

“How pure can a research program be, and still command public support? How practical can it be allowed to become without losing the essential spirit of true scholarship?”

Problems of Financing Research at a Private University

by L. A. DuBridge

I wish to introduce this subject by talking about research problems at *one* private institution — namely, Caltech. I know that these problems will be found in other institutions — both private and public. And I know also that quite different problems may be faced by still other institutions — both private and public.

Caltech is a small private institution with a highly selected student body, restricted to about 700 undergraduate and 500 graduate students. When it was reorganized into its present form in 1920, it became devoted to the proposition that research and teaching should be inseparable activities in a school of science and engineering. Hence small teaching loads, adequate funds for research, and a small student body selected for its creative and research potential have always been the ideals — and these ideals have, to a substantial extent, been achieved.

A second pair of ideals was also adopted; namely, that all research activities should be of a basic nature aimed at the extension of knowledge — but, at the same time, the Institute would choose its fields of interest in such a way as to be of maximum service to the community and to the nation. Thus, at the same time that cosmic-ray research was begun in 1921, there was also initiated a program of research on the problems of high-voltage transmission of electric power. Structural organic chemistry and aeronautical engineering came along next. Later, genetics and jet propulsion — and so on.

In this respect Caltech and many other institutions face a serious choice. How “pure” can the research program be, as a whole, and still command community and public support? How practical can it be allowed to become without losing the essential spirit of true scholarship, the search for new knowledge?

There is, of course, no unique answer to this dilem-

This article has been adapted from a talk given by President DuBridge at the Symposium on Basic Research held at the Rockefeller Institute in New York City on May 14. The symposium was sponsored by the American Association for the Advancement of Science, the Alfred P. Sloan Foundation, and the National Academy of Sciences. The entire symposium record will shortly be published in book form by the AAAS.

ma. Yet every institution must find some answer which is both consistent with its own ideals and consonant with its circumstances and responsibilities.

Our aim at Caltech has been to lean over backward in the direction of basic or pure research, and I shall try to explain how we seek to maintain this posture under today's conditions.

First, we find that a small student body is a prime asset. If our teaching load were allowed to outrun our research capacity, we would then have a large teaching staff inadequately provided with research facilities or funds. The pressure would be great to accept any kind of research task for which funds were made available, just to keep the faculty busy. This, you will admit, could lead to unhappy results.

The problem of selection

But even under the best circumstances the selection of research activities and research fields remains a critical problem. The momentary glamor of a well financed but inappropriate project may have to be resisted in favor of the long-term benefits of more basic research activities. To assist in reviewing this situation our faculty and trustees invented the device of a faculty committee on sponsored research. Before an actual proposal for research support can be forwarded to any outside agency — private or government — it must be reviewed by this committee to be sure that it conforms to our ideas of what constitutes basic research. Inasmuch as this committee, with a rotating membership, has been in existence for many years (since 1946) its policies have been well established and are well known to the faculty. It does not often have to veto a project any more. But it has done so and can do so at any time.

This does not mean that there have been no "practical" projects. There have been many — even in the basic science fields. For example, a few years ago one of our biochemists, Professor Haagen-Smit, who had had one too many sniffs of the famous Los Angeles smog, went into his laboratory to see if he could artificially create that characteristic odor. With one eye on the Los Angeles motor traffic and the other on California sunshine, he was soon able to show that gasoline vapor *plus* ultraviolet light did produce a typical smog cloud, and he had soon elucidated the basic ideas of the chemistry of that particular type of air pollution.

However, it is in the engineering departments that the most difficult questions arise as to what is fundamental research and what is practical development which could be more appropriately done in commercial laboratories. Engineering is *applied* science, and engineering research must have some relevance to the practical needs of men. Yet, even here it is normally possible to distinguish the projects which are aimed toward a basic extension of engineering knowledge and toward new contributions to engineering practice,

from those which are aimed solely at the perfection of particular devices or techniques.

Our computer laboratory does not aim principally at the improvement of computer circuitry, but rather at basically new ways of using the computer as an instrument to solve scientific, engineering and technical problems, and as a tool to aid in the development of applied mathematics. The aeronautics laboratory does not design airplanes; it learns about the properties of air flow.

One useful criterion which helps many decisions in this field is that to be acceptable in any area a research program must be one which is consistent with and contributes to the educational program. This means it must be one in which graduate students can participate. This means, among other things, it must not be "classified," either for reasons of trade secrecy or military security. Also, it must not be one which provides exclusive patent rights to the sponsor. As far as the *on-campus* program is concerned, these rules are now rigidly followed.

Does that mean we have no way of being of service in the field of national defense or industrial development? Not necessarily. When we have found it necessary or desirable — since the close of World War II — to undertake classified activities, they have been done in off-campus installations where restricted access does not inconvenience the teaching program or interrupt the free access to all parts of the campus.

We operate two such off-campus installations now: the government-owned Jet Propulsion Laboratory (now the principal laboratory of the National Aeronautics and Space Administration for space flight research) and the Cooperative Wind Tunnel (owned cooperatively by a group of aircraft companies). In both cases Caltech initiated the work of these laboratories during the war and has continued them ever since under a nonprofit management contract.

A number of years ago a temporary project was carried on in leased space about two miles from the campus. Thus we are enabled to preserve the condition of free access to all parts of the campus by faculty and students, which we regard as a precious asset not to be relinquished except in times of extreme emergency.

The problem of finance

How, then, is our basic research program financed?

Here again it must be emphasized that in our case the size of the faculty is determined by the total funds that are available rather than by the number of students to be taken care of. Nevertheless, our able research staff does have an insatiable appetite for more research funds and for continually expanding research programs. Hence, the problems of financing the rapidly rising costs of research and the rapidly growing program are severe indeed.

It may be of interest to list our sources of support.

In listing them I shall list support for both teaching and research, for I do not know how to determine at Caltech how many pennies of each dollar go to teaching and how many to research. This is not because our bookkeeping department is inefficient, but only because we purposely mix the two activities so thoroughly that separate budgeting is impossible even in *principle*.

Out of a total *campus* budget of 9 million dollars (in 1957-58), endowment income provided 32 percent; gifts and grants from nongovernment sources provided 20 percent; government grants and contracts (including overhead) provided 35 percent; and tuition and other sources provided 13 percent. During the past 10 years the total budget has doubled. The percentage (but not total volume) of government funds has declined (from 41 to 35 percent), that of private gifts has risen (from 13.5 to 20 percent), and the others have remained nearly constant.

We hope and expect that these various sources of support will retain the present relative positions in the future — that is, in round numbers: endowment, 30 percent; gifts, 30 percent; government contracts, 30 percent; tuition, 10 percent. Whether this is just the right ratio or not, no one can say. But one can say that maintaining *all* of these sources of support is of very great importance to any private institution.

It is, of course, just here that all private institutions have a common problem — that of obtaining income from a variety of sources to support both educational and research programs.

Erosion of funds

There is no question but that the relative importance of endowment income in the private universities has been declining in the nation as a whole. This has sometimes been mistakenly referred to as the “erosion” of endowment funds. Actually, endowment funds have not eroded at all; they have, as a whole, risen rapidly both in book and in market value and they have also increased in their earning power — when properly invested — nearly as fast as prices have risen. Every private institution which has been on its toes has also secured substantial fractional increases in its endowment funds in recent years, and these increases are continuing.

Yet, research and teaching costs have outrun endowment income, not only because the prices of specific products have been inflated, and not solely because salaries and wages have risen sharply, but because the equipment, materials, techniques and manpower for doing research and teaching have changed so greatly. Intricate and enormous machines and instruments, requiring large crews to build and operate them, were almost unknown before the war, even in industrial laboratories. Now they are commonplace.

Clearly, this radical change in research activities

has not been financed by endowment funds. The change has been possible only because government funds have been available in substantial amounts.

Granted that some government funds have been misplaced and misused; granted that some have been used to support the kinds of things that universities should not be doing; it is still true that government funds have been the backbone of the growth of basic research in the universities in the postwar period. The chief trouble has been that government funds for basic research have not been available in large enough amounts, compared to the funds available for applied research or for testing and development. It is this fact that has forced many universities to take on development projects in order to have something going on that could be called research. A major problem of the future is to keep these funds for basic research growing at an adequate rate.

Government control

Increasing government support of research raises the question of whether or not the government will assume control of the universities if it provides funds for their research. The chief answer to this question is that it has not happened yet. The chief threat of control has come not from the government agencies who administer the funds, but from the panels and advisory committees (composed largely of professors!) who pass upon projects *and budgets* before they are accepted. Many of these groups have steadfastly opposed proper overhead payments on research contracts, have opposed including allowances for the salaries of professors working on the projects, have opposed block or departmental grants, and have required of the prospective research worker such elaborate and detailed proposals and reports that a type of bureaucratic committee control has grown up which suppresses daring ideas and takes administrative control out of the hands of the universities themselves.

All of these things are done with the most pious protestations, of course. “It isn’t good for the universities to receive overhead reimbursement and thus become dependent on the government,” they say. Or, “It is not good for the professor to have part of his salary paid by the supporter of his research.” (Why not? Somebody has to give the university money to pay him.) Again, “Block grants are bad for they put too much power in the hands of the department heads.” So a committee in Washington decides *it* is more competent to allocate the funds than the university officials!

As a longtime faculty member myself, I can pray fervently that both I and my faculty may be delivered from dictatorship by government faculty committees. Give me a good smart administrator to deal with and I can dispense with faculty advisory committees, *except when they deal with purely scientific affairs*

and not with administrative or fiscal matters. Scientists, when they get into government, are their own worst enemies. When they have control over activities of their colleagues — through the administration of research grants — they become autocrats of the most difficult kind.

These are serious matters. The rapid rise in research activities has required the universities to expand their plants, their business offices, their maintenance facilities and their libraries. Research grants or contracts which have not borne their share of these costs have been parasites on other sources of funds. It is quite all right to talk about the desirability of the university "sharing the cost" of research with the sponsoring agency. But what with? Endowment funds, as we have said, have scarcely kept pace with rising costs of carrying on the same operations, to say nothing of adding new ones.

Corporate executives, I find, get understandably glassy looks in their eyes when they are asked to give money to a university to cover indirect costs of research being sponsored by government agencies because these agencies cannot afford, or are not allowed, or simply refuse, to pay the full costs of the research which they take credit for supporting. Corporations and individuals alike have trouble understanding why they should be asked to underwrite those costs. So the universities don't ask them to. They ask for "unrestricted funds," or funds for "general support." But of course this is just a euphemistic way of requesting the same thing — money to pay the costs of research which others are pretending to support.

Now I must say that corporations as a whole have been exceedingly generous in responding to this appeal for unrestricted funds, and this has saved many an institution, including my own, from going broke in recent years. Or rather, I should say, unrestricted corporate support has enabled us to abandon our prohibition against accepting funds from government agencies which do not pay full costs. We now can accept such funds in limited amounts and still remain solvent.

Problems of government support

The principal problems in connection with the government support of research are:

1. To increase the funds available for basic research;
2. To persuade all government agencies to pay full costs of the research they support (including the prorated share of the faculty salaries);
3. To enlarge the degree to which block or departmental or general grants are made available for strengthening an *area* of science rather than only a particular project; and
4. To persuade the Bureau of the Budget and other fiscal and auditing agencies to modify radically the

cost-accounting practices which they now insist upon and which are inappropriate to educational institutions. (With some difficulty I restrain myself from a further discourse on this latter subject, which is even now a subject of strenuous and difficult negotiations between the universities and the government.)

Private funds

What, then, about the nongovernment sources of support for research in private universities?

The problems here are many, but, though they are not easy, they are not impossible. Granted that the government will continue to support a substantial share of university research — especially the large and expensive projects — private funds still play a critical role. Individuals, corporations and foundations should continue and expand their contributions to endowment funds, operating funds and building funds. Private sources are free to follow the theory that the strength of the basic research program in this nation is primarily dependent on the strength of the institutions that carry on such research. Hence, the most important way to finance research is to finance the institutions — to provide what they need in order to acquire facilities, pay adequate faculty salaries, and maintain the plant in order to attract and support the best research people. Especially is it important to provide the long-term support essential to a real scholarly atmosphere in which new ideas are likely to thrive. New ideas must be born *before* clever and startling research proposals can be submitted to the government. Private funds, wisely given, can enhance the intellectual ferment in our great centers of learning and thus create the environment in which new ideas will arise.

I would not be honest if I did not point out that there are troubles in the administration of private funds for research also. The indirect costs of privately sponsored research are just as great as for government sponsorship. As I have already suggested, the universities have found it embarrassing to pass the hat elsewhere for these costs. So they have done two things: (1) sought more funds — given largely on an annual basis — for "unrestricted" purposes (i.e., to raise salaries and pay overhead); and (2) asked private sponsors of all projects to pay their prorated share of these costs.

Private foundations have been understandably reluctant to do either of these two things. They wish to see their limited funds going for direct, recognizable costs of identifiable projects. Besides, they could point to plenty of institutions where the president or treasurer was a bum but the biology professor was a whiz. They wanted no funds to be diverted from the professor. And obviously, too, their money would "not go as far" if a quarter to a third of it was allocated to indirect costs. "Better to supply 15 hungry

men with bread than only 10 with butter too.”

I do not pretend to offer any easy formulas for solving this problem. Many foundations and other private agencies have found ways — a variety of ways — to assist. I am only setting forth the problem and asking that we all face the fact that those great research institutions of this country, the private universities, no longer have — if they ever did — “funds of their own” to disperse freely. All their funds are gifts (except, of course, tuition fees). Furthermore, a large share of these gifts now come on an annual basis and not in the form of permanent endowments. Professors on tenure, who resist having their salaries paid partly from project funds because they are on an annual basis, should become aware of the fact that other sources of funds are on an annual basis too and, whether we like it or not, that’s the way things are these days. This does not mean the professors will not be as surely paid; it only means that *every* possible source of funds must be tapped.

There are some who will bemoan the fact that the universities have allowed themselves to reach such a terrible state. And I admit that universities have been more concerned about national welfare than with their own financial security. The private universities could have pulled in their necks and refused to expand their research until endowment funds had been secured to underwrite it. Some, indeed, did so. But if all had done so and left it to the state universities to become the only research centers, the private university in this country would have been doomed to oblivion. And that would not have been good even for the state universities.

Paying the bills

But the private institutions as a whole met the challenge and took the risks. Fortunately, the largest sources of new funds did pay full costs, and these helped to carry the other projects which did not. Annual unrestricted gifts were sought and found also — and somehow the bills got mostly paid — that is, all were paid except the professors’ salaries. *They* had to wait — partly because the professors themselves did not realize the new turn which university financial problems had taken.

If we now raise our eyes from the specific research problems in a specific university to the broader problems of academic research in America, what difficulties do we see? There are many, of course — fiscal, administrative, jurisdictional, political. Some people worry about the “balance” of our research effort — that we will spend too much money on space and not enough on cancer, or vice versa. (Incidentally, I have frequently seen cases of general agreement on how much is “not enough”; I have never seen a generally accepted way of learning how much is “too much.”)

Great segments of science and technology now have

enormous popular appeal, and special purpose groups can whip up considerable enthusiasm for spending huge sums on this disease or that — or on nuclear power or oceanography or radio astronomy or other perfectly respectable areas, both basic and applied. Hence, so-called “categorical” funds grow and multiply — both in private and government circles. Of course, one can say that if there are only enough categories, with plenty of funds in each, then full freedom of choice is again available.

But is it?

I shall forever pity the physicist who is anxious to learn about the puzzling behavior of liquid helium II, wasting his time trying to decide whether this is solid state physics or nuclear physics, or maybe oceanography, and whether he should submit proposals to ONR or OOR or NSF. And how can he write a detailed proposal when he is just exploring, when he is just curious?

Fortunately — in precisely this situation and others like it — the Sloan Foundation has indicated that it was interested in supporting inquiring minds, and would be glad to have such minds worry about any questions on earth they pleased.

The final challenge

Here is the great challenge to universities and to all who support them: Are we attracting the cream of the nation’s inquiring minds to our campuses, and are we there giving them full encouragement and support in pursuing whatever lines of endeavor interest them — preferably with no questions asked? That is a difficult challenge, possibly an impossible one. But unless we have inquiring minds that are really free to inquire — even in fields outside the cognizance of any Washington or New York committee — then we can never reap the full benefits and satisfactions of free and unfettered scientific research.

And now, as I bring this paper to a close, I realize that I have spent too much time on what seem like dirty administrative problems. I would have enjoyed it much more if I had been describing the magnificent achievements in scientific research the past 10 years have witnessed. From the center of the earth to outer space; from the nucleus of the atom to the nucleus of the cell; from the theory of solids to the evolution of the universe; from the structure of proteins to the geography of Antarctica; from cybernetics to astronautics, great new areas of science have seen astonishing advances. Thousands of young men and women have found fruitful and satisfying careers in scientific research and America’s universities, private and public, have become national assets of prime importance — not only because they aid in the advance of welfare and security, but because they are the congenial homes of the inquiring minds, the great stimulators and supporters of that restless and adventurous thing, the human spirit.