

Scientific Progress, the Universities, and the Federal Government

The White House, on November 20, released a report of the President's Science Advisory Committee on "Scientific Progress, the Universities, and the Federal Government." The report was drafted by the Committee's 14-man Panel on Basic Research and Graduate Education, after long study of the present relationship between the Federal Government and the universities.

The quotations from this report, and the comments on it that follow have been prepared by George W. Beadle, acting dean of the faculty and professor of biology at Caltech, who is a member of the President's Science Advisory Committee, and of its Panel on Basic Research and Graduate Education.

Why should the Federal Government continue to appropriate larger and larger sums for the support of academic research and manpower training in the sciences and engineering? In the words of the President's Committee:

Both the security and the general welfare of the American people urgently require continued, rapid, and sustained growth in the strength of American science. Other reports of qualified bodies, and earlier reports of this Committee, have argued in detail the reasons which make this growth vital to us all. We believe that most Americans are in favor of more and better science. In a general way Americans recognize that scientific understanding is at once highly valuable in its own right and quite indispensable for the sustained progress of a modern industrialized

society. We are proud of our great accomplishments, and we become concerned whenever it appears that our scientific effort in any field may be second-best. Most of all we have learned to recognize that the defense and advancement of freedom require excellence in science and in technology.

But our acceptance of these quite modern ideas does not mean that we understand fully their consequences for our policy and practice: American science in the next generation must, quite literally, double and redouble in size and strength. This means more scientists, better trained, with finer facilities. Many forces contribute to this urgent need for growth. Our population is rapidly increasing, so that there are more and more young people to be taught, and we have nothing like the number of qualified teachers we need even now. Science itself is expanding so fast that our efforts would have to be much increased, if we were only to keep up with its general international momentum. The training of scientists takes longer than it used to, and the facilities needed in a modern laboratory are usually much more complex and expensive than those that were needed only a few years ago. Science and technology today have steadily growing mutual impact, so that the practical man has need of the closest and most immediate access to new results in basic science. Thus both science and scientists must be more and more widely diffused throughout our society. We need more men doing more things, with more support, in

more places. And each of these requirements is better measured by multiplication than by addition. It is the simple truth that if this country is to safeguard its freedom and harvest the great opportunities of the next generation of science, the level of its scientific investment must be multiplied and multiplied again.

Yet the right word is *investment*. What this country spends on excellence in the sciences is not money gone with the wind. It is money that brings us handsome returns, and of many kinds. In immediate economic terms the proposition is clear enough: what we have done in science has brought our society riches many times greater than what science costs us, and this will be true as far in the future as we can see. In economic terms, indeed, scientific investment has quite extraordinary power. Ordinary capital investment puts savings to work on labor-saving machinery that is already known and understood; the increased wealth produced is what separates the developed modern society from helpless poverty. But scientific and technological investments are still more powerful tools, since they invest in the discovery of what we do not yet understand. We are only just at the beginning of the use of scientific investment in this large sense, and the returns it can bring in are literally incalculable. Simply in terms of economic self-interest our proper course is to increase our investment in science just as fast as we can, to a limit not yet in sight.

But we should not emphasize only the material returns of scientific investment. Science yields a return also in the quality and humanity of our civilization. Science is not merely an inducement to progress, it is an affirmation of man's respect for nature and a way to the fulfillment of some of his highest capacities. Science is enriching, but at its best it is much more: it is enlarging to the spirit. This higher value is one we should never leave out of account in our desire to reassure ourselves that science "pays." Indeed any shortsighted calculation of return-on-investment is likely to be self-defeating. Scientific progress does not occur in any neatly predictable way; nor can we be sure ahead of time which research project is likely to have particular consequences for our prosperity or security. Moreover scientific discovery is not easy, and many experiments fail. Nothing could be more unwise than an effort to assign priorities or judge results in basic research on any narrow basis of immediate gain. It is the advance of science as a whole on which we must rely, for material as well as other returns.

Much of this basic argument for the strengthening of American science applies equally to other fields of learning. While this report centers

on the needs of science, we repudiate emphatically any notion that scientific research and scientific education are the only kinds of learning that matter to America. The responsibility of this Committee is limited to scientific matters, but obviously a high civilization must not limit its efforts to science alone. Even in the interests of science itself it is essential to give full value and support to the other great branches of man's artistic, literary, and scholarly activity. The advancement of science must not be accomplished by the impoverishment of anything else, and the life of the mind in our society has needs which are not limited by the particular concerns which belong to this Committee and this report.

We do not, in this report, attempt to consider what direct responsibility and interest the government has for strengthening basic research and graduate education outside the sciences. This is a subject which deserves careful attention, but it is beyond our mission. What we can say, however, is what earlier reports of this Committee have regularly emphasized, that neither the government nor the universities should conduct the support of scientific work in such a way as to weaken the capacity of American education to meet its responsibilities in other areas. *The costs of scientific progress must not be paid by diverting resources from other great fields of study which have their own urgent need for growth.* (Italics added.)

Thus, after pointing out that ". . . the process of graduate education and the process of basic research *belong together* at every possible level" and stating the ways in which government can best provide the needed support, we find the following:

But when all these things have been said, the first and greatest of responsibilities comes back to the Federal Government. No matter how many diverse elements of our society may join in their support (and the more the better), basic research and graduate education are in the end, by their very nature, a problem for the nation as a whole, and so for the national government. There is not one physics for California and another for Texas. A first-rate program in Massachusetts or Connecticut must not be limited to New Englanders. Science flourishes by honorable rivalry, but not by any effort to consider only narrow or local interests. Both basic research and graduate education must be supported in terms of the welfare of society as a whole. It is in this large sense that the role of the Federal Government is inevitably central.

The truth is as simple as it is important: *Whether the quantity and quality of basic research and graduate education in the United States will be adequate or inadequate depends*

primarily upon the government of the United States. From this responsibility the Federal Government has no escape. Either it will find the policies — and the resources — which permit our universities to flourish and their duties to be adequately discharged — or no one will.

The Institute's part

What is the situation at Caltech? Without substantial help from the government both our research in science and engineering and our educational accomplishments would be far less than they are today. Omitting the 50 million dollar annual expenditure at JPL, which is government-owned and Caltech-operated, some 43 percent of the 1960-61 academic budget of 12 million dollars comes from government sources. And this is not high as other strong academic institutions go. The extent of such support will almost surely increase in the future, for, as the Committee says, there is simply no other source of funds of the magnitude required to meet the needs of future years.

Dependence and control

The question is often raised, is it wise for a private institution like Caltech to become so dependent on government? What if the funds should be suddenly cut off or drastically reduced? Clearly we'd be in a bad way. But this will not and cannot happen short of a complete economic collapse of the nation. And in that case all institutions, private and state, would collapse too. The dependence is mutual. No longer can a modern nation remain economically strong and free without supporting academic research and education in a big way. So long as Caltech remains strong, sensible, and effective, we as an institution will continue to receive support.

What about control? "... the hand that controls the purse..." Government support comes from many agencies and for many purposes. Most of us believe that this is as it should be, for that is a part of our insurance against control. The government is not a monolithic giant capable of acting in unison in all its parts. A second part of our protection against control is our private support. This we must continue to have in some reasonable proportion to government support. Our own resources from foundations, individuals and industry is of the greatest importance to our freedom. Properly used, a part of this support can serve as a kind of "independence fund." If the policies of a given granting agency become unreasonable and unacceptable, we use such funds in refusing to be controlled. The fact is the Institute has several times done just this — with the full support of the Board of Trustees. If we are right and our principles are sound, we will not lose. Furthermore if we act sensibly as a part of a very large community of academic institutions, private, municipal and state,

we are just too large and important a part of society ever to have to submit to control by government in any undesirable way.

On this point of control, the President's Committee has this to say:

Perhaps the most important single task of the universities is to see to it that their own standards of freedom and excellence are maintained in a period of growing connection with government. While we do not share the notion that government money is necessarily subversive of university freedoms, it is obvious that large-scale Federal spending, like any other form of patronage, has its hazards. In the record of the last fifteen years, there is much more ground for hope than for fear, but occasionally government action has distorted the direction of research or unwisely discriminated against particular scientists on irrelevant grounds. It is to the credit of the government that such cases have been the exception, not the rule, and we commend the good sense which has led the Administration to oppose discriminatory and useless affidavits of disbelief as a condition for fellowship aid.

But the first and greatest responsibility for keeping our universities free and self-reliant rests with the universities themselves — with their faculties, their administrators, and their trustees. What they do not defend, others will not find it easy even to understand, while when they are staunch in their principles and vigilant in their practices, the record suggests that neither the Federal Government nor any other source of support is an overwhelming threat to them. Courage and vigilance are essential, but there is no ground for a timid mistrust of government in and of itself. The right concept is that of partnership, with each partner respecting the rights and responsibilities of the other. For this there is need for a constant effort of communication and understanding, and we repeat that the first responsibility here rests with university people.

Faculty salaries

There are many — a decreasing number, I hope — faculty members who believe it unwise, immoral or both for a part of a faculty member's salary to be paid from a government contract or grant. In this we must learn a new way of life, for it is clear that in more and more ways and to a greater and greater extent faculty salaries will come from government funds.

Here is what the Committee says:

And there is more to it than money and time for research. The really great scientific faculty cannot be the servant of other men — it has to be secure in its own freedom and responsibility.

Too many university administrators suppose that faculties can be bought and managed like baseball teams. It is not so. Universities need brave trustees and strong administrators, but in the end they are what their faculties make them. That the United States today has a number of first-rate faculties is our greatest single scientific asset. To sustain them and to provide the conditions for the growth of more is the greatest single task of American university administrators.

In placing first and central responsibility upon the universities here, we do not mean to underestimate the importance of what government does or does not do — quite the contrary. In our judgment the general pattern of Federal support for science has so far developed with very little regard for the problem of building strong faculties, and we think it urgent that careful thought be given to changes in policy that may help the universities discharge this great responsibility. The basic difficulty at present is that most Federal funds are tied to specific research projects in a way which makes it hard for universities, in making long-term appointments, to rely in any way on Federal funds. This difficulty is compounded in some agencies by policies which discourage the use of Federal money to pay the salaries of senior faculty people. We believe that these practices and policies need to be revised in the light of the proposition that nothing is more clearly in the general interest of the Federal Government than a rapid increase in the quality and quantity of the nation's teaching scientists.

We do not venture to prescribe the ways in which the government and the universities can best serve their common interest at this sensitive and highly important point. Experience is a powerful teacher, and so far we have no knowledge of what can happen when the government and the university become jointly concerned with strengthening the ranks of senior scientists in our universities. There are many instruments that can be used here. At one extreme is the relatively simple practice of paying an appropriate share of the salaries of all faculty members engaged in a federally-supported project; we think that this policy should in general be adopted as an interim measure, even though it often has the disadvantage of perpetuating the misleading distinction between "teaching" and "research." At the other extreme is the method, now used in Great Britain, of large general grants for all purposes to all universities; we doubt if any such pattern could or should be accepted here. In between are such devices as the training grant, which can often be used for professional salaries, and the so-called "institutional" grant, in which broadly inclusive support is offered for a relatively large sector — say "biological science" —

over a relatively long period of time. We believe that the government and the universities should take energetic measures to put into effect programs in this middle ground, with the specific objective of making Federal money not simply a reinforcement of scientists already holding tenure, but a stimulus and a support in the appointment of more such men. We repeat that in the general interest a rapid increase in the number of such permanent professorial scientists is needed.

We recognize that many university scientists are strongly opposed to the use of Federal funds for senior faculty salaries. Obviously we do not share their belief, but we do agree with them on one important point — the need for avoiding situations in which a professor becomes partly or wholly responsible for raising his own salary. If a university makes permanent professorial appointments in reliance upon particular Federal project support, and rejects any residual responsibility for financing the appointment if Federal funds should fail, a most unsatisfactory sort of "second-class citizenry" is created, and we are firmly against this sort of thing. A variant of this same abuse is the practice of permitting extra pay to faculty members from grants or contracts, during the regular academic year. It seems to us fundamental to the spirit of a university that a man's salary from the university itself should not be supplemented by extra term-time payments for work that is properly part of his professorial responsibilities. (Summer compensation for research work is a separate matter, since most academic appointments plainly leave the summer months free for other activities at additional compensation.) Just as a professor should not be responsible for obtaining the funds to pay his regular salary, so also there should be no bonus payment for "landing a contract."

But in our judgment the possibility of abuse is not a good argument against action. We are convinced that when a university is firm in accepting institutional responsibility for payment of all senior salaries, and protects its staff from improper pressures or incentives, it can and should seek Federal support for salaries as for other needed elements in basic research and graduate education.

It is today a widespread practice for faculty members in science and engineering to be paid from government funds during two or three months of the summer — 22 percent or 33 percent over and above the regular stipend. And it has just been announced by the National Institutes of Health that substantial funds are now available to add faculty members in colleges and universities in "health-related" areas, their full annual salaries to be paid from this source.

The Caltech plan for faculty salaries

The President's Committee endorses the payment of summer salaries from grants and contracts, largely, I believe, as a matter of practical expedience. I am a dissenter on this point, for I believe this is a compromise with the principle that there "... should be no bonus for landing a contract." A summer salary not otherwise available is a bonus, in a sense determined by the faculty member himself. I believe the Caltech policy provides a proper way of arranging for partial support of faculty salaries. This policy provides that every faculty member has the option of being reimbursed on a twelve-month basis, with one month provided for vacation. Some reasonable fraction of the total stipend, as determined by the fraction of time spent on supported research, may be charged to the grant or contract. The total annual salary is guaranteed by the Institute, in return for a commitment to spend eleven months in recognized scholarly activity, whether this is supported by outside funds or not, and whether it is done at the Institute or elsewhere on the basis of leave-of-absence with salary. Thus the individual faculty member is rewarded for what he does and not merely for his success in "landing a contract." He may be paid from outside funds for a proper fraction of his time spent in grant- or contract-supported research, without reference to the way that part of his time is distributed through the eleven months. He does not then need to rationalize what he does during the three summer months. "Is it all right to attend a Science Teachers Institute, supervise graduate students, work on that book or try out an idea in an area not covered by the grant?" I fear that under the alternative policy of summer salaries from grants such rationalization is sometimes pushed to the very brink of illegality or immorality.

The Institute policy has the great additional advantage that the faculty member doing scholarly work in an area in which grant or contract support is unavailable is not penalized financially as compared with his colleague in more favored areas.

Most people will readily agree that our policy is right in principle. At the same time they may point out that it is not possible in their own institutions because there are so many faculty members outside science and engineering that available funds will not support such a plan. They therefore choose to continue living on a double standard of faculty salaries.

There is a real danger that competition will force the Institute to give up a fair and desirable policy, for obviously our policy is a more expensive one. If we were to revert to the more general practice, we could more easily increase salaries in the sciences and engineering to meet outside competition for faculty members in greatest demand by other institutions. With a given income available for faculty salaries such a change would obviously mean a redistribution

of salary funds — more for those in grant-favored areas, less for others. I sincerely hope we will resist pressure to do this. If we are all convinced our policy is sound and right, we can resist. At the present time our 1959-60 average faculty salary is the second highest among academic institutions of the nation, *after adjustment to a nine months basis* (AAUP Bulletin, Summer 1960). The annual take-home salary is of course 22 percent higher for everyone. I do not mean to suggest that this standing is reason for complacency. The substantial increases effective for 1960-61 are tangible evidence that every effort is being made to improve our competitive position. If we are to maintain top excellence in quality of faculty, we must do everything possible to achieve and hold a top position in salaries. And we can, if we will, do this without compromising a policy that is right and fair to all.

The overhead bugaboo

There is one highly undesirable way in which government — and other — granting agencies may unknowingly do great harm to colleges and universities. This is through continuing to think in terms of "purchase of services" — of getting the most return for the dollar. Thus funds are often restricted in such a way that certain direct costs and none or only a part of the indirect costs of research are reimbursed.

Since the full costs, direct and indirect, must be met by the recipients of such grants, the deficit must be made up by a redistribution of available funds. Thus by increasing research activities in science through grants that do not meet full costs, other activities are often robbed in the process. Unfortunately faculty members who do research do not always fully appreciate this. Their first loyalty often is to their science, not to an institution — and it can be argued that this is as it should be. As a consequence they are inclined to say, "Indirect costs are not my problem. They belong to the business office." They may fail to recognize that the indirect costs of added research may have to be met at the cost of needed faculty salary increases.

Fortunately, at the Institute most faculty members understand the indirect cost problem. Those who do not agree with the Committee's recommendation:

We repeat the recommendation of an earlier report that "Government departments and agencies concerned should uniformly modify the grant and contract provisions to permit universities and non-profit research institutions to charge full cost of research performed for the government — including overhead — and to amortize capital expenditures as an allowable cost."

may find it worth while to read a recent article by Norman Kaplan in *Science*, **132**, 400, 1960) and a reply by President DuBridge (*Science* **132**, 1746, 1960).