

SOME THOUGHTS ON FEDERAL SCIENCE

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IN REPORTING to my peers on my stewardship I shall be brief and cover only that portion of my duties that have direct impact on you. I shall not touch on the problems associated with the internal management of research and development within the Navy Department.

The three topics that I shall touch on are:

- I. An estimate of the monies that will be available for research in the new fiscal year starting this July.
- II. Observations about the general topic of project research, indicating areas of potential danger to science.
- III. And finally I would like to make some observations with regard to the responsibilities of scientists in areas other than pure research.

SOME of you have been deeply concerned during the last few months, starting last September, regarding an Executive Order that was being drafted in the Bureau of the Budget which dealt with the responsibilities of the Science Foundation and its relation to other Government agencies engaged in support of science. Coupled with this concern with the Executive Order, there was some lifting of the eyebrows because of statements in regard to pure research coming from various responsible people associated with the Department of Defense. There was a third factor—a potential shifting of funds among the several agencies involved in support of research.

The Executive Order has been issued. The monies have been distributed. And let me summarize the state of affairs at present, and how ONR is affected.

The major portion of the Executive Order reiterates the several functions assigned to the Science Foundation by law. There are a few additional thoughts in the Executive Order. It encourages all agencies in the Government to engage in research that is closely related to their missions. It also states that the Science Foundation will assume greater and greater responsibility for the support of research in this country. This last statement expresses the desire of the Executive Department of the Government, and it can occur only if Congress supplies the funds. Fortunately, Congress each year has

increased the Science Foundation's appropriation. We are unhappy about the derivative but at any rate it is of the right sign. The first statement regarding research closely related to the mission of an agency requires interpretation. If this—basic research closely related to the mission—is taken literally, it has an element of inconsistency. I think there is sufficient wisdom among those of us in Washington responsible for the administration of these programs to give proper interpretation to this phrase. Let me at this time try to outline a little bit how we in the Navy Department interpret this phrase.

We intend to continue to support basic and fundamental physics and science. We will support it in the same fashion in the future as we have in the past. For purposes of planning, we will support three broad areas:

(a) Fields of science that are of such importance to the Navy that we in the Navy must assume almost national responsibility for the health of those fields. An example in this area is oceanography. In physics, some of these fields are in—for lack of a better word let me say—classical physics; these are possibly best characterized by the big blue books that Cambridge University Press has traditionally published. Lamb's "Hydrodynamics" is an example.

(b) The second area is again very vital to the future technical capabilities of the Navy but other agencies in Government and industry also rely on this area for their future technical growth. An example in physics, I would say, is solid state or, to put it more broadly, problems that can be handled in non-relativistic quantum mechanics. I don't want to imply that we are not interested in the Dirac equations or the Retherford-Lamb experiment.

(c) The third area is much more nebulous than the first two. We want to have listening posts in various scientific fields and we want to maintain contact with the most imaginative people in science. These fields and these people on superficial examination may not be relevant at this time to the Navy's needs, but we must know what is going on on the frontiers of various scientific fields and we must maintain contact with the best minds in science. It is my personal belief that

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these areas may be the ones that ultimately will have the maximum impact on future Navy technology.

Even before the issuance of the Executive Order, this type of division, these three areas that I have mentioned, has been the basis of our program planning. Even before the Executive Order was issued, we started to make certain changes in our program. We have reduced support in certain scientific fields, and increased support in others. This was always done with concurrent conversations and exchange of views with the Science Foundation. And I would like to point out that if one is to maintain a vital and dynamic program, one must from time to time shift areas of interest, and we took the opportunity to do this when the Science Foundation came into existence, so that things were not just dropped without any responsibility. For example, we decided some time ago to reduce our effort in the general field of cryogenics with the understanding that the Science Foundation would pick it up. This does not mean that we have lost interest in low temperature phenomena, it simply means that our interest in low temperature phenomena will appear in programs such as solid state. Thus we will support low temperature as part of other programs rather than just in its own right as cryogenics.

This general approach that I have stated has been accepted by the Department of Defense, and I assure you that the Science Foundation is in agreement with it. Similar reorientation, similar philosophy, is occurring in the Departments of the Army and the Air Force, and I am sure they also have the appreciation that the closer you tie basic research to this notion of end items, the less benefit you derive from research.

Now in regard to monies, I can give you only the readings in terms of the money bills as they have been passed by the House of Representatives, for further action by the Senate. The Senate may modify these bills. I would venture to say that the Department of Defense will spend about the same amount of money for scientific research in this coming fiscal year as in the last fiscal year. There will be some slight reductions, reflecting reduction in the general research and development appropriations. Within the Office of Naval Research, in the general area of scientific research, we may make more funds available in this coming fiscal year than in the current one. If my memory serves me correctly, the appropriation in this current fiscal year for the Department of Defense was about \$1.3 billion for research and development. As the bill was passed by the House, this sum for the next fiscal year is \$1.15 billion. The Science Foundation's budget was increased by \$3 million. So, with the increase in the Science Foundation appropriation, possible slight reductions in the Army and the Air Force, and no reduction, possibly some increase, in the Department of the Navy, the total funds for scientific research, at least in the physical sciences, from all sources—the Department of Defense, the Atomic Energy Commission, the National Science Foundation, and other agencies—will be about the same, with the possibility of a slight increase.

THERE have been a number of public speeches and addresses which have implied that Government support is wrecking American science, and that this project system, or projectitis, is a potential malignant tumor on the brains of our creative and able scientists. It is very vital that speeches of this character by men who have no immediate responsibility continue to be made. This generates ideas and forces those with responsibilities to be thoughtful and self-critical. However, occasionally one must look more carefully at these extreme statements, and actually try to see the potential harm and good that science derives from the present support from Government.

If one looks at *The Physical Review*, and talks to young people in physics, one cannot but be impressed very profoundly with the vigor of American physics, its quality, and the quality of the training that young men are receiving. And it is also fair to say that much of the money that was made available for this high quality creative scientific work and the training of young men came from the Federal Government. I think that, in all fairness to those institutions that have received Federal funds, it is well to observe that those institutions that fortunately need no Federal funds, on the whole, have been no more productive, no more imaginative, than those that have received Federal funds.

The things to watch are uniformity of support and support from only one source. These are the real dangers. In order to maintain freedom in science, so that the scientific community creates the problems, so that the best in science can flourish, one must be sure that universities themselves provide support, that private foundations provide support, that industry provides support, that several agencies in Government provide support, and that everyone does not use the same administrative procedure in determining what should be supported.

In the good old days a department head may have been tyrannical or arrogant and may have stifled the young men in his department. A research committee of a university may have similar characteristics and produce similar consequences. But there are many department heads and many research committees, so that no single department head, no single research committee, can affect very profoundly the national scene or inadvertently suppress the best and the good in science.

There are two aspects to this uniformity in the support of research. One is the pattern of selection of the work to be supported, and the other is diversity of sources of funds. We in ONR in the past—and this will continue in the future—have always tried to have a variety of means in providing support. We support individuals on a project basis. We support laboratories, where the program in detail is selected essentially by those who are responsible for running the laboratories. We support, jointly with the AEC, large nuclear machines, which are essentially laboratories. The work done on these machines is determined by the group around the machine. Our administrative machinery is

varied, and we do not have uniformity in providing support. At times we use evaluation committees; at times our staff directly selects the projects and program for support. Within ONR, we have very consciously avoided a pattern, and have met each situation as an individual problem and tailored our administrative machinery accordingly.

However, there is a tendency throughout the Government, and unfortunately this tendency is also being copied by various private organizations that make funds available to science, to support research more and more on a project basis, giving smaller and smaller sums of money and using the same mechanism, such as committees, for evaluation. Everyone will have a good average program, but we may be overlooking the exceptional. There is grave danger in this. The tendency to give money in smaller and smaller chunks stems from the administrator's feeling that he can act more responsibly for small projects than for large sums distributed by those closer to the bench. Somehow I feel that Government agencies should be encouraged to experiment with various types of machinery in providing support and that various methods of selection should be employed. Individuals, laboratories, departments as units should be supported, and evaluation of proposals for support should not reside only in committees.

The other disconcerting activity is the drive to get all possible data on science in this country—how much money is going into physics, how much is going into this kind of physics and that kind of physics, what part of the country is getting it, how much industry is putting into research, how much Government is putting into it, which departments in universities get it, which don't, etc. There is a certain vagueness at this point as to what these numbers, these statistics, will be used for, but the social scientists are in there gathering this information, and I think this has an element of potential super-planning of science on the national scene, planning that is based on factors other than content in science. Let me assure you that this has not yet occurred, but there is every indication that once these numbers are available they will be a basis for those who think naively that we need a national plan for science to ensure that monies are well spent, in the right part of the country, in the right department, evenly distributed, etc., and the content of science will be lost in the process. These gatherers of statistics, who really do not know why they want them or how they will use them, are like alcoholics—only more and more data will satisfy them.

These are the dangers that I foresee, *two of them*, that everyone will use the same mechanism in providing support, the various Government agencies, the various private foundations; and, secondly, that this accumulation of data on science and scientific activities in the hands of the social scientists may become the basis for national planning for science, with the numbers hypnotizing the planners and the content of science never considered.

FINALLY, it is customary for those of us in Washington in addressing our colleagues to ask you to come to Washington, take leaves of absence, and share the responsibilities in the administration of science. This I want to do.

However, in these troublesome times, and each one of us gives his individual weight to the factors that make the world around us appear troublesome, I should like to say more. There has been a great deal of talk to the effect that there is not enough basic research, and we need more basic research. As a consequence of this talk, I think we are losing appreciation of the many serious problems of great urgency facing the country that scientists as a group must contribute to, and we must realize that not everyone can do research because some have to assume some responsibility for the nation's technical health as it reflects our military preparedness. Once the national policy results in making available over \$1.5 billion for research and development in the Department of Defense and the AEC in order to be better prepared in case of attack, we as physicists have a responsibility. To meet the problems of national defense, physicists can join certain laboratories on leaves of absence, or come down to Washington, but all of us cannot have the privilege of just engaging in research.

Basic research in physics is in fine shape—look at *The Physical Review* and our other transactions. There is no danger to physics if some of you would be concerned with problems associated with our national defense. As individuals some of us may have to sacrifice the privilege of doing basic research for a year, two years, or even five. As a group we must recognize the existence of this need—the need to serve our country in a capacity that will utilize our skills and training, and permit us to make our maximum contribution. We, as a group, must provide the climate for and give proper recognition to those who leave basic research and undertake these classified problems. We must face up to the dual problem, ensuring that physics continues to prosper intellectually and that proper support is given to our national policy.

The war created a certain group of physicists who know how to deal with military matters. Some of those who have this unique training have continued to work very hard in this area that I am talking about. My concern is that we are not training any young men with the same skills. We have to devise mechanisms whereby we can replace the older generation, not only to push forward the frontiers of physics but to make physics, and training in physics, useful in dealing with the common defense.

I make this plea because I feel that I am in a unique position to see both the needs for basic research and the needs for defense. And I think the record of ONR is such that this plea is not made in a trifling manner. We serve both masters, and it is possible to do it. It is the responsibility of all of us to meet both types of needs, for we have the skills both for research and for some of the important problems in defense.