

a problem with which the committee was concerned. The discussions might be held here and constitute part of the record, or they might be held in a more informal atmosphere at our building and be off the record. The British have had considerable success, and also some problems, with a standing committee consisting in part of members of Parliament and in part of scientists. That committee meets periodically to discuss matters that are to come before Parliament. I do not think that a standing committee would be the best arrangement here, but perhaps it would be useful to arrange some *ad hoc* joint meetings that would serve a similar purpose.

As a third possibility, the AAAS may at times be able to carry out analyses or studies that would be of use. As an example: for the past two years the Association has had a group of physiologists, chemists, economists, urban planners, and public health specialists, with

the help of a small staff, conducting a study of the problems of air pollution that are beginning to be of general concern and have long been of concern to some local areas, notably Los Angeles. We will have the report ready for publication next year. Last month we published in Spanish and later this fall will publish in English a review of American experience in the handling of arid-land problems. We published the Spanish version first because it constituted the United States' contribution to the Latin-American Congress on Arid Lands that was held with UNESCO assistance in Argentina last month.

Both these studies were planned and written not with any particular legislative or congressional problem in mind, but rather as efforts to bring together the available information on an important matter of public concern. I hope that they will be widely useful. They might have been of more direct

use to you had we discussed with you your interest in such matters before we started the two studies.

As an example of how such discussions in advance might be useful, I refer again to the problem of geographic distribution of federal support for scientific research and for science education. These are questions of obvious concern to Congress. They are matters that affect the operating policies of a number of government agencies. And they are of great importance to the educational institutions of the country.

Obviously the suggestions I have made would by no means wholly solve the problem of giving Congress the competence it seeks in handling scientific and technical problems. But if, after you and the staff have had an opportunity to consider these and other ideas, it appears that the Association can be of worthwhile assistance, we shall be glad to continue this discussion.

News and Comment

The Big Picture: House Committee Hears Views on Basic Problems of Science-Government Relations

One of the problems afflicting congressional treatment of science is that, because of the committee system, the congressional diagnosticians rarely look at the whole patient.

The quality of the legislative end product is by no means overwhelmingly affected by the dispersal of major scientific jurisdictions among some dozen committees, but this appears to be an important factor, one that contributes to the production of conflicting decisions. For example, the congress will endorse massive technical commitments, such as space, oceanography, and atomic energy, but will fail to recognize that much of the manpower that these programs will require in a decade is now being intellectually shortchanged in financially strapped secondary schools.

A quick way out of this situation is difficult to achieve, for the committee system is here to stay, and, furthermore, it would merely be a jump from the frying pan to the fire if, by some legislative magic, the whole of science were to be entrusted to one or even a few committees. If this were to come to pass, an intoxicating concentration of power and authoritarianism, rather than fragmentation and diversity, would probably be the problem, and who is to say that these would be preferable?

A sizable part of the solution would therefore seem to lie along the lines of slowly educating the congress in what is known about how science thrives. Happily, such an effort has been going on during the past few weeks, before a subcommittee of the House Science and Astronautics Committee, the witnesses being Frederick Seitz, president of the National Academy of Sciences; Jerome B. Wiesner,

the president's science adviser and wearer of multiple hats in the executive branch's science advisory apparatus; Edward Teller, the nuclear physicist, who is professor at large at the University of California; Paul Gross, president, AAAS; and Leland J. Haworth, the recently installed director of the National Science Foundation.

In the past, scientists aplenty, including the aforementioned, have appeared on Capitol Hill to discuss this or that aspect of science; in the case of these latest hearings, however, the difference is that the witnesses were asked to paint very wide and broad pictures, and not to address themselves to the problems of a particular segment of the scientific community.

They responded by painting broad and wide, and while each addressed the committee in his own fashion, many of them made the same points:

1) The Cold War is losing force as an impetus for scientific spending, and the nation will therefore have to begin to accept public well-being, rather than national defense, as the principal motive for large-scale support of research and development.

2) In allocating research funds to educational institutions the government will have to break away from the practice of making the rich richer. The development of new geographical areas of scientific excellence should be given weight, along with the need for meet-

ing the government's immediate research requirements.

3) With research and development now one of the largest single items in the federal budget, economic and political realism dictate that the nation cannot pursue every reasonable technological possibility.

4) But, if priorities have to be determined and hard choices made, basic research, which accounts for only 5 to 10 percent of the total R&D budget, should be protected against budgetary restrictions. The justifications offered were that basic research is relatively cheap, it is closely tied to the educational process, and it provides a reservoir of knowledge that is indispensable for creating possibilities for application and development.

The forum for the presentation of these views was the Science and Astronautics Committee subcommittee on science, research and development, a ten-member body chaired by Emilio Q. Daddario, a Democrat from Hartford, Connecticut. Since it is becoming difficult to distinguish the science investigators without a scorecard, it might be pointed out that the Daddario committee is not the Select, or Elliott, committee which was recently established by the House to conduct a comprehensive investigation of federal support of research and development. That committee, chaired by Carl Elliott, Democrat of Alabama, is still putting together a staff for its difficult assignment, and is yet to be heard from.

Any suggestion of rivalry between the two committees is diplomatically discounted by persons associated with either, but Daddario's people are hard put to suppress their pleasure at having gotten off to a fast start, and they offer the view that if Elliott is going to fulfill his mandate, his committee will have to plow a lot of the same ground.

By far the most wide-ranging and freewheeling discourse was delivered by Wiesner, who put aside a tightly drawn prepared statement to deliver a 2½-hour, off-the-cuff soliloquy, followed several days later by a second appearance that ran for another hour and a half. To some extent Wiesner's performance was unquestionably confusing, but, as he candidly pointed out, pat answers are overwhelmed by the problem of extracting the maximum value from a \$15-billion-a-year investment in as delicate and little-understood a creature as scientific research and development. He told the commit-

Wiesner Leaving White House Post

Jerome B. Wiesner, the president's science adviser, has confirmed published reports that he plans to resign in the near future to return to M.I.T.

Wiesner, who also holds the post of Director of the Office of Science and Technology, originally agreed to serve the administration for 2 years, then extended his stay at the President's request. The date of his departure has not been announced, but, according to his office, it is likely to be in the spring. A successor has not yet been named.

tee that he was pleased "to talk about the questions that are on your mind to the best of my ability and in a sense to share my confusion with you, because I think that some of the questions that you are asking about and looking into are questions that none of us can give a complete and comprehensive answer to or a plan for some of these things." Wiesner then went on to present a thesis that may be summarized as follows.

The Cold War turned out to be something of a blessing in disguise for American science and engineering, for "it gave us sort of an automatic motivation to carry out a very intensive and extensive research and development activity." But now, while military-motivated research and development will continue at a high level, we have arrived at a point where we are confronted by a new situation, one that brings us to a "crossroads" in government support of research and development. The military payoff from basic research is not going to be as great as it was in the past; this is because it is becoming increasingly difficult to find new militarily useful applications. "While we will continue to make investments in the military field and in atomic energy," Wiesner explained, "I think the progress won't be so great, so the motivation to drive as hard probably will not be there." Furthermore, we are experiencing a drop-off in the rate of useful civilian applications from militarily inspired research. "There will be new developments, new materials, new understandings, and so on, from this work, but the kind of direct transfer that took place, for

example, in the aircraft industry, is not as likely to happen here."

As a result, he said, we are going to have to recognize that national security means "more than arms . . . and in the end it can't come from arms, though I think we must continue the process of refining our military achievements and probing selectively for new possibilities. But . . . security means more than that, it means good relations with others, it means a strong economy, a healthy people . . . and science contributes . . . in a major way to all these objectives.

"I think one of the problems we are all wrestling with now is how to identify these more general, but equally important problems and how to keep our technological enterprises working on them, because it is easy to put off some of these things."

"Our basic problem in the government, in the broadest sense, is to bring an understanding of all this, of technology and science, to bear on serving the collective needs of our people, and it is a process that no one of us can handle alone; it must combine the skills of the statesman, the politician, the scientific expert, the engineer, the entrepreneur, or industrialist, and demands a major effort for understanding and setting the guidelines."

As for the critical question of how much the government should spend on research and development, Wiesner said that he has found no certain guidelines, except that "one should continue to make investments in research and development until the marginal returns in the future from the investments you make just equal the investments, and according to the economists we are a long way from that point." But the trouble with this rule, he added, is that "I don't think anybody can tell us how to make assessments here, just as I don't think anyone could have measured what the ancillary byproducts of an investment in air defense were going to be to the economy, or can put a price tag on the value of penicillin."

Protect Basic Research

Nevertheless, he said, choices will have to be made, but he offered the hope that basic research would be the last to feel the pinch, unless basic research expenditures "get to be considerably higher than they are now, which may happen when you are wanting large numbers of expensive tools in all fields. . . ." However, he added, "we

at least ought to be willing to try to support all the really outstanding people who are interested in doing basic research. It is the inexpensive end of the spectrum . . . and really small numbers of people in the country are involved in basic research compared to applied research and development. They are also people . . . who on the whole are involved in training, teaching our scientists and engineers, our new teachers, and for all these reasons I believe that these are the criteria we should use there.

"At the other end of the spectrum, when you start talking about application, the development of a specific aircraft, or a booster, or some process of desalinization . . . I think we should be awfully careful. . . . In any event, in all these fields where the costs are so very high, I think one needs to look very much harder and know that he wants what you are going to develop, and it is likely that [the new development] can do something a lot better than what you have today."

Wiesner proceeded to caution against any effort to impose overall management on the nation's technological endeavors or to devise any sort of master plan for research and development. "As we worry about all these problems . . . of who is doing what, and what are the involvements and what are the possible conflicts, I hope that you would keep in mind . . . that it is not possible always to plan what is the best way of doing something, and allowing a lot of freedom for experimental interactions, and for things to evolve . . . I believe [this is] one of the reasons why we have created this very effective and strong technological scientific community."

The case for wider geographical distribution of research funds was emphasized by Gross in his committee appearance (and was almost simultaneously offered by Wiesner in an address at the centennial observance of the National Academy of Sciences).

It is necessary to recognize, Gross said, "that there is now an overemphasis on research at the expense of teaching and an overemphasis upon short-time research goals at the expense of a broadened research competence. . . . I propose, therefore, that the government's total objective in supporting science would be better served if immediate research competence were not the only criterion for the distribution of funds and if some grants for research and for the improvement of

science education were to be made either on a formula basis or by selection of especially promising institutions with the intent to develop first-class institutions in parts of the country in which they do not now exist.

"To the extent that federal funds can be used to accomplish this purpose," Gross continued, "it will be necessary to use a larger fraction of that money than we have been using in past years in the form of institutional grants rather than individual project grants, and it will be necessary frankly to recognize the desirability of placing a larger amount of the total budget into universities that have the potential of reaching top rank but that have not yet done so, for it is in our long-run interest to have top-quality universities and research laboratories widely placed throughout the country."

The case argued by Gross is sweet music to the ears of have-not institutions and states, but it is not a case that is readily digested by the legislative process, or even by many leaders of the scientific community. A lot of the congressional pressure directed against NIH, for example, arises from the feeling that NIH has not been demanding high quality as a condition for grants, and the National Science Foundation regularly finds itself on difficult terrain when it seeks congressional approval for institutional improvement. In addition, among some of the administration's most influential science advisers there is the feeling that the rich get richer for very good reasons, and that the possibility of making the deserts bloom is rather remote. As one of them put it recently in a conversation, "It is foolish to take a regional view of this. We are one country, with an excellent transportation system. If the midwest is lacking in first class research facilities, this is more than compensated for by the strength of the east and west coasts."

Teller's Appearance

The inclusion of Teller on the witness list is interesting for a number of reasons. First of all, it tells something about the committee's eye for press attention, since, though Teller is an estimable scientist, he does not head a major science institution and fellow witnesses were summoned principally because they do. Teller, because of where he has been and what he has done, unquestionably has a great deal to contribute to the committee's education, but it is hard to escape the

conclusion that it was Teller's public appeal, rather than his knowledge, that led to his inclusion on the witness list. If the goal was to solicit the views of knowledgeable scientists, Teller would, of course, command a hearing, but as the only scientist not speaking for a particular institution, his selection was somewhat curious. His views on federal support for science are also of interest at this point, since there is some speculation that if Goldwater were to succeed to the White House, Teller would succeed to Wiesner's spot. This is only speculation, premature and unconfirmed, but in view of the identity between Teller's and Goldwater's views on nuclear testing and the degree to which the Soviets can be trusted, it is not an outlandish speculation. It draws some support from the fact that the number of distinguished scientists in sympathy with many of Goldwater's major positions is rather limited.

On the basis of the views Teller expressed before the Daddario committee, it would appear, however, that he and Wiesner see eye to eye on many of the principal issues involved in government support for research and development. Teller, too, spoke without a prepared statement, in somewhat disjointed fashion, but the main points he made were these.

"There is no field as difficult to direct as research. Science and the consequences of science deal with the unexpected. To plan it in detail means to emasculate it. . . . Research is a game, led by curiosity, by taste, style, judgment, intangibles. It seems unreasonable to spend a great effort of the best people on play, yet it is a fact that the really decisive things are coming from that game, and always have."

Teller went on to state, as other witnesses did, concern about the status of applied research in the United States. "Throughout our universities, the best people are brought up with the idea in mind that pure research is the most wonderful thing, the one thing worthy of attention of the best people. . . . In the way of applied research, I would say the picture is not dark—it is just not good enough."

Another problem, he continued, is elementary and high school education. "Our children are not inspired by the teachers whom we seem to be able to afford. Our general approach to education is such that a youngster will get his first real contact with exciting problems when he is 20 years old. The his-

tory of science has demonstrated that the human brain is most fertile in the teens. . . . How to awaken in our schools and in the general public a real appreciation not only in the results of science, but also of the great intellectual value . . . the value of this wonderful adventure of science, how to bring that home to the children and to their parents . . . is a really big problem."

Teller added that he felt the federal government should increase its investment in research and development. "I realize," he said, "that the level of expenditure has reached the extent where detailed criticisms of the big items are called for. That one has to be selective, particularly where very great chunks of money are involved, seems to me obvious. At the same time, I think that the few percent of the national income which we spend on research can be increased and should be increased . . . I am convinced that our whole future welfare and our whole future safety is involved in precisely these efforts, and I am unequivocally behind spending more money, with the only restriction that I am fully aware of the fact that to spend more money is not enough—you also have to know how to spend it. . . ."

Spread Support

Teller also joined in the plea for broader geographical distribution of research funds, pointing out, "I fully realize that to carry out such a policy there will be interests hurt with appropriate and political consequences, and decisions of this kind will have to be defended. . . . If in State X there are few government funds going on the basis of few attractions and poor performance, then I think appropriate thought should be given as to how conditions in that locality, in that State, could be improved to make that part of the Union perform better."

With the NASA budget, which is the Science and Astronautics Committee's largest responsibility, out of the way, the Daddario committee plans to continue its studies during the coming months with a continuing series of hearings. The transcripts will be published and distributed without charge, probably early next year. Copies of "Hearings before the Subcommittee on Science, Research, and Development" may be ordered from the House Science and Astronautics Committee, Washington 25, D.C.

—D. S. GREENBERG

C. P. Snow: Second Thoughts on the Two Cultures Likely To Keep the Pot Boiling

Britain's C. P. Snow, sometime scientist and now highly successful man of letters, started something with his 1959 lecture, *The Two Cultures and the Scientific Revolution*, which, he says in a recently published postscript to the lecture, makes him feel like the sorcerer's apprentice.

As Snow himself has said repeatedly, the freshet of controversy he released was somewhat surprising since the views he expressed in the lecture were by no means novel. Nevertheless, Snow's felicitous title phrase and its accompanying thesis of a gulf yawning between scientists and the rest of society has become a familiar marker buoy in discussions on science and society. Or as Snow himself said in the March 1960 issue of the London review *Encounter*, "almost by chance, a nerve has been struck."

Certainly fuel for the controversy over Snow's thesis was piled on by attacks which took a highly personal turn, notably one in 1962 by F. R. Leavis, a literary critic who delivered a scathing indictment of Snow as thinker and writer in a kind of maledictory address delivered when Leavis retired from his post as a reader at a Cambridge college [*Science* 135, 1114 (30 Mar. 1962)].

While Snow has often written and spoken in recent years about the Two Cultures, he has up to now maintained a Buddha-like reserve toward his harshest critics. Two weeks ago, however, the *Times Literary Supplement* of London published Snow's piece called "The Two Cultures: A Second Look," which is obviously intended to be the author's authorized second thoughts. It is also to be incorporated in a new edition of the lecture. In this piece Snow obliquely, but unmistakably, replies to Leavis and other critics from the other culture.

In this *TLS* piece, Snow by and large stands by his original case. There are some clarifications and changes in emphasis, to be sure, but no major recantations. Snow is, however, somewhat more hopeful about prospects of avoiding the disaster of nuclear war. Part of the force of his original lecture derived from his pessimism about the future. Snow argued that the implications of science were not sufficiently weighed in the making of

policy. Now he is encouraged by the partial test ban and says, "If I wrote the lecture again now, there would still be anxiety in it, but less dread."

To the criticism that the use of the word *culture* is misleading in the sense that he uses it and that there are more than two cultures, anyway, Snow admits that the terminology may be inexact, but quite reasonably repeats that he wanted "something a little more than a dashing metaphor, a good deal less than a cultural map."

As for his thesis, in restating it in the *TLS* piece, Snow says it goes "something like this. In our society (i.e., advanced Western society) we have lost even the pretense of a common culture. Persons educated with the greatest intensity we know can no longer communicate with each other on the plane of their major intellectual concern. This is serious for our creative, intellectual, and above all, moral life. It is leading us to interpret the past wrongly, to misjudge the present, and to deny our hopes of the future. It is making it difficult or impossible for us to take good action."

"I gave the most pointed example of this lack of communication in the shape of two groups of people representing what I have christened 'the two cultures.' One of these contained the scientists, whose weight, achievement, and influence did not need stressing. The other contained the literary intellectuals. I did not mean that literary intellectuals act as the main decision makers of the western world. I meant that literary intellectuals represent, vocalize and to some extent shape and predict the mood of the non-scientific culture: they do not make the decisions, but their words seep into the minds who do. Between these two groups—the scientists and the literary intellectuals—there is little communication and instead of fellow feeling, something like hostility."

Snow avers that he regrets this state of affairs, but it is a subject to which he returns in what is really the central section of his appendix to *The Two Cultures* and in which, somewhat by indirection, he scores off Leavis.

First, Snow notes that he believes the division between the Two Cultures to be deepest in England and feels he did not emphasize this enough in the lecture. He then makes a comparison which is likely to surprise as well as flatter American academicians.

"In the United States, for example,"