and capped by volcanic islands, were to subside, the only evidence that it once existed might be such a line of drowned former islands and linear ridges (*11*). The guyots of the central Pacific were islands roughly 100 million years ago, and if they mark a former rise, the period of its subsidence must have been quite short compared with the age of the earth.

The East Pacific Rise differs from most broad oceanic elevations in another respect: the northern part is at the margin of an ocean basin rather than in the center. Thus, although all ocean basins have oceanic rises or former oceanic rises in the middle, not all ocean rises are in the middle of basins. In Africa and western North America the rises appear to penetrate continents. In fact, a feature as broad and low as an oceanic rise is difficult to recognize unless there is a large, relatively flat ocean basin on each side. Several marginal oceanic regions with anomalous levels, such as Melanesia and Indonesia, may have the same mantle and crustal structure as oceanic rises.

Continental drift, as suggested by the parallelism of the Atlantic coast lines and the crest of the Mid-Atlantic Ridge, has been a very attractive concept for continental geologists, particularly since it was revitalized by the paleomagnetic evidence for polar shifts and possible drift. Marine geologists, on the other hand, have been reluctant to accept the concept of continental drift because they find no evidence for it in the geology of the sea floor. Indeed, the existence of rises centered in the Indian and Pacific oceans seemed to eliminate the possibility that Africa and South America had moved away from the Mid-Atlantic Ridge. However, if a random distribution of relatively short-lived "oceanic" rises is accepted, the picture is entirely different. If all rises were in the center of ocean basins it would not be clear whether the convection current, or another agent, which produced the rise centered itself relative to the margins of the basin or created the basin. With rises bordering the Pacific and penetrating Africa, it appears more probable that most rises are centered because the margins of the basin have been adjusted by convection currents moving out from the center. If so, the African and East Pacific rises may mark relatively young or rejuvenated currents which have not yet had time to produce much continental displacement. Even so, east Africa is being torn by deep rifts and Baja California has almost been separated from North America along the crest of the East Pacific Rise.

It is apparent that the study of oceanic rises and ridges, which was accelerated by the IGY, is one of the most fruitful fields in geology and geophysics. According to present planning there will be few, if any, months during the next three years when there will not be oceanographers at sea attempting to advance this study (*12*).

References and Notes

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Research Overhead

DuBridge and Kaplan exchange views on overhead payments for basic research in private universities.

The article by Norman Kaplan [*Science* **132**, 400 (12 Aug. 1960)] presents such a confused and misleading argument for "stopping all overhead payments for basic research in private universities" that it will probably be ignored in most informed circles. Nevertheless, since it occupies an important place in a distinguished scientific journal, and since it represents the type of thinking that is frequently met in discussions of this subject, it seems important for the sake of the record that it be answered in some detail.

Apparently Kaplan bases his opposition to overhead payments on the following arguments.

1) "Concentration on them [overhead payments] obscures some more basic problems and postpones the search for more general solutions."

2) Since "the university has not made a profit or typically realized full costs on its storage facilities [that is, its libraries] [or] its teaching," there is no reason why it should realize full costs on research activities either.

3) Overhead payments would "clearly not solve the over-all financial crisis in the universities."

4) Full cost reimbursement would bring dangers of federal control of the universities.

There is no substance to any of these arguments.

1) The question of formulating an over-all research policy for the United States has been searchingly examined by many agencies ever since the famous Bush report, "Science—the Endless Frontier," in 1946—most recently by the President's Science Advisory Committee. Such studies are also a continuous responsibility of the National Science Foundation. There is no evidence that in any case these policy studies have been hampered or obscured by the question of full cost payment. Nearly all the serious studies have recommended that the federal government reimburse the full costs of research in universities. But far from obscuring the

main issues, such recommendations have clarified the problem of research support by emphasizing that if research is to go forward, then *all* the costs of it have to be paid by someone. Ignoring the indirect costs is what obscures and confuses discussion of research support.

2) The argument that students or library users do not pay full costs of the services they receive falls of its own weight when applied to research. The tuition charges that can be levied against students are governed by many factors outside the control of the private university—for example, ability to pay, competition from "free" public universities, the generosity of various donors of scholarship funds, and so on. There has been a growing tendency to raise such charges to the point where they do represent full costs, and indeed at some private institutions tuition payments actually represent 80 percent or more of the total income. However, just because, for strong but irrelevant reasons, student costs cannot be further increased at present is no argument against, but rather an argument for, the recovery of full costs on federal research agreements. Losing money on one operation has never been considered a sound business argument for losing money on all operations. It is vitally important that universities put more of their meager resources into the teaching function—for example, into teachers' salaries—and this they can better do if the overhead costs on research projects are reimbursed. Because students and their families commonly cannot afford to pay full costs hardly means that the federal government cannot afford such payments.

3) That overhead payment will not solve *all* financial problems goes without saying. But it does solve one—namely, finding the funds to pay the large indirect costs of research. Financial problems, like other problems, must be solved one at a time. Abandoning one solution because it is not a complete solution is a sure way to financial disaster. Universities must look to many sources for funds to continue their teaching, their research, and other activities. They look to private individuals, to corporations, to foundations, and to government. Each gift or grant made to a university is for a particular purpose or function. Gifts for scholarships cannot be used to pay the salary of the purchasing agent; neither can the income from an endowment fund given to support a professorship in history or physics. "Unrestricted funds" must be found to pay business and administrative costs and the costs of plant maintenance—and such funds are very hard to obtain. Why should not every donor be told of the *full* costs of carrying on the activity he is interested in and then invited to reimburse all costs wherever practicable? If universities had unlimited endowment funds for unrestricted use, the problem would be less critical. Apparently university administrations have been unsuccessful in convincing their faculty members that this is not the case.

4) Finally, of course, the argument that paying full costs of research brings on more vicious dangers of federal control than paying only partial costs has been shot to earth many times but keeps rearing its ugly head. The agencies that pay full costs have *not* attempted to control universities, any more than the agencies that do not. In fact, those that do pay full costs have *ipso facto* given the universities more freedom than those that do not. The reasoning is very simple: No university administration can well turn down a large grant to support the research work of a professor who has worked very hard to secure the grant. If the grant does not carry full cost reimbursement, the administration must find other funds to cover such costs. This means that other concerns of the university must suffer—for example, professors' salaries, employing a new instructor in history, maintenance of the physical plant. New unrestricted funds simply cannot always be found, or found soon enough. Hence, the university is forced to a decision to unbalance its program in some way to meet the new requirements. When full costs are reimbursed, however, no other activity of the institution need be damaged in any respect; the university is still free to pursue its program of allocating resources in accordance with its own best judgment. In fact, if the new research grant continues something that was in progress anyway (perhaps on a smaller scale), the general budget may be somewhat relieved, and the university is thus helped to attain the objectives it has itself decided to seek.

It is true that the university fiscal officers and government fiscal officers have many long and difficult arguments about how indirect costs are to be computed; it is true that university accounting procedures are often affected by government regulations. But it is also true that such difficulties arise also in cases where indirect costs are *not* fully reimbursed. And it is also a fact that such fiscal arguments do not result in substantial federal control of university *academic* policies. The problem of federal control is, in short, quite independent of the problem of full cost reimbursement. Abolishing overhead payments would neither decrease nor increase the responsibility of each university to make sure that grants from *any* source—private, corporate, or government—do not result in interference with the university's freedom to formulate and carry out its own academic policies.

Many faculty members appear to believe that the road to academic freedom is through financial poverty. However, history proves that, in fact, the opposite is the case.

I have not attempted to give a complete presentation of the case for full cost reimbursement in federal research grants. Such résumés may be found elsewhere *in extenso* (for example, in references cited by Kaplan). Nor is this an attempt to point out *all* the half truths and misstatements in the Kaplan article. It is simply an attempt to set the record straight on a few issues raised by that article.

It is true that the research function is a relatively new one in American universities—at least it is new in its present scale and importance. It is true that new issues have been raised, new policy questions must be answered. It is also true that the long-range scientific strength of America, of the free world, and of all civilization is critically dependent on the vigor and quality of the research activities carried on in American universities. It is vital to the interests of mankind that such research be continued and expanded. This can only be done if the fiscal problems encountered are faced with realism and understanding by administrations and faculties of all universities and also by all agencies of the government. To declaim against reimbursement of indirect costs because the money appears to go to the business office rather than to the professor is only to exacerbate and perpetuate the difficulties we face in strengthening our universities and their research capacity.

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Kaplan Replies to DuBridge

My article, "Research Overhead and the Universities," was more concerned with raising questions and issues than with providing any immediate solutions or practical suggestions for policy. The rather drastic suggestion that all overhead for basic research be stopped was made to draw attention to more serious and more general problems, which will be explored in much greater detail in forthcoming papers. The case against overhead payments was examined in a somewhat larger context than the usual one of financial needs. DuBridge's reply avoids the major issues with which I was concerned. Consequently, I appreciate this opportunity to clarify what I still think to be the main issues and expand on them here as space permits. At the same time, I will comment briefly on the arguments raised by DuBridge.

It is perhaps necessary to point out that I am not one of those who believes, as DuBridge suggests, that poverty helps to preserve academic freedom, either in educational institutions or for the individual faculty members. I do not believe that reimbursement of indirect costs should directly benefit the professor rather than the business office. I do not believe that universities have unlimited endowment funds for unrestricted use. I do not believe that there are many university faculty members who believe any of these things attributed to them by DuBridge. Such *ad hominem* assertions lend little weight to DuBridge's main argument. It should be possible to raise questions and to examine the case for an unpopular position without having one's motives impugned and one's intelligence questioned.

DuBridge focuses on the overhead problem as one important problem calling for a solution in the immediate future. He does so without calling into question any of the other present policies or aspects of the over-all financial support structure for research. To bear in mind these other considerations may be somewhat difficult for a college president faced with glaring deficits in his annual budget, where additional reimbursement for indirect research costs will undoubtedly alleviate the immediate problem considerably. But it is precisely for this reason that I sought to link overhead considerations to the larger problems involved.

Despite the many excellent studies of research policy with which we are all familiar, our approach to such policy has nevertheless been piecemeal, and, typically, we have *reacted* to recurring crises with temporary and restricted expedients which then tend to become part of the patchwork design called policy. The history of the policies and practices related to the overhead issue itself is but one very restricted example of this tendency. The National Science Foundation action, effective 1 January 1960, allowing up to 20 percent of the total direct costs for indirect cost in new research proposals, is a case in point. Is this simply a continuation of a compromise drift (in 5-percentage-point steps) toward ultimate recognition that indirect costs should be supported in greater measure than they have been? But why not 25 percent this time, and why not a clearer recognition of the direction of the drift and the forthright step of full cost reimbursement immediately?

Rather than concentrate on how much overhead is to be paid and how it is to be figured, is it perhaps not more fruitful to ask whether basic research should indeed be concentrated primarily within our universities? If so, how much should be concentrated there, and what other kinds of institutions might also be involved in such an effort? Should we consider some sort of independent institutes such as the Max Planck Institutes in Germany, which are not directly affiliated with existing universities and whose main objective is the promotion of basic research without the normal interferences introduced by university life? We might also consider some more home-grown examples, such as the Institute for Advanced Study, the Rockefeller Institute, the Carnegie Institution of Washington, and even DuBridge's own California Institute of Technology, as possible models of research-oriented institutes with relatively less emphasis on teaching large masses of students.

Such an arrangement of universities and institutes might well permit the individual scientist to tailor his entire career more precisely to his needs than can be done in the university alone. For example, in his most productive phase the scientist could concentrate all his energies on research in a research institute. At another time he could return to the university and perhaps devote only a part of his time to research while getting some stimulation and change from a program of teaching. At still another time he could move back to full-time research, and perhaps toward the close of his career he might wish to concentrate all or nearly all of his energies in teaching.

Such a plan might well result in capturing "the best of both worlds" for the individual scientist and the institutions. It might also provide additional strength and vigor for our national research effort.

DuBridge suggests "that the long-range scientific strength of America, of the free world, and of all civilization is critically dependent on the vigor and quality of the research activities carried on in American universities." While this is the sort of statement with which one finds it difficult to disagree, the possibility should be considered that the research and scientific strength of America need not be concentrated entirely in American universities.

The pressure on universities, which is likely to increase in future years, to teach more students and to devote themselves to still other functions is so great that the question arises as to how much more of an expansion of research effort is possible, especially among the large university research producers of today. Some universities have already begun to ask basic policy questions about how much expansion of research they can afford in the light of the expansion of teaching that will be required. What kind of balance of teaching and research is desirable? What kind of teaching (graduate and undergraduate) goes together with what kinds of research (large-scale and small-scale, basic and applied)? It is important to reconsider the whole problem of financing our universities, for both teaching and research, and not attempt small-scale, piecemeal solutions.

Further, wherever research is supported, the question of how it should be supported has already been asked many times but still seems to defy a general solution. Perhaps we are now ready to consider abandoning such heavy reliance on the project grant type of support. I am not at all certain that block grants, which are usually offered as a desirable alternative to the present system of short-term grants, constitute a sufficiently broad solution.

It is agreed that full overhead payments will not solve the university's over-all financial problems. While it cannot be denied that such payment might solve one part of that problem, my whole article was based on the thesis that *our approach has already*

been too piecemeal. I disagree with DuBridge's implication that, having solved one problem partially, we can then proceed to the solution of other parts of it while everything else remains constant.

Full reimbursement may bring with it a host of new and unanticipated problems which may make any over-all solution all the more difficult. For example, it might perpetuate the present system of short-term, specific project grant support. Even more important, it might encourage many of the more impoverished schools to accept research projects which bear little relationship to their teaching functions, simply to get on the research "band wagon" and to share the wealth.

In this context it should be noted that poverty (financial or intellectual) is in itself a form of control. Federal agencies with specific missions are more prepared to support certain kinds of research than others, and a university which does not have adequate financial and intellectual resources may be tempted to tailor its research objectives to what is popular and easily supportable. Providing full reimbursement for overhead costs might well prove an additional temptation too strong for such institutions.

It should be unnecessary to repeat the point that "control" may take many forms and affect our spectrum of colleges and universities in a wide variety of ways. Full cost reimbursement will not necessarily result in control of our universities, any more than partial support of research will. But that danger does exist—not because the federal agencies want to exercise that control and not because they are "paying much of the piper's wage," but because some universities, in the process of backing into increasingly larger scale research programs, are abdicating their responsibility to exert control. Further, the rather prevalent attitude that federal subsidies to education are *ipso facto* dangerous because they would lead to control while federal support of research would not have the same effect has tended to obscure our thinking on the whole problem of control.

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Science in the News

"Science" and Advertising: the Federal Trade Commission Is Seeking a Way to Curb Abuses

A few weeks ago the makers of One-A-Day brand vitamin pills published a full-page advertisement in newspapers around the country intended to show why everyone ought to take vitamin pills. The ad was elaborately dignified: the type faces used were small, considering the size of the ad, and not too bold; the brand name was not emphasized; the tone of the piece was not that of a salesman trying to peddle his wares but of a public-spirited organization trying to perform a service by putting the facts about vitamins before the public.

The burden of the argument was that studies by the U.S. Department of Agriculture show that the vitamin content of typical diets is sometimes below the minimum recommended intake; therefore, to be on the safe side, everyone might well spend a few cents a day on a multipurpose vitamin pill, such as One-A-Day brand, to protect himself and his family.

The ad, and others like it promoting other products, presents a peculiar problem. Both Federal Trade Commission officials and nutrition experts in Washington for the AMA convention last week agreed that the ad was scientific hokum. The so-called "minimum" recommended daily intakes established for vitamins, they point out, are actually two or three times the minimum required for good health; therefore the fact that a typical diet may contain less than the established "minimum" of one or more vitamins is no argument for taking vitamin pills; indeed, a person might be receiving one-half to one-third the "minimum" requirements of several vitamins and still not be suffering from vitamin deficiency.

What is disturbing about this particular ad is not that it is misleading. Nearly all over-the-counter (that is, nonprescription) drug advertising is to some extent misleading. (An example is that of an ad that appeared during the Asian flu epidemic of three years ago. A laxative manufacturer advertised: "If you have Asian flu and need a laxative, take ———." The possibilities of this approach are endless; "If you have cancer and need a headache pill, take aspirin.") But whereas the general public can be expected to regard an advertising pitch with a certain amount of skepticism, an advertisement masquerading as a public-service announcement and invoking, by suggestion at least, the authority of some widely respected source—usually, these days, a scientific source—naturally tends to allay such skepticism.

"Public-Service" Advertising

The Federal Trade Commission, which is responsible for protecting the public from misleading advertising, has become interested in this "public-service" type of advertising and is now seeking a good example of which to make a test case. The FTC works under a number of handicaps, one of them being that the burden of proof normally lies entirely on the government. It is one thing to demonstrate that the information on which an advertisement is based does not really prove that it would be a good idea for everyone to take vitamins. It is another and far more difficult thing to prove that there is no reason whatsoever for the ordinary person to take vitamins.

The principal case where the burden of proof shifts from the FTC to the advertiser is that where the public safety is involved. Here the advertiser can be made to show that his product, although possibly worthless, is at least