

The Independent Research Institution

By *Vannevar Bush*

Some remarks concerning the role played by independent research institutions in the advancement of basic scientific research.

IT IS SOMETIMES MAINTAINED that the day of the independent research institution is over, that henceforth fundamental research belongs to the universities with heavy governmental subsidy, and that such an institution no longer occupies a unique position in the national scene as it once did. When this view is based on more than a casual estimate of national trends, it usually implies two criticisms: first, that the research institution is isolated and that the interchange and cross-fertilization of a university community is necessary for best progress in these days when disciplines are becoming more intimately interlinked; second, that fundamental research and the education of brilliant students should be closely related and that the research institution is prone to become ingrowing and stodgy in the absence of the continual impact of young minds.

These are cogent points, and the research institution that wishes to preserve its health had better pay attention to them. The problem of isolation is mitigated when research departments of an institution are located close to a university, as some of ours are. But isolation is more a matter of attitude than of geography. It is quite possible for two departments of a university, in adjacent fields, to occupy the same group of buildings for years without a trace of genuine col-

laboration or mutual inspiration; such isolation is in fact exemplified all about us. On the other hand, a research department far from universities may become a national or even a world intellectual center in its field, the place where those intimate interchanges between masters occur which are often the seeds of progress. In biology Woods Hole has performed this function admirably; and in genetics Cold Spring Harbor is now a mecca, as are Mounts Wilson and Palomar in astronomy. Interchange, the antithesis of isolation, has its burdens and its abuses; too much of the wrong sort can be a nuisance. But the department or institution which gives the appearance of being sufficient unto itself, which neither gives nor takes, which tries to crawl into a hole where it will be undisturbed in pursuit of its inclinations, is sick and in need of a radical operation.

One should not make the error of regarding formal education as the only means of contact with youth. Formal education is not the business of the research institution. But if a research institution allows itself to become old in its ways, the fault is its own. It can and must, if it is to maintain its vigor, expose itself constantly to the influence of young minds. Much depends on how they are selected and how they are treated. Contact with a group of graduate students in a university has its needling effect and its invigorating influence; it also has its chores and involves duties to students of only average ability. The research institution, if it will, can select the cream, not only in mental capacity but in the subtle characteristic of being able to fit well into a scientific community. Once selected, its younger staff members can be made genuine participants in its programs and in its group arguments and plans. Organization within a department, discipline of a sort, grades and titles, are of course necessary. But there should be no caste when a group of scientists meet for a scientific discussion, in twos or tens; and there should be no discrimination on account of age or reputation. The youngster, in a gathering of two or fifty, should be given his opportunity on the floor by common consent, provided only that he has something to say and knows how to say it briefly and to the point. And if he does not know how, he will soon learn, with encouragement and in the right atmosphere, provided he has the stuff. Though the problem of inducing participation on the part of younger members is not unique to the research institution, it is especially important to it; for the influence of the presence of youth is hardly automatic in the institution's case, and the dangers of getting into grooves and of slipping into scientific fixity are greater in a community of scientists alone than in more diversified aggregations.

These are the prime dangers of the independent research institution. But they are more than offset by its advantages. The advantages could be enumerated and examined at length. But only two will be treated, two central points which are often misunderstood.

The author is president of the Carnegie Institution of Washington. This article is an excerpt from Dr. Bush's *Annual Report* (1953) to the trustees of the Carnegie Institution.

It has long been realized that one of the most effective ways to ensure outstanding achievements in fundamental research is to locate the individual of genius and support him liberally as he pursues his own way. This is indeed important, and Andrew Carnegie realized it fully, as is shown by the early records of the Carnegie Institution of Washington. But there is more to it than the simple statement indicates, and the independent research institution is in a good position to refine and develop the simple idea to advantage.

We need genius, of course. But there are geniuses who are utterly lone workers, who are lacking in generosity and unduly jealous of their reputations, who will retire into a cubicle and work with no man. Great things have been accomplished by such individuals in the past and will be in the future. But much more has been and will be accomplished by those who have brilliant creative skills combined with human attributes that make them always welcome in a community of their peers. Their full accomplishment may not appear in their own papers, for they will be surrounded by devoted disciples, and their creative contribution will be in men as well as in direct results. The independent research institution furnishes an ideal climate in which such individuals can function to best advantage. Within it the program of each department, created by the staff itself, never handed down from above, is more than the sum of its parts. Each senior member formulates his own program, of course; but he does it in concert with his fellows, so that a departmental program emerges, interrelated, mutually contributory—a broad program for progress on which all can embark with enthusiasm. A university department can do this too; but it is more readily done by a research institution, free from the distractions of teaching and the manifold set of relations that exists in a faculty.

The other part of the problem of supporting genius is to find the genius before he has matured and made a reputation; for otherwise, changing his environment at best merely gives him a wider opportunity and at worst is a form of piracy. There are occasional leaders in science and learning equipped with a sixth sense who can do this well. Such a one was Daniel Coit Gilman, who, putting full time into the effort for a considerable period, assembled at Hopkins a brilliant congeries of scholars: Rowland, Welch, Osler, Gildersleeve, Remsen, Martin. But such gifted leaders are far more rare than the geniuses they seek. In fact it is doubtful whether genius is as rare an attribute as it is generally supposed to be, and whether there are not far more men who would blossom into great creativeness if given the chance. One means of attracting men to a university faculty is the august committee of selection, which passes on nominations and brings men of distinction in from the outside. This means is not an effective one for finding the promising youth at the beginning of accomplishment, for committees very seldom take risks. It can, moreover, be deadening to the morale of the youngsters struggling up inside the organization. The best way to pick young men of promise is to have the

selection done by a man in the same field, subject to checks. This is the way it is done in the Carnegie Institution of Washington. The person who makes the initial selection is the director of the department. His checks are of two sorts. First, his senior staff participate with him, suggesting and judging; and one can be rather sure that if they welcome a youngster with practical unanimity he will fit, even though to a casual lay observer he might seem to be rather a queer specimen of the race. The other check is by the President and Trustees, who, though they can hardly compare individuals in detail, can certainly ascertain that standards are held high and adequate diligence is employed in the search. The best way to get a new young scientist of great creative ability into a group is to have a group that is made up to a considerable extent of men of just that character, and then allow them to select their novices, with provision for rotation and further selection—all under the leadership of a scientist with judgment. Judgment in the selection of men is, in fact, one of the primary attributes of a successful director of research. Again, all this can be done in a university department. But the tightly knit group in a research institution can do it better.

There are many things which a university can do better than a research institution. But this is a discussion of fundamental research. In this field the research institution is paramount and is by no means an obsolescent form of organization. It can, if it will, carry on fundamental research in a most fruitful way, better on the whole than can be done anywhere else. So there is a place for it in the future if conditions are such as to allow it to prosper.

The principal condition, though not the only one, for ensuring the prosperity of research institutions is financial. It is, moreover, a matter of endowments rather than of current funds for projects.

There have been important trends in the financing of research in this country. Since 1920, according to a recent report by C. I. Campbell, the fraction of the total national income devoted to research has been multiplied by ten. But the fraction devoted to fundamental research has increased relatively little. The federal government has entered strongly into support of research, but its entrance has brought a host of problems, and its support is largely confined to projects, some of them in basic research. These projects allow an organization such as a university to expand its operations. But they do not create new centers of research, nor do they allow old ones to proceed to a permanently secure basis of larger effort. The Carnegie Institution of Washington has not participated in government contracts, except in the case of a few projects where there seemed to be a duty to do a temporary piece of work. It has not felt that enlargement on the basis of such contracts would be entirely healthy, and it is strongly inclined to retain its complete independence. Although the federal program has been an aid to many a college or university in time of difficulty, it has its dangers, and participation should be circumspect.

The great foundations have turned away from endowment grants, and the new foundations that are formed do not enter this field. There are many reasons for this. One valid reason is that giving away money in great sums transfers the responsibility for its use to others, and a foundation often prefers to do its own thinking, beyond the mere selection of a few institutions from among many to receive its largess for the furtherance of their several purposes. This change in the policy of foundations, however, adds to the great sums being spent on a project basis. And the temporary project is not a sound way in which to carry on fundamental studies of depth or subtlety.

The project idea, introduced largely during the war and as a necessity at that time, is far better adapted to applied research than to fundamental research. This is part of the reason why fundamental research has not been expanded to the extent that it should be. The foundations here have to some extent missed an opportunity. As the government entered strongly into scientific research, they moved out. If they had moved into basic research, they might have preserved a balance. There was plenty of opportunity for them to exercise their talents of review and analysis in seeking areas of opportunity, for the scope of fundamental research has expanded far more than the means for its furtherance. There was hence opportunity to create new institutions, endowed and independent, where they were most likely to prosper. A bit of this has been done; and there are exceptions to the comments above, of course. Carnegie Corporation donated five million dollars for endowment to the Carnegie Institution of Washington when it was sorely needed. But in general the foundations have not tackled the problem of extending fundamental scientific research in this country, nor is there any great indication that they will do so.

New independent research institutions have been established by individual philanthropists—the day of great fortunes and of great altruism accompanying them is not over. Yet these have been largely directed at specific objectives, often in the medical field, and often of a semi-applied nature. This is not because men of wealth lack interest in search for the unknown or appreciation of the value, spiritual or aesthetic if you will, of the search for understanding, unencumbered by more immediate objectives. It is rather that such men understand better the sufferings and needs of humanity and are anxious to alleviate them.

This may be a reflection of our cultural immaturity. As we proceed, there may be more among us, highly successful in affairs, anxious to serve humanity, who will wish to look at the stars, or delve into the earth, or probe for the secret of life, not because it will add to the comforts or reduce the hazards of existence, but because it may render us a more dignified and understanding race with greater satisfaction in living. If so, there will be more and greater independent research institutions devoted to the search for knowledge for its own sake.

Miscellany

Government

Identical bills to amend the Atomic Energy Act of 1946 were introduced in both houses of Congress on April 15th by Representative W. Sterling Cole and Senator Bourke B. Hickenlooper, chairman and vice-chairman, respectively, of the Joint Congressional Committee on Atomic Energy. The bills, proposed in response to a request by the Administration, would authorize the President to transmit certain categories of atomic weapons information to our military allies and would permit the AEC to exchange with friendly powers restricted data on the industrial applications of atomic energy. The recommended legislation would also clear the way for private development of atomic power by establishing regulations governing the licensing of critical materials to industry and the operation by industry of atomic facilities.

In an Executive Order dated March 17, President Eisenhower has given explicit recognition to the need for a sound national science policy and has set down clearly his views concerning the role to be played by the National Science Foundation as a central agency for the effective coordination of Federal scientific activities. Emphasizing the importance of science to the national security and welfare, the President expressed his strong belief "that this Nation must extend its support of research in basic science" and called upon the Foundation to make periodic policy recommendations designed to "strengthen the national scientific effort and furnish guidance toward defining the responsibilities of the Federal Government in the conduct and support of scientific research". The Foundation, he said, "shall be increasingly responsible for providing support by the Federal Government for general-purpose basic research through contracts and grants. The conduct and support by other Federal agencies of basic research in areas which are closely related to their missions is recognized as important and desirable, especially in response to current national needs, and shall continue."

Organizational changes providing for four associate directors of the National Bureau of Standards have recently been announced by NBS Director A. V. Astin. R. D. Huntoon, former director of the Bureau's Corona Laboratories, has been named associate director for physics. The three remaining posts have been filled by Wallace R. Brode (chemistry), A. T. McPherson (testing), and N. E. Golovin (administration).