that aggression does not pay," that is to say to punish the State of North Vietnam and its supposed agents, the National Liberation Front in South Vietnam, until they will cease to interfere with the people of South Vietnam in their development of an indigenous society and a self-chosen form of government. The underlying premises of fact are widely disputed. The Geneva Convention of 1954 established all of Vietnam as a single country, to be administered temporarily by separate governmental structures until a national election scheduled for 1956 but unilaterally cancelled by the government in South Vietnam. The first insurrection was by residents of South Vietnam against what was a non-elected military government. Participation by North Vietnamese troops at no time reached or approached the number of participating U.S., quite aside from the imbalance in material.

As the war has been intensified, the casualties inflicted on the civilian population both in the South and in the North, and the ever-widening destruction of all means of supporting life and of communications render any "victory" for the people of that unhappy country more and more hollow. As a nation, we seem to have maneuvered ourselves into a situation in which we destroy our friends as effectively as we punish our adversaries, and no end is in sight.

While we are engaged in South Vietnam in a war that is part foreign war, part intervention in the internal strife of a country in which democratic government is notably absent, much urgent business elsewhere is being sidetracked.

On the domestic scene, programs of social improvement are being cut back, the sense of direction present in the Kennedy and early Johnson administrations gives way to frustration, and the struggle for civil rights degenerates into squabbles among political factions. In the field of international relations, we are rebuilding walls of mistrust between East and West that had begun to crumble in the early sixties. We cannot expect to meet open minds across the conference table on the part of diplomats of Eastern countries while we call for holy crusades against the communists in South East Asia. In the meantime, our traditional allies, the great nations of Western Europe, are hurrying to disengage themselves from policies that they fear might commit them to participation in a wholly unnecessary Third World War.

Perhaps the United States has committed grave errors in the past few years but, so it might be argued, given the present impasse we have no choice but to stick it out, to continue to pursue this war. If we limit ourselves, if we make sure that certain military measures are not taken (ground attacks against North Vietnam, attacks against China, use of nuclear weapons), we can prevent this war from engulfing the world. But if we were to disengage ourselves, we should betray our allies-in-arms, we should abandon the people who relied on us to the tender mercies of the aggressors from the North.

In answer, it should be pointed out first that the precise range and rate of escalation is not in our hands alone. Our forces have taken such steps as to introduce chemical weapons against crops and against people, and not in response to any specific analogous enemy measures. We cannot rule out the possibility, even the likelihood, that others, either imagining a specific threat that we did not intend, or spying what they consider an opportunity for grossly one-side military advantage, will initiate new military adventures. These have been the justifications for military escalation from times immemorial; they have been our justifications in Vietnam. We must anticipate that they will operate for our enemies as well, as long as the war increases in scope and in ferocity as it now has done for several years.

But the alternatives are not between pursuit of our present course and heedless withdrawal. Many eminent persons, not allied with our adversaries, have urged on the United States new policies. It is not for us to recommend a blueprint of action, or to endorse someone else's recommendations in detail. But the voices of men such as U Thant, de Gaulle, and the Pope should command our respect and our open-minded attention. A number of unilateral steps suggest themselves, which do not depend on the cooperation of North Vietnam but which will tend to prepare the ground for a cease-fire. These steps should certainly include the cessation of bombing in North Vietnam and the cessation of strategic bombing in the South; formal declarations that we shall not be the first to use nuclear weapons in the present conflict, that we shall no longer use chemical weapons nor use biological weapons, and that we shall not furnish such materials to the government of South Vietnam; a formal declaration that we shall recognize the National Liberation Front as a full-fledged participant in any negotiations that may develop. We should assure all governments of South East Asia that we are not building bases for the delivery of strategic weapons near them and that we are cutting back bases that may have been built. And we should certainly discontinue the build-up of our military manpower in the Southeast Asia region.

All these measures, and others, may help to generate a climate in which a cease-fire and an armistice become possible. Even if they do not have this effect for a considerable length of time, we shall have done a great deal to confine the danger of world-wide conflagration, we shall be giving the voices of rational counsel in the other camp a chance, and we shall greatly reduce the suffering that we are imposing on a distant people who have done nothing to us to deserve this imposition.

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Chairman.....Marvin Kalkstein

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The FAS, founded in 1946, is a national organization of scientists and engineers concerned with the impact of science on national and world affairs.

Sources of information (given in the articles in parentheses) are for further reference. Items reprinted directly from other publications are designated as such in an introductory paragraph.

NEWS ITEMS

The South Chinese nuclear test, carried out with a guided missile on October 27th, involved enriched uranium, as have all the previous Chinese tests. (*New York Times*, 2 Nov. 1966; *Washington Post*, 2 Nov. 1966; AEC release, 2 Nov. 1966). China's supply of enriched uranium may afford that country some flexibility in nuclear weapons design it would not have if it had to depend on plutonium. A common Western guess is that China may now be able to produce enough uranium for about 20 Hiroshima-sized (20 kilotons) bombs per year.

AEC Chairman Seaborg announced (AEC release, 1 Nov. 1966) the signing of an agreement, effective November 1st, under which the Argonne Universities Association (AUA) will formulate, approve, and review the policies and programs of the Argonne National Laboratory. The University of Chicago, which has operated Argonne since its establishment in 1946, will be responsible for the Laboratory's operation in accordance with AUA policies. The 26 Midwestern universities which make up AUA are: University of Arizona, Carnegie Institute of Technology, Case Institute of Technology, The University of Chicago, University of Cincinnati, Illinois Institute of Technology, University of Illinois, Indiana University, Iowa State University, State University of Iowa, Kansas State University, The University of Kansas, Loyola University, Marquette University, Michigan State University, The University of Michigan, University of Minnesota, University of Missouri, Northwestern University, University of Notre Dame, The Ohio State University, Purdue University, St. Louis University, Washington University, Wayne State University, and The University of Wisconsin.

Soviet-American agreement on a treaty for peaceful uses of space may be imminent (*Washington Post*, 8 Nov. 1966). The remaining difficulty still appears to be Soviet opposition to bilateral tracking arrangements (see item on this question in October *NEWSLETTER*.)

But Soviet-American agreement on the details of a nuclear non-proliferation treaty may depend on discussions which will not begin until January or February at the Eighteen Nation Disarmament Conference in Geneva (*Washington Post*, 8 Nov. 1966). Difficulties still remain over the West German role, if any, in Western nuclear strategic planning and decisions. One encouraging development is a vote by France in favor of a November 2nd UN resolution (*Washington Post*, 3 Nov. 1966)—passed by 100 votes to 1 (Albania)—calling on all states to avoid actions that might encourage nuclear proliferation. This is the first time in recent years that France has voted with the U.S. and Russia on a nuclear weapon issue. France has not signed the 1963 partial test ban and has so far boycotted the Geneva Disarmament Conference.

Further developments related to the non-proliferation issue include Polish and Czech proposals (*New York Times*, 25 Oct. 1966) for broadening atomic energy controls in both Eastern and Western Europe, and an Indian demand (*New York Times*, 1 Nov. 1966)—softened somewhat the next day (*Washington Post*, 2 Nov. 1966)—that a non-proliferation treaty be accompanied by a nuclear weapons production cutoff by all countries. (We hope to include some discussion of the Polish and Czech proposals in an article on IAEA controls and related issues in the December *Newsletter*.—H.L.P.)

Gerard Piel, Publisher of the *Scientific American*, won the 1966 Bradford Washburn Award of the Boston Museum of Science. The award is given annually to an individual "... who has made an outstanding contribution toward public understanding of science." (*New York Times*, 9 Nov. 1966)

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SOCIAL SCIENCES AND THE POLITICS OF SCIENCE

Following are excerpts from an article entitled, "Social Sciences: Where Do They Fit in the Politics of Science?" by Luther J. Carter which appeared in the 28 October 1966 issue of *Science*.

Social scientists and a growing number of people in Congress and the Administration are beginning to give hard thought to the place of the social sciences in the scheme of social science—government relations. Thus far there seems to be no consensus as to what new institutional arrangements should be created, but the feeling is strong that something should be done. The catalog of problems which intrude upon relations between the social scientists and government is still being compiled. Problems which must appear obvious to many social scientists, however, are those having to do with money, professional independence, and influence and visibility.

The mounting interest of members of Congress in the social sciences is undoubtedly a reflection of the increasing seriousness of such problems as the upheavals in the Negro ghettos, the overwhelming demands on big-city school systems, and the near-chaos in public transportation. The rapid growth of federal support for the social sciences, and of the involvement of social scientists in the work of government, is evident from NSF figures showing that the total federal contribution to research in these fields increased from \$35 million in fiscal 1960 to \$188 million in fiscal 1966.

Nothing has done more to alert social scientists and government to the problems inherent in their deepening involvement with one another than the "Camelot" incident. Project Camelot, the long-since canceled U.S. Army-sponsored study of political instability in Latin America and elsewhere, produced, even before it was well launched, a political furor in Chile (*Science*, 10 September 1965). The reverberations of Camelot are still being heard and seem sure to influence the proposals certain to be made in the next few years to safeguard, in appearance as well as in fact, the scholarly independence of government-sponsored research done in the United States and abroad. The echoes from Camelot will be part of the background noise while relations between the social scientists and government are being studied.

... Senator Fred R. Harris, an Oklahoma Democrat, plans to hold hearings early next year on his bill, which he and 20 cosponsors introduced on 11 October, to establish a national social science foundation ("NSSF") as a parallel agency to the National Science Foundation and the new National Foundation for the Arts and the Humanities.

... In the House, Dante B. Fascell of Florida is sponsoring an NSSF bill, which he introduced in June along with a bill to create an Office of Social Sciences in the Executive Office of the President (parallel to the Office of Science and Technology) and a bill to authorize the holding of a White House conference on the social and the behavioral sciences.

... Representative Henry S. Reuss of Wisconsin, chairman of the House Subcommittee on Research and Technical Programs, is undertaking a study of the government's use of social science research in coping with domestic problems. He intends to find out to what extent the social sciences are used in government programs dealing with such problems as crime, poverty, racial discrimination, and the dehumanizing aspects of life in the great cities. The Reuss subcommittee hopes to hold hearings in January or February, with people from government and the academic and professional communities called to testify.

Further indication of congressional interest in the social sciences is found in the proposed amendments to the National Science Foundation Act of 1950. The amendments, prepared by the House Subcommittee on Science, Research, and Development, chaired by Emilio Q. Daddario, include a provision stating explicitly that the "social sciences" are among the fields which NSF is to support.

Support of social science research by NSF totaled almost \$16 million in fiscal 1966, but as recently as the late 1950's

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support for such research was both cautious and skimpy. The NSF act refers specifically to such fields as mathematics, biology, and physics, but, by a vague reference to "other sciences," has made support for the social sciences permissive but not mandatory.

The Science and Astronautics Committee, in a report issued after it had approved the amendments to the NSF act, referred to the social sciences as "still relatively primitive" but extremely important to human welfare. It took issue with the "contentions of some" that in seeking federal support the social sciences should look, not to NSF, but to other agencies, and perhaps should find a "niche" in the Foundation for the Arts and Humanities.

... Leland J. Haworth, director of NSF, will get a chance next year, during hearings on the NSSF bill, to try to lead Senator Harris to take a more positive view of what his agency can and will do. Harris and his staff man, Steven Ebbin, who has a Ph.D. in political science from Syracuse University, have concluded that NSF is unlikely to become an important source of support for social scientists who want to do research in areas of social change.

They believe that, under present conditions, the social scientist who needs federal support for work in such areas is out of luck unless he is willing to "plead at the cash register" of the very agencies for whom his research may have policy implications. The NSSF contemplated by the Harris bill would be a source of support for any social science research which meets high professional standards.

... On the question of creating NSSF, the reactions one gets from social scientists range from strong enthusiasm to skepticism, if not outright opposition. Evron Kirkpatrick, executive director of the American Political Science Association, told *Science* he was strongly in favor of establishing NSSF though he added that APSA has taken no position on the matter. In his view, the new Foundation would give social scientists something which they can never expect from an NSF run principally by natural scientists—a voice in the upper levels of the administration. The position of director of NSSF would be prestigious, he said, and would attract a noted social scientist.

... The best solution to the problem of increasing the social sciences' visibility and influence may be to have them well represented as part of the President's existing science advisory apparatus. For example, two or more social scientists could be named to the President's Science Advisory Committee, as Herring has suggested, and perhaps a senior social scientist could be appointed to serve as a principal deputy to Donald Hornig, the President's science adviser and director of OST.

To ignore the already well functioning science advisory establishment and set up a separate social science advisory structure might prove to be a strategic mistake. Much of the influence of PSAC and especially of the Science Adviser, who has close ties with the Bureau of the Budget, stems from the fact that the President looks to them for advice on questions involving major federal expenditures for new technology. The impact of technology on people's lives is such that the social scientist's concern with technology is not less than the natural scientist's. Moreover, many social scientists want nothing done that would discourage further development of the "interface" between the social and the natural sciences.

A way to encourage research on fundamental problems and to protect the scholarly independence of social scientists is for the government to make large "block" grants of research funds to universities. The university would use the money at its own discretion, though some funds might be earmarked by the granting agency for use in neglected areas of research. Alex Inkeles of Harvard's Center for International Studies has suggested that the operations of the United Kingdom's University Grants Commission be looked to as a model.

Perhaps another major advantage of the block-grant approach would be the fact that it would give NSF, NSSF, or perhaps a U. S. equivalent of the British grants commission some insulation from political reprisal. At least, the granting agency's officials, having fewer decisions to make as to the kind of research to be supported, would be less exposed to attack.

The issues confronting the social scientists in their relations with government are obviously difficult, and do not lend themselves to hasty responses. There is, then, perhaps merit in Representative Fascell's proposal for a White House conference on the social sciences. The American Political Science Association has endorsed the proposal, and certain other associations are said to have done so as well. Preparations for the conference would require a year or more . . .

NEWS ITEMS

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The Vietcong used non-poisonous gas grenades against American troops (*Washington Post*, 11 Nov. 1966) for apparently the first time in the Vietnam war. (The possibility of reciprocal use of CB weapons was mentioned in the scientists' statement published in the October *NEWSLETTER*.) No American injuries were reported.

The U.S. told Russia that "a very small amount" of radioactivity leaked into the air from a recent underground nuclear test in Nevada (*Washington Post*, 10 Nov. 1966). But the State Department claimed the incident did not violate the 1963 partial test ban treaty because no debris was carried outside the U.S. The State Department said it was "looking into" the question of whether an underground test on October 27th may have resulted in a technical treaty violation.

CURRENT ACTIVITIES OF THE WASHINGTON ASSOCIATION OF SCIENTISTS

In its early meetings during September the WAS reviewed current policy problems of interest to the FAS and particularly the problems of arms control in which FAS has been most interested in the past. It concluded that there were not enough new developments to warrant an extended series of meetings in areas such as nuclear proliferation and the test ban, but that the Chapter would remain alert for such developments and would be ready to participate in a Washington dialogue on these subjects when the need arose. In the meantime, the members felt that several problems of direct interest to the scientific community deserved examination, and it currently is focusing on two of them.

1) The President has recently signed a bill creating a 4-year liberal arts college and a 2-year technical institute in the District of Columbia. WAS is surveying the needs for technically trained personnel, especially laboratory technicians and other similar personnel utilized by the many research organizations in the Washington area. The Chapter will also meet with D.C. officials to obtain information and present our views on the kinds of training programs that appropriately might be established at the new technical institute.

2) The Chapter is exploring, in a series of meetings and informal seminars, the implications of recent trends in federal support of research. It is examining such questions as the most desirable balance between research and training funds in an era in which federal funds are not growing as rapidly as in the past. The group also expects to explore alternative criteria for distributing federal funds among the various scientific fields and disciplines, although it recognizes that this is a formidable task and that progress on it, if any, will be limited.

SCIENTISTS DEFINE TECHNOLOGY'S AIM

Following are excerpts from an article by Peter Bart which appeared with the above title in the New York Times on 30 October 1966:

Some of the nation's leading physical scientists and social scientists took time out this week to ponder the moral and social impact of their technological discoveries.

... Their observations were made at a special three-day convocation on Scientific Progress and Human Values marking the 75th anniversary of the California Institute of Technology. The meeting was attended by 124 delegates from universities and learned societies and by 1,500 students from Caltech and nearby institutions. . . .

Dr. Murray Gell-Mann, professor of theoretical physics at Caltech, said that society must give new direction to technology, diverting it from applications that yield higher productive efficiency and into areas that yielded greater human satisfaction. The "old drive" of science, he said, was to master, control and even destroy man's natural environment. The new drive, he continued, must be to create a richer and more satisfying life. . . .

These sentiments were applauded by Carl Kaysen, director of the Institute for Advanced Study at Princeton, N. J., who emphasized that existing government institutions were no longer equal to the job of selecting and guiding the uses of technology.

"Technology is moving faster than our ability to assimilate it," said Dr. Simon Ramo, a prominent scientist and industrialist. Dr. Ramo urged the development of a new class of men called socio-technologists, who could "effectively link scientific developments with social betterment."

Science, he said, can provide many answers to improve the texture of human life, but scientists cannot persuade the public to utilize them. As an example, he observed that technology could provide a vastly more humane and efficient transportation system for sprawling Los Angeles, but only a new class of socio-technologists could persuade the public and the politicians to put that system into effect. . . .

In addition to debating the future applications of science, the convocation also heard some forecasts about the quality of human life from a panel of distinguished biologists.

Dr. James Bonner, professor of biology at Caltech, said that biologists were on the verge of finding a way to eliminate senility, thus facilitating a human life span of 200 years. Before long, he said, scientists will also be able to control reproduction, determine the most attractive life spans and, in general, direct the process of evolution.

Dr. Robert S. Morison, director of the Division of Biological Sciences at Cornell University, predicted that the family would suffer a great decline in prestige as society continued to grow more complex.

While the family is "a fine mechanism for transmitting conventional wisdom in a relatively static society," he said, "it is relatively poor at assimilating and transmitting new knowledge essential to survival in a rapidly moving world."

Dr. Morison said the growing awareness of the population problem and of human genetics would also "weaken the prestige of the family as the basic unit of human reproduction."

Finally, the biologist observed that "increasing knowledge in the plasticity of the human nervous system in early life will encourage further invasion of the home in the name of ensuring equality of opportunity."

Following the decision of the University of Pennsylvania to discontinue secret government-sponsored research (see the September NEWSLETTER), the FAS Council is interested in finding out the extent of concern on the part of FAS members about such research. Facts about and examples of secret research will be welcomed by the Council, and should be sent to FAS Chairman Marvin Kalkstein via the FAS office.

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the main, Government will continue to support undirected research strongly, but it will also be looking for opportunities to invest more substantially in what may be called "directed" research, which means the deliberate, systematic, and programmed effort to seek a well-defined research or development objective—possibly through contract rather than grant mechanisms. If you ask me whether this will take some dollars that might otherwise be budgeted for expanded academic science, I can come no nearer to a clear answer than to grant the possibility of this kind of trade-off. . . .

Carey, who is well acquainted with the panic-prone nature of the scientific community, softened this a bit, however, by adding that the funds for new applied-research programs might possibly be diverted from other fields, such as conservation or transportation, and he went on to state that "Government is not very likely to lose sight of the hard reality that in one way or another it will have to provide for the growth and stability of the academic institutions."

Surgeon General William H. Stewart presented views that were quite similar to Carey's. But NIH Director James A. Shannon, who is said to be not altogether happy with the trends that are now appearing, devoted most of his talk to a brief history lesson on the development of polio vaccines—with particular emphasis on the difficulties encountered along the way "because of an inadequate amount of fundamental information upon which to base the targeted programs." In conclusion, Shannon stated that the existing "mix" of applied and basic biomedical research "has a strong internal logic, which, if interfered with, must be with a full appreciation that (a) the goal is important; (b) the science base is adequate or can be made adequate as part of the organized effort; (c) the losses which may accrue from mounting the programmed effort are counterbalanced by the prospective gains, and (d) developmental work is in itself a hazardous process at times costly of dollars and manpower and without assurance of success."

(Shannon's historical review of the polio vaccines, it might be added, held the audience fascinated as nothing else did during the conference, which raises a point that has often been made about science policy planners: in many cases they appear to have little systematic knowledge of the history of science; nevertheless, while ignorant of the way science has worked in the past, many of them vigorously grapple with the problem of how it should be made to work in the future.)

In recent years, many persons have come to regard Alvin M. Weinberg, director of the Oak Ridge National Laboratory, as perhaps the most innovative thinker in science policy planning. His papers, "Criteria for scientific choice" (*Minnerva*, Winter 1963) and "But is the teacher also a citizen?" (*Science*, 6 August 1965) represent an order of originality and insight that put to shame a good deal of the stuff that now clogs public discussion in this area. At the Oklahoma meeting Weinberg was up to form and elevated the already high level of discussion by examining some of the scientific and technical realities that govern our ability to attain applied-research objectives:

... there is a difference between the physical and biological sciences with respect to the degree to which their underlying scientific structure can be efficiently mobilized for achieving practical goals. The physical sciences and engineering, though they may have started independently . . . have now been so intertwined and integrated, and the physical sciences themselves are so advanced, that given an applied goal in engineering, there is often nothing but money that stands in the way of achieving the goal, provided basic science has shown this goal to be achievable. I can't stress too strongly the importance of this latter proviso. Thus, applications in the physical sciences fall into two great categories: those projects whose basic feasibility has been demonstrated; and

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those equally desirable projects whose basic feasibility is yet to be demonstrated. . . . The bulk of biomedical research is in the pre-feasibility stage, and therefore, the underlying basic research must be done broadly. Since most of our knowledge is in the prefeasibility stage, the vital link between basic and applied biomedical research is much more haphazard and unpredictable than I suspect our President would like it to be. . . . I think it is fair to say that most basic molecular biologists would work directly on a cure for cancer rather than on what they are now doing, if only they knew how to make real progress. We don't cure cancer because we don't want to, but rather because we don't know how to cure it.

Weinberg, however, went on to argue that "there are some rather substantial areas in biomedical science where we probably have reached the feasibility stage or at least closely approached it and where the President's 'vital link between pure research and practical achievement is rather clear and definite."

In this group, he said, he would place the application of engineering science to the development of the artificial kidney. "To be sure, the artificial kidney is a cumbersome and awkward thing; yet artificial kidneys do work. We have passed the feasibility stage, and what seems to be indicated is massive development . . . to reduce the technique to widespread practice." Other examples, Weinberg continued,

would be further development of medical scintillometry, automation of clinical chemistry, and development of the zonal centrifuge and the 1-angstrom electron microscope.

Characterizing these problems as Prospects for Big Biology, Weinberg argued that the national laboratories, such as those operated by the AEC, were ideal institutions for undertaking huge, costly programs that require multidisciplinary coordination, a view that was in many respects seconded by Harvey Brooks, dean of the school of engineering and applied physics at Harvard. "The range of technological capabilities represented by these laboratories," Brooks said, "is extraordinary, but after a few years, the magnificent machinery tends to get devoted to less and less significant problems and it is extremely difficult to redefine their missions in response to the changing goals of federal science. . . . We do not treat our federal laboratories as a common national resource to be used flexibly for many of the purposes of government. Rather we tend to regard each laboratory as the inviolate preserve of the agency to which it belongs. . . . I feel it is time we learned how to use these institutions more flexibly for national purposes with less worry about roles and missions."

I would like to stress that, in the limited space and time available for describing and quoting from the papers at the conference, it is not possible to do justice to their quality and scope. Fortunately, the proceedings are to be published by McGraw-Hill early next year. They are highly recommended reading for anyone interested in the problems of science and public policy.

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