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Federal Money and University Research

Some historic failures suggest major political issues that may still be involved in the support of science.

Don K. Price

The recent hearings by the Daddario subcommittee on the record and the mission of the National Science Foundation give us an opportunity to reconsider the whole subject of government support of university research. When I was asked, along with many other witnesses, to submit my views, I said that I thought the Foundation had been a remarkable success (*1*). And so it has. By any crude measure of political or financial success it would be hard to beat. Vannevar Bush and his cohorts first proved their ability to turn basic theory into practical accomplishments during the second World War. Then they persuaded a suspicious and jealous Congress that basic science was worth supporting for its own sake—or at any rate without inquiring too closely about its connection with practical results.

This was an impressive short-run triumph. Even more impressive was the fact that it reversed, apparently, some of the nation's most cherished long-range political habits or prejudices. Tocqueville, for example, had observed a century earlier (*2*, p. 52) that in the United States "a science is taken up as a matter of business, and the only branch of it which is attended to is such as admits of an immediate practical application." Later he went on to say (*2*, p. 320) that "the spirit of Americans is averse to general ideas; and it does not seek theoretical discoveries."

This general observation could have still been considered applicable to American science in the 1930's, as it had been during the 1830's. For a century or so Americans not only accepted Tocqueville's verdict but gloried in it. Mark Twain's *Connecticut Yankee* typified the pride in the practical and useful, the scorn for theory, the glory in self-support and contempt for government authority, that seemed at the end of the 19th century typical of the United States.

It was no mean feat to overturn this traditional attitude. Yet by the middle of the 20th, the picture was radically different. Federal tax funds were going to the support of academic science that made no claim of immediate utility. You can measure the input by the hundreds of millions of dollars per year and the output in Nobel prizes and the articles in scientific journals; by either standard it has been an impressive performance.

These are the things that impress scientists most. But students of politics should, I think, be more interested in a by-product of this revolution in the relation of science and politics—should be concerned not merely with the impact of government support on science but with the impact of science on government. For Tocqueville's was only one of two characteristic European predictions about America in the 19th century that turned out in the 20th to be all wrong. The other was Macaulay's. He observed—and it is significant that this came not from a Tory but from a Liberal and the father of the reformed civil service—that the American Constitution was "all sail and no anchor"; by abolishing the special status of the aristocracy and the special privileges of the wealthy, Thomas Jefferson had turned over political power to the envious masses, who would soon tear down all the institutions on which civilization depended and bring us to anarchy or socialism or—by way of reaction—to military despotism in the style of Napoleon III (*3*).

It seems to me that the failure of Macaulay's prediction had some relation to the failure of Tocqueville's. The building up of strong independent scientific institutions, now supported in part by government money and with a long history of interest in government policy, and the tremendous strength, within the federal system, of corps of scientific personnel with an extraordinary influence on policy and an extraordinary capacity to resist political control or discipline—these have helped us create a constitutional system that, to admirers of parliamentary responsibility, seems all anchor and no sail.

But even though this general political speculation may be relevant, let us get down to the precise topic of this seminar. It is clear that we have made a revolution in the relation of the federal government to colleges and universities. In that sense, we are dealing with a new problem. But even though we have come a long way from Tocqueville and

The author is dean of the Graduate School of Public Administration, Harvard University, Cambridge, Massachusetts. This paper was prepared for the introductory session, on 6 October 1965, of a series of seminars held by the Brookings Institution on some major policy issues involved in federal programs of scientific research at universities. It is printed by permission of the Brookings Institution and will be included in a volume that the Institution plans to publish on these seminars toward the end of 1966.

Macaulay, we have not completely abandoned all our old political habits. And political and administrative professionals cannot afford to waste time indulging themselves in political self-congratulation. For nothing is so temporary in politics as a great victory.

This particular victory, it seems to me, rests on a rather shaky pair of foundations—namely, the reaction to the Depression, and the fear of war. You remember the couplet

> The Devil was sick, the Devil a monk would be;
> The Devil was well, the devil a monk was he.

The immediate occasion of our conversion to government support of basic science was of course the fright of the second World War. The scienitsts had performed miracles that enabled us to win the war and that promised to help us establish endless prosperity. They accordingly became as popular and respected as the businessmen had become in the 1920's, after they helped mobilize America's industrial power in the first World War. As the experience of the businessmen in 1929 suggests, this is not necessarily a guarantee of permanent popularity.

The Depression was probably responsible for a change in our national mood or attitude that, even before the second World War, did much to change the status of science in our political system. It was the notion of automatic progress, based on a union of applied science and free private enterprise, that had let the leaders of America assume that politics and government were not things that need concern the best minds in the country. The Depression shattered that faith. Moreover, it came along at a time when leading scientists were painfully aware that wherever science is taken up only as a matter of business, as Tocqueville observed, it was sure to be a second-class kind of science, and also at a time when Marxist intellectuals throughout Europe were posing fundamental questions regarding the connections between the philosophy of science and political ideas.

Out of all this ferment something had to bubble up. To the extent that, even before the second World War, the Depression had begun to lead politicians and scientists to take each other more seriously, it probably provided a more enduring basis for a satisfactory relationship between the two than did the threat of war.

Predicting Difficulties

Yet it would be naive to assume that the present volume of government grants to universities for theoretical science could have been stimulated solely by a zeal for pure learning on the part of administrators or congressmen. The mixed motives that have led to this tremendous volume of appropriations are likely to lead to difficulties in the long run. If we were to try to predict the main types of trouble that are likely to arise in the future, in order to safeguard against them, we should do two things.

First, we should quit hypnotizing ourselves by projecting the trends of the past 15 or 20 years. Even if this rate of increase could continue indefinitely, which I take to be impossible, it could do so only by including within our definition of research a lot of work that would necessarily be different in kind or in quality from the type of science we have been seeking to support in the past.

In terms of sheer quantity, however, I venture the guess that we will continue to try to explore the endless frontiers of federal subsidy for scientific research. Businesses have been persuaded that scientific progress is the key to industrial prosperity. Military planners are certain that it is the key to military strength. The universities themselves, especially the great public institutions, have grown into a powerful interest group which, in influence with the Congress, takes its place along with the businessman and the farmer. And perhaps the most powerful fact of all is that the executive hierarchy is infiltrated at the top levels with men whose personal interests and training are conditioned by scientific and technical education, or by career patterns which lead them to look to institutions outside the government service for intellectual leadership. The nature of the executive service is reinforced by the nature of the constitutional structure: the committees of Congress are not as disposed to follow the leadership of a disciplined political party, or a disciplined central bureaucracy, as to follow the rather diverse leadership of the specialized committees. They of course are tempted to run off in all directions at once and to give far more weight to the opinion of experts, or to the results of scientific research, than to any central political leadership.

We used to think that this would work only in fields where hard-headed politicians would be persuaded by practical results—the big bang of modern weapons, or the magic bullets by which medical research would provide miraculous cures for dangerous diseases. But now that the Office of Education has managed to persuade congressmen to support even research on the processes of education itself—and has even wangled support for its program from the professional educators themselves—it seems clear that there are hardly any limits on the amount of money we will choose to spend on research grants.

But lack of money is not the only thing to worry about. Even though universities may be getting ample grants, they are certain to run into other political difficulties. And so my second suggestion, if we are to try to guess at the types of political problems that may arise in the near future, is that we should look to the past for some lessons. For this purpose we should quit, for the moment, admiring the great success story of the Bush report and the National Science Foundation and look back on some of the earlier political failures that are within the memory of living men. The record of some of our failures will perhaps suggest some of the major problems, some of the fundamental political attitudes, that complicate the relation of government to science in our political history.

Quite arbitrarily, I think I would choose four of the failures as starting points for speculation. These are the Science Advisory Board of 1933–1935; the National Research Fund; the Kilgore Bill, in which a National Science Foundation was first seriously proposed; and the Research Board for National Security. Let me take each of them up in turn, not merely to explore ancient history but in order to introduce some very contemporary problems.

Science Advisory Board

The Science Advisory Board was the first committee of eminent scientists which the Executive Branch ever asked for comprehensive advice on national policy. President Roosevelt commissioned a blue-ribbon panel from the National Academy of Sciences and National Research Council, under the chairmanship of Karl T. Compton, to produce a program to beat the Depression. The program, to the horror of the sanhedrin of the Academy, pro-

posed federal grants to universities, private and public alike, and cited as precedent for government grants to the Ivy League the long history of federal aid to the land-grant colleges. The program might have gone through in spite of the fear on the part of the private universities that their status would be compromised if it had not been for Honest Harold Ickes, who stood pat on the old tradition: public aid should go only to public institutions (*4*).

On the face of the matter, we have completely abandoned Ickes' point of view. He represented the staunch old faith that public funds should be devoted only to public purposes and, moreover, that a strict line should be drawn between private institutions, which are not dedicated to public purposes, and government agencies, which are. This was the distinction that led the United States to end its support of ecclesiastical establishments, discontinue the awarding of monopolies to private business, and stop the licensing of privateers in time of war—in short, to eliminate the last vestiges of guilds and feudalism in our political system.

Since we are now clearly relying heavily on private institutions, through various types of governmental grants or contractual arrangements, we have the automatic impulse to safeguard the public interest by tightening up the specifications and the inspection of performance, under the contracts.

This is all to the good if the government is buying goods or services that can be precisely specified in advance. On the other hand, if it makes a deliberate political judgment that our national purposes will be advanced by supporting and enlarging the amount of scientific research that is carried on in independent universities (whether private or state), because the very quality of independence produces results that are more in the public interest than results that could be produced within the regular administrative hierarchy, then we have a very different situation. Then we are obliged to ask whether our administrative and contractual arrangements are really designed to carry out this policy judgment. It seems clear to me that they are not, perhaps because we never explicitly made such a national policy judgment. Instead, we backed into it, making every effort not to look at what we were doing. We pretended we were only buying specific pieces of research from independent sellers, or that we were only supporting by grants particular projects that would add to the sum total of science. And we woke up in surprise to find that these bits of support were about to convert our national system of independent universities into a system dependent in large measure on federal support, since project grants had displaced other funds within the university budgets, so that indirectly even the humanities had benefited from them.

Now, of course, the terms of that relationship are being debated between government and university officials. And the ways in which universities have traditionally run their affairs do not make it easy to assure conscientious auditors and contract officers that the public interest is being protected. In the past, much of the private money that has come to universities has come from bequests, or from enthusiastic alumni who do not know or care very much about the details of the scholarly interests that are being supported, or from knowledgeable donors who do know and who respect the necessity of leaving researchers a great deal of freedom to pursue their unpredictable purposes. In none of these relationships do university scientists become accustomed to justifying the details of their work to the sources of their funds.

Moreover, universities have commonly tolerated, or encouraged, a large amount of individual entrepreneurship; their professors have never been entirely dependent on their salaries for their incomes. The resistance of the faculty of the University of Chicago, a generation ago, to an employment contract which offered somewhat higher salary in return for an agreement to turn outside earnings over to the university was a good illustration of the practical faith in free-wheeling individual enterprise even among those who doubted its merits in political theory. The general freedom of professors to accept royalties from their writings, fees for consulting and lecturing, and various kinds of special payments from special sources has encouraged habits that make the government-university relationship difficult. The inclination, for example, to pick up a bit of extra money for work during the summer or on weekends could be ignored when such opportunities were open only in exceptional cases. But when universities began to use federal funds to offer prospective faculty members extra compensation for summer work, or reduced teaching loads to enable them to earn outside consulting fees, the matter of outside earnings obviously became a policy issue of some importance. But the problem is hard to deal with because this kind of individual enterprise in financial matters corresponds to the kind of freedom and initiative in intellectual matters that characterizes the most productive centers of scientific research.

Now I am unable to join those who deny that there is a problem, or that it can be dealt with by asserting that professors are morally superior to other people and can be trusted with funds without being subjected to any administrative check whatever. A few years of experience in a grant-making foundation is likely to give anyone a more pessimistic view of human nature. Nevertheless, it is by no means clear that we can solve the problem by imposing on the universities the kind of overly detailed centralized checks that, within the government itself, have proved so wasteful and so destructive of responsibility.

Perhaps the first thing is for the universities themselves to recognize their own responsibilities more clearly. It is now obvious that their relationship to the government is now for them big business, and it is up to them to organize themselves to handle matters accordingly. On this point I need say no more than was said last year by the Committee on Science and Public Policy of the National Academy of Sciences in its report "Federal Support of Basic Research in Institutions of Higher Learning." The strengthening of university administration, in order to discharge fully whatever responsibility for the custody and expenditure of public funds may be involved in research grants, is a basic necessity.

But from the point of view of the federal government, it is by no means clear that its own interests are protected by the maximum amount of detailed supervision of universities, or detailed bookkeeping within universities. We learned (at least in theory) more than a generation ago that the kind of detailed checking that then went on in the General Accounting Office saved very little in the way of expenditures and cost tremendous amounts in the effectiveness of management. Something analogous seems to me to be going on now in the relation of grant-making agencies to universities. On the one hand, the auditors and investigators who are the guardians of

our public conscience tell us that we must check on the detailed performance of detailed obligations in this relationship, just as in any other. Thus we see the beginnings of a steady multiplication of paper work and the filling out of reports on time spent on work done under particular project grants. Thus, too, we see a new requirement for cost sharing. And the question is raised whether a questionnaire circulated by a university aided by a federal grant should not be controlled by the Budget Bureau as if it were a government questionnaire.

It is easier for the President to say, perhaps on the advice of his Science Advisory Committee, that "more support will be provided under terms which give the university and the investigator wider scope for inquiry, as contrasted with highly specific, narrowly defined projects," and to emphasize the fact that in "the vital top segment" of higher education "education and research become inseparable" (*5*), than to get these fine generalizations translated into practice by auditors and contracting officers. From my personal point of view, the worst thing about the nature of this relationship at the working level is that it gives the leaders of American higher education, who are going to have a profound influence on what the next generation of college students think about government and politics, a wrong impression of what "administration" actually is, and one that is a powerful deterrent to the selection of public service as a career.

Similarly the principle of cost sharing, which makes a great deal of sense if a small foundation is about to go fifty-fifty with a university, has very little effect on the way business is handled if the proportion is set at 5 percent, as the National Science Foundation now suggests, or at 1½ percent, which is more to the taste of Representative Melvin Laird. Matching in much larger proportions cannot be required without wrecking university programs. But matching in these proportions, even though it is better than the refusal to pay the total amount of indirect costs, is still relatively ineffectual; on the government's side, it is mainly a pious gesture, and on the university's, a continuous minor irritation, and not much of an incentive toward economy.

Nevertheless, at the very minimum those interested in the government-university relationship have to take into account the fact that there is a deeply rooted distrust of irresponsible establishments in our political tradition, our inherited ways of thinking. I for one think it is a healthy tradition if only it is put into effect in ways that correspond to the modern problem. The essence of the modern problem is that the extent of government interests is too great, and the need for positive action too broad, for the public interest to be satisfied adequately by detailed supervision at routine subordinate levels. We must find ways to delegate authority and encourage initiative and responsibility in the relation between government and universities. We should be able to do so at least as well in this relationship as in state grants-in-aid, where the institution which receives the grants is made more generally responsible for the detailed accountability.

But this depends on a proper system of incentives, and *that* we do not yet have. We need something to substitute for the type of requirement that in effect asks a scholar to punch a time clock when he quits research and begins teaching, or when he quits thinking about university-supported research and begins thinking about government-supported research. The filling out of forms along these lines is nothing but an invitation to creative fiction; if a university scholar is any good, he cannot possibly know where one type of activity begins and the other ends.

The problem cannot be solved by detailed bookkeeping requirements. It can only be solved by a system which gives the university an incentive to take the same point of view as that required by the higher interests of government policy. And this is of course the most powerful argument for moving, at least in part, from a system which bases support for research on a series of small narrowly defined projects to a system of broader general grants—to the "program project" or the institutional grant.

The argument here is exactly the same as the argument against detailed line-item budgeting. Money that is available only for a narrow specific purpose is money that the general administrator has no incentive to avoid wasting, because he cannot apply any savings to any other purpose. If the university is to be given an incentive toward rigorous economy, this cannot be done by the principle of cost sharing; it can only be done by making the grant funds available for longer periods, and over broader areas of subject matter so that the university administrator thinks of them as his "own" funds and economizes accordingly.

The main difficulty comes from contrasting government grant funds with the university's "own" funds. The very notion of private ownership is misleading in thinking about the incentives that control a university's business. The general unrestricted funds of a university are not available to be converted into personal profit; it is rather the precisely restricted funds, controlled by the intentions of the donor, which a university administration has no incentive to control in the interest of academic austerity. For this reason I think that a waste of funds would be greatly reduced if, on the whole, the government—without giving up the project grant as its main instrument of support—would move in the direction of support on a broader basis, putting more general substantive as well as financial responsibility in the hands of the university faculties and administration.

National Research Fund

The second traditional public attitude which complicates the government-university relationship is our congenital mistrust of the government career servant. The episode in our recent history that best illustrates this point was the action of the National Academy of Sciences, during the late 1920's and 1930's, in setting up a National Research Fund with the purpose of raising private funds to supply the rapidly growing basic research needs of the scientific community. To many of those who lent this effort their support, it must have seemed that this was the last chance to avert the necessity of government subsidy, which had always been anathema to the Academy. It is hard now to recall how deep and conscientious were the objections of the scientific leaders of only a generation ago to accepting general subsidies from government sources.

Later, when it was clear that the subsidies had to be swallowed, the pill was sugared either by an approach (especially in the initial Office of Naval Research program) that paid great deference to the academic traditions of free research, or by arrangements which made the awards depend in the

main on decisions, not by members of the career government service, but by panels of advisers from independent universities. Hence the statutory framework of the NIH advisory councils and the popular practice of using outside panels for decisions on project grants.

This system obviously has great merit, especially in the making of decisions on the scientific aspects of any question. These are the aspects that predominate in judgments on particular research projects. But as the government broadens the basis on which it gives support to universities and begins to make much broader grants for institutional or program support, the scientific ability of particular investigators becomes proportionally less important, and more importance attaches to a vast range of subjects on which the specialized scientific knowledge of an advisory panel is much less decisive. For a detailed argument as to the decreasing extent to which the responsible official may lean on his specialized advisers, as grant-making programs come to be based less on specific research projects and more on broader types of institutional grants, I refer you to the report of the review procedures panel in the report entitled "Bio-medical Science and Its Adminisistration," a study of the National Institutes of Health.

Under my first point, I suggested that we should not think about the question of government supervision of university research programs as one in which an increase of control by government agencies would actually insure more responsible use of public funds; the argument against such an increase is not one on behalf of the university but on behalf of the government itself. In this second point, the reverse is true: we have reached a stage in this relationship in which it is no longer in the university's interest to keep the government weak at the level where the key decisions are made. It would be positively to the advantage of the universities, I believe, if their own members did not have so predominant an influence in the making of grants to them, and if the government should rely a great deal more on a career government service of high quality. For if these funds are controlled entirely by panels of outside advisers, the system is in danger of degenerating into petty academic politics, because the major nonscientific issues will not be recognized and faced up to squarely. This situation can be prevented only if a strong group of career officers can, by high-quality staff work, identify the major issues for debate and decision. This will not keep the universities and the private advisers out of the act; indeed their voice will always be more influential than that of the career bureaucracy at the top political levels where the key decisions will ultimately be made. It will only let those decisions be framed in the light of a consideration of general alternatives, which our present system makes it difficult for us clearly to understand.

The Kilgore Bill

So far we have dealt with the broader policy issues regarding the support of science by sweeping them under the rug, and by pretending that a completely free enterprise system of project grants can be backed by an unlimited continuation of increases in the amount of available funds. If we are to face these questions we have to confront squarely the conflict between the view that governmental decisions regarding scientific institutions should be made according to the judgment of the leaders in the scientific community and the view that they should be made by political authority. This brings me to the third big failure that I would like to recall. *Failure* is not the word that most leading scientists would apply to it—they would consider it a fortunate outcome. But the successful enactment, in the main, of Vannevar Bush's program was the defeat of Senator Kilgore's. It may be useful to stop to recall that the first major political effort for the establishment of a National Science Foundation was not that of Dr. Bush but that of a West Virginia senator, who frightened all of the leading scientists by his apparent assumption that science should be under government guidance.

In some ways Senator Kilgore and his closest advisers took an approach to science that resembled that of Bernal, Haldane, and other Marxists. Senator Kilgore thought that the sciences could be advanced through subsidization as applied sciences, with an eye on practical development. Moreover, he was perfectly willing to support the social sciences on equal terms with the natural sciences, assuming that the ultimate end of science was to solve social problems and advance the purposes of human welfare. The similarity in these respects to Marxist thought did not go unnoticed among conservative leaders of scientific institutions. But they might well have noticed that in these respects Thomas Jefferson had anticipated the Marxists. And on a key political test—the point on which Jefferson differed most sharply from the Marxists—Senator Kilgore was clearly a Jeffersonian; in his mind science did not fit into a tightly integrated national system, in which decisions would be made on a centralized basis. He wanted a quota system which would require that grants be distributed among the several states much on the pattern of the agricultural research grants and the land-grant colleges. If it was a planning of science that he favored, as the frightened leaders of the Academy warned each other, it was a populist sort of planning growing out of a deeply American political tradition.

The Kilgore bill was defeated. Moreover, it was generally forgotten through almost a positive effort on the part of scientists. It was pushed back deep in our national political subconscious. But its central notions are slipping up on us again rapidly—as the Commerce Department proposes that the "trickle down" theory will not let the nation devote a fair share of its science to applied programs affecting domestic prosperity and human welfare; and as the social sciences creep into the programs of the NIH and the National Science Foundation; and, even more important, as the National Academy of Sciences begins to study systematically, with the help of social scientists, the problems of organizing and supporting the natural sciences themselves. And they are creeping back, finally, as natural scientists and their university administrations throughout the country organize political action toward getting their share of the grants, being convinced that the problems of competition will grow worse rather than better in the future as the rate of increase of the federal research budget slows down.

What we have to worry about, it seems to me, is not that government as such will decide at high levels of authority to restrict the freedom of universities and scientific institutions. It is not that social planning will impose itself from some central power center on institutions throughout the country. It is, rather, that an even more damaging form of political interference will be generated from within the scientific community itself, and that local and regional rivalries will throw so many general policy decisions into the political arena that it will be hard to work

out any orderly and systematic policy for supporting science on standards of scientific quality.

Research Board for National Security

The fourth question of which I am reminded by one of our historic failures is the civil-military double standard. Not many people remember the brief episode, shortly after the war, of the effort to create a Research Board for National Security. During the time when the plans for the National Science Foundation were stalemated by the disagreement over whether the director should or should not be responsible to the President, there was a considerable danger that the military services would cut off the war-time support of science before any civilian agencies were prepared to take it up. This led to the proposal that the National Academy of Sciences should create a Research Board for National Security, to which the military services would transfer funds, to be given out in grants to universities and research laboratories. The Director of the Bureau of the Budget stopped this move, largely because he thought that public funds should not be dispensed by a nongovernment agency like the Academy, and also because he anticipated President Eisenhower in his distrust of the scientific-technological elite in alliance with military power.

Harold Smith, the Budget director in question, had a good bit of Harold Ickes in his political make-up. He distrusted establishments. But on this issue his opponents were more in tune with the national mood than he. As a nation we distrust only civilian establishments. It is only career civilian officers who have no political appeal, and only the civilian departments that cannot wangle from Congress a high measure of delegated authority and administrative discretion.

From the point of view of the universities and the scientific community, it was a magnificent accomplishment when the Office of Naval Research stepped into the breach and held the fort until NSF and NIH could bring up their resources—and went on holding a good part of the fort thereafter. From that time until the present, of course, the vast majority of research and development funds—even a majority of basic research funds—has come from federal agencies whose missions are not primarily to support basic science or higher education but to direct science toward programs supported for purposes of national security and military strength.

On this issue I am far from being against the military services. I would give them more money for science and not less. But as a matter of balance, I think that the military basic research funds themselves are in danger of waste because to a large extent they are spent in universities which do not have adequate general support for their general functions of research and education. The Department of Defense, as a matter of fact, has shown more awareness of this point in its development of institutional and programmatic forms of support than have most of its civilian competitors. The qualities of independence and critical scholarship and leadership in basic theory, on which the whole research and development enterprise depends, will be threatened unless the central structure of the universities is made strong enough to sustain the structure of specialized research grants.

We now face the question of whether the support of scientific research and higher education can be seen as a public purpose in itself. From the educational point of view we are supporting universities throughout the country by something perilously close to political subterfuge. We are putting so much larger a proportion of our money for science into specific projects, on account of the financial double standard within the United States budget which favors military over civilian purposes, that we are in danger of a serious lack of balance. It still remains true today, in spite of all the recent advances in support of research for educational purposes, that it is much easier to get funds from the Congress for purposes of military power than for general civilian objectives. AEC and NASA, as well as the military services, depend largely for congressional support on considerations of international power and rivalry. Aside from the case of the National Institutes of Health, the grants for support of applied science for the civilian purposes of government are either tied to obsolete patterns of science support, as in agriculture, or stalemated by the fear of social action interfering with private enterprise, as in the case of the Commerce Department.

Conclusion

We are separated from the era of the Science Advisory Board of the mid-1930's only by a single generation, but we are now required to deal with a set of political problems—problems in which science is inescapably involved—that its members could never have foreseen. We have to learn how to support an educational and scientific establishment, including private as well as public institutions, without either destroying its freedom or leaving it in a position of privileged irresponsibility. We have to learn how to fit the research interests of free scientists into a pattern of public policy, and to take account of the need for balanced national development while building up our existing centers of high scientific quality. And we need, equally obviously, to devote our knowledge to the service of human welfare, as effectively as it has been enlisted in the service of national defense. We obviously have not yet learned how to do all these things. But we can at least begin, if we are not afraid to make some changes in some of our most stubborn political and administrative habits.

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