

DuBridge Discusses Science Budget, Support and Organization

Lee A. DuBridge, the President's Science Adviser, believes that we are unlikely to see any rapid growth in US science soon. The budget situation will be tight for two or three years, and no major new expenditures are in sight.

He anticipates that the fraction of total US academic science that is supported by the National Science Foundation will grow, and that changes in the structure by which science funds are administered in Washington are unlikely. DuBridge thinks that a reduction in the rate of rise of PhD production is justifiable; he hopes to develop quantitative criteria soon.

Recently DuBridge talked with *PHYSICS TODAY* on topics ranging from the Federal science budget and organization to physicists' responsibilities and the public attitude to scientists. Here are his answers to our questions:

What about the suggestion that NSF should have perhaps a third or a half of the Government's funding of research and the rest could be left to the mission agencies?

Well, this is a difficult question, and I think it is clear that changes will not occur rapidly. The mission agencies have a valid interest in basic research. I think they have a valid responsibility for helping support the scientific base of the country on which their own future technologies will be built. But it is desirable also to have one agency whose sole mission is the strength of American science, and that is the National Science Foundation. Over the years its fraction of the total support of research has of course grown, and the fraction supported by DOD has declined. DOD supported 80% of the university research in the country a number of years ago. That's declined to something like 20%.

I anticipate that the fraction of the total academic science budget of the country supported by NSF will grow for a variety of reasons. But it's risky to make sweeping proposals for change because many Congressional committees are involved, and they may or may not agree with the changes. If one dropped out of the budget some of the science support of the mission agencies, there is

no assurance that the committees that deal with NSF would agree to increase the NSF budget by corresponding or larger amounts. So changes have to be made with careful consultation, and with some care as to the speed at which they occur. But I think there is general agreement in the Administration that a phased-in increase of NSF's proportion of the total research support is desirable.

One suggestion that comes up frequently these days is the idea of tying the R&D budget to the gross national product.

Yes, that's a question we are going to be carefully considering in PSAC [President's Science Advisory Committee] and in the Bureau of the Budget. Ever since World War II it has been clearly the implied policy—though often not very explicitly stated either in legislation or in Executive orders in an overall way—

continued on page 48



LEE DuBRIDGE told *PHYSICS TODAY*: "... it is unreasonable to expect a resumption of the rapid rate of growth of the early 1960's. We must learn to live with restricted budgets."

AEC Classifies Brueckner Idea For a Fusion Reactor

Theorist Keith Brueckner has filed nine patent applications for a controlled-fusion reactor. AEC promptly classified the applications Secret-Restricted Data and is permitting theoretical calculations to continue. Brueckner told *PHYSICS TODAY* that he is not allowed to discuss the technical content openly. He did tell us, "It's a new way of containing and releasing fusion energy. It's a theoretical idea only, which has been supported by limited computer runs."

Although the US controlled-thermonuclear research (CTR) program has been declassified since 1958, AEC automatically classifies all possible military applications of atomic energy.

Brueckner got the idea while working part time (he is a professor at the University of California in La Jolla) as technical director of the KMS Technology Center.

After the patent applications were filed in November, KMS representatives met with the AEC commissioners in February and proposed carrying out a research program under AEC security regulations. Funds would come from

several different commercial organizations.

AEC General Counsel Joseph Hennessy told *PHYSICS TODAY* that AEC is completing a technical review and will then confer with KMS again. One aspect being studied is whether the potential weapons applications of the idea can be separated from the reactor concept. Because Brueckner has been a consultant to many AEC laboratories and a member of AEC advisory committees (including the CTR standing committee, of which he is no longer a member), Hennessy said AEC is also evaluating the question of who owns patent rights.

Several years ago AEC classified the development of the ultracentrifuge, which is used to separate uranium isotopes. It then limited development (under security control) to a few US firms. Meanwhile the Dutch, French and Germans proceeded with commercial development of the technique. AEC is required by law to classify any atomic-energy work with potential military applications.

—GBL

DuBridge

continued from page 47

that the Federal government would support scientific research and development, both to maintain the strength of American science, American university science included, and to help implement the missions of the various Federal agencies. However, there has never been a formulated policy as to the specific budget implications of this overall general policy. In the days when science budgets were rapidly growing the formulation of specific budgetary allocations hardly seemed necessary. The various agencies were able to increase their scientific activities as they felt necessary to perform their missions. And there was a steady—not rapid enough, but still continuous—growth in the National Science Foundation.

With budget limitations people are now asking what fraction of the Federal budget should go into science; what fraction of the GNP should go into science; what fraction should go into research rather than development; what fraction should be supported by the different agencies as compared to NSF? Well, these questions have not yet been formulated very well, and they have not been answered in terms of specific policy decisions or legislative actions, and indeed it is not clear that they can be quickly.

You think they will?

I think it is likely that various groups will try to evolve some guidelines. But I doubt if any administration would want to tie its hands, or the hands of succeeding administrations, to fixed commitments on the size of the research and development component of the Federal budget. The needs of defense rise and fall; the needs of the space program rise and fall; the needs for work in atomic energy, housing, transportation, health, and many other fields rise and fall. So a fixed overall allocation of Federal funds to the total R&D package would seem to be a very difficult thing to evolve in the first place. Also, I doubt if the Congress would allow its hands to be tied when it comes to examining the R&D budget year by year in terms of the changing needs of the country and changing priorities.

There are frequent proposals for centralizing the Government's science activities, for creating a Federal "Department of Science." What do you think about this?

Well, one trouble is that there are so many proposals which are labelled "Department of Science" that it is hard to say what you are talking about. I have always said that to put all scientific research and development into a single department would be extremely unfortunate, because this would rob the mission agencies of their science base and their responsibilities for building the technology that they need. Neither DOD, nor HEW, nor Interior, nor Housing and Urban Development, nor the Transportation Department could possibly be expected to delegate all their responsibilities for R&D to another department. On the other hand, I have never said that the present structure is ideal and not subject to change; we are groping for good ideas to improve it.

However, it seems to me that structural changes are not likely to be critical in the science funding situation at the present time. Changing the structure offers no guarantee that you will change the funding. In fact there are many who believe that organizational changes in the Executive branch of the Government might actually decrease science funding. This is because you would effectively alter the committee structure in the Congress and therefore alter Congressional attitudes and responsibilities for science support. You might well plan on one agency taking a larger part of the support, but the cognizant Congressional committee might not feel the same way.

I think the more basic problem is that the national enthusiasm for the support of science has waned. And it has even become negative in some quarters. There are many people who say science and technology are spoiling our society, or spoiling our environment, or damaging the quality of life.

On the question of the public attitude toward science, you said recently that scientists often appeared as "self-seekers." Could you elaborate on this?

I wasn't questioning the intent of scientists to do their best for the country; I think they all are trying to do it. But when they and they alone plead for additional funds, the Congressional recipients of those pleas are likely to regard the scientists as self-seekers.

Science needs a larger clientele of support. We need to have industrial people, business people, lawyers and citizens who recognize and support the validity of having strong science in this country, and who have reasons for going, themselves, to their Congressmen and saying that it

is important to the national welfare to have science adequately supported. There was a public outcry for greater support of science after Sputnik, for example, and Congress in its tradition responded to that. Similarly, there was strong popular support for science after World War II. In these two periods the Federal Government responded to public attitudes; now, it's responding to public attitudes that have become much less enthusiastic. I think the science community has a responsibility for trying to explain to the public the value of science, the goals of science, the usefulness of science, the benefits that science has given to our society and can in the future; and to persuade Congressmen that Federal money for science is a good investment, not solely because science is a great intellectual undertaking, which it is, but because it has great national usefulness, which it does.

Do you see an analogy between the opportunities that physicists have now, in working on problems of importance to society and in being "relevant," and what they had in World War II, when they went off and did a great variety of jobs?

There is one main difference between now and World War II. What physicists did then was to convert themselves to engineers and apply their knowledge of science to technological problems, to the development of weapons and techniques of defense that the country needed. Today the problems are less technological. There are technological components, but there are also large components of economics, sociology, human feelings, human relations, questions of what you mean by the "quality of life." So physicists, chemists, biologists and other scientists and engineers may well join forces and collaborate with social scientists, economists, political scientists and others to see how a total social problem can be solved, to see what political actions must be taken to implement new technologies and to bring them to bear on improving the quality of life. Instead of just technological problems, we now have interdisciplinary problems. I think there will be many opportunities in universities and government for scientists to work with individuals trained in other fields to attack problems which are far more complex, for instance, than the technical problems of space or of military technology.

On the question of the value of science to our society, on the "relevance" ques-

tion, what roles do you see for physicists?

Well, I think the first responsibility of a physicist is to be a good physicist, to learn his subject, to learn the values and mechanisms and methods of research, to learn about the relations of his subject to other scientific disciplines, to pursue creative research and teaching, if he is in a university, or to pursue good research and development, if he is in industry.

Also, I think the further development of physical science is important to our social welfare in the future. We need much more knowledge about many things to help solve some of our social problems. We need to know more about even such mundane subjects as air and water pollution, and mechanisms for controlling pollution. Of all the engineering and technological tasks that need to be done, many can well be carried on by physicists who are willing to get into the applied-sciences area.

One matter of concern to many physicists, of course, is the science-funding situation. What are the prospects of a turn-around?

Overall, the Federal Budget situation appears to be tight for the next two or three years. That doesn't mean there can be no turn-around for science, but it means it is unreasonable to expect a resumption of the rapid rate of growth of the early 1960's. We must learn to live with restricted budgets; exactly how restricted, I think it's impossible to predict at this point. But major new sources of income for the Federal government do not seem to be immediately in sight, and this means that major new expenditures are not in sight. But there could still be some resumption of the growth of academic science, for example. I hope there will be but it's very hard to predict for more than fiscal 1971, for which the President has requested an increase.

At least compared with former years, there is now a large oversupply of science PhD's. Do you think that universities should aim to cut down their PhD output?

This is being carefully studied, and it's hard to get an easy answer. As research funding climbed at the rate of 21% a year, over the period of roughly 1957 to 1967, so did the support of graduate students. The sticky problem is just what should the rate of production of PhD's be today. The trouble is, if you decide how many PhD's you need this year, that doesn't tell you how many you'll need

five years from now, and therefore how many students should be encouraged to enter graduate school.

The rapid increase in PhD production in the last few years is probably too high for the foreseeable future. Probably some reduction in the rate of rise of PhD production is justifiable. But we have not been able to find criteria that tell us just what that means in terms of the total number of graduate students there should be, or the total number of new ones each year. We are studying that and we hope to have some guidelines developed soon. —JBP

Congressional Study Advocates A Centralized Science Agency

The National Science Foundation should be reconstituted as a new and unified government science agency, the "National Institutes of Research and Advanced Studies" (NIRAS), according to the House Subcommittee on Science, Research and Development. The Subcommittee, chaired by Emilio Q. Daddario of Connecticut, would bring together into NIRAS science and educational activities, now spread through many government agencies and costing about \$2.3 billion per year. The new agency could be initially established by Presidential executive orders without major Congressional action.

It seems unlikely that NIRAS or any "department of science" will be soon established in the government. But coming at this time it should help to focus debate on some pressing questions of US science policy: the "breakdown" in the pluralistic mission-agency support sys-

tem; the need, especially when money is leveling off, for better management of federal science support; and the fundamental question of how much science US taxpayers are willing to pay for.

Initially, NIRAS would have three institutes. The Institute of Natural Sciences would include NSF, NIH and other research programs. The Institute of Education would absorb graduate-level education programs from several agencies, and various federal institutional support programs. The Institute of Arts, Humanities and Social Sciences would be comprised of the present National Foundation on the Arts and the Humanities, and a new National Institute of Social Sciences.

NIRAS would take up "basic research projects determined to be no longer relevant to agency missions." For now, national laboratories and applied R & D programs, such as those of AEC and NASA, would stay with their present agencies. NIRAS could absorb "other programs and parts of agencies" in the future.

Along with establishing NIRAS, the Subcommittee would strengthen the "science superstructure in the Executive Office of the President." The staff of the Office of Science and Technology (OST) should be substantially increased. The OST Director should have Cabinet status. OST should more thoroughly and continuously evaluate Federal research programs; it should "assume a planning, coordination and evaluation role" in Federal higher-education programs in the sciences, and it should probably be the executive-branch focal point for technology assessment. —JBP

THE PHYSICS COMMUNITY

APS Group Studies Job Problems; CPPS Proposes Permanent Group

A Committee on Economic Concerns has been appointed by the American Physical Society in response to the recommendation of its Committee on the Problems of Physics and Society, headed by A. M. Clogston of Bell Telephone Laboratories. CPPS also proposed the formation of a permanent group on physics and society, which would replace CPPS when it disbands in January 1971. These proposals, made at the April APS meeting, are the results of a six-month study.

At its first meeting on 29 June, the Committee on Economic Concerns, headed by Lee Grodzins of MIT, endorsed a proposal to support an extension

of the Placement Service of the American Institute of Physics. The proposal consists of the hiring of a full-time person, who, according to Grodzins, would "develop new approaches to the placement problem." APS has already set aside \$40 000 for this proposal and for the committee's work.

What form the permanent group on physics and society will take is still being discussed by the APS council. Initially, CPPS advocated a new division, but, says Clogston, "this idea has been met with considerable trepidation because of the extension of the concept of technical division to include nontechnical activi-