27 December 1963, Volume 142, Number 3600 SCIENCE

Federal Expenditures and the Quality of Education

Some changes in the present pattern of expenditures would improve both higher education and research.

Harold Orlans

What, since World War II, has been the relation of federal expenditures to the quality of higher educational institutions, of instruction, and of research, and what changes, if any, should be made in the present pattern of expenditures?

Such large questions can hardly be answered simply or to everyone's satisfaction, and if I am so foolhardy as to answer them, it is not from a vain illusion that my answers are all correct (and, still less from an illusion that they are the only correct ones), but from a conviction that the questions are important. My conclusions are drawn mainly from a study of the effects of federal programs on departments of science, social science, and the humanities at 36 universities and colleges, undertaken by the Brookings Institution for the U.S. Office of Education (*1*). Better federal policies for higher education and research will come only from a continuing evaluation of present programs and a continuing effort to reconcile their actual effects, what we really want, and what is practicable.

Funds Highly Concentrated

With the decline of the broadly distributed expenditures for veterans education, federal funds during the past decade, devoted largely to scientific research, have been highly concentrated at a few of our strongest universities and institutes of technology. This is not to say that the correlation between research expenditures and the quality of scientists at particular institutions is necessarily high; still less, that the faculty of one physics department with ten times the research volume of another is ten times as good; too many transitory and historical factors of special government and faculty interest supervene to make for so simple a relationship. (For example, good as they are, I doubt that the scientists at Iowa State University would claim to be inherently superior to their colleagues at Harvard or Yale, but for a variety of reasons, going back to Frank Spedding's pioneering work in casting high-purity uranium at Ames in the spring of 1942 and the subsequent establishment on campus of a major atomic research center, Iowa State has received more money from the Atomic Energy Commission than either of those Ivy League schools.) But, overall, relying on the best professional judgment of scientists in evaluating the merit of research proposals has served admirably to maximize the strictly technical aspect and to minimize the irreducible personal and political factors in research allocations.

Comparison of representative institutions that have a large volume of federal research with those that have a small volume demonstrates this convincingly. Among the former, one will find a few flabby Goliaths whose strength is attributable to their size rather than their temper, and among the latter, some stalwart Davids. But, taken as a whole, the institutions with a large volume of federal research are patently superior, in the quality of their faculty and their students, on most available measures, including the judgment of department chairmen and faculty at institutions with less money to spend on research. Nor can it be claimed that their superiority has been achieved simply because of federal money. Although that money has not hurt, these schools were famous before the war and had a high level of research, supported from private and state sources, long before the government entered upon the scene.

What, then, have been the educational effects of the large but concentrated federal spending for research and development, which ran well over a billion dollars last year?

Good Effects Far Outweigh Bad

As I later discuss some harmful effects, I want to start by stating as emphatically as I can that the good effects have far outweighed the bad. The present strength of our national scientific and technological enterprise has its roots in the talent, knowledge, and ideas engendered at our great institutions of learning, and should federal aid to these institutions be curtailed without compensation from other quarters, that enterprise would wane. Federal programs at universities have enormously enlarged our knowledge in the basic and applied sciences; have fashioned and outmoded whole industries; have brought each of us great rewards (and 15 minutes' notice of death); and have, as a by-product, raised the prestige, the influence, and the income of scientists. What is wrong with the present pattern

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is not that it bestows benefits upon certain institutions and most sciences but that these benefits have not been shared adequately by important groups of institutions and nonscientific disciplines, and that excessive concentration on research has substantially reduced the return in ideas from each additional dollar and has had some harmful effects on education, even in the sciences.

One group of institutions neglected by federal programs has been the good liberal arts colleges. The best of these have students as able as those of any university and maintain a sense of community and a degree of personal contact between senior faculty and undergraduates which has been or is being lost at even the best universities. These colleges can facilitate precisely the kind of individual research and authorship needed as a corrective to the collective scholarship our free-enterprise society so strangely generates. For these and other reasons one can confidently advise many students in the humanitites and social sciences to choose a good college over a good university; however, the science student will usually be better off at a university. The pace of scientific progress is so rapid that science instruction at colleges often lags far behind that at universities; government money has improved the equipment, enlarged the number, enhanced the status, and reduced the burdens of scientists at universities far more than at colleges. Indeed, while at universities the current teaching load of scientists is well below that of humanists, at colleges it is higher. Altogether, it is understandable that the shortage of faculty at liberal arts colleges is most acute in the sciences, and federal policies have surely contributed to the problem. A comparatively small investment in scientific research, facilities, fellowships, and education at good colleges should now yield greater dividends in scientists and scientific ideas than the same investment at our universities.

State Universities Neglected

Another group of relatively neglected institutions is the great state universities. A few, such as Michigan, Illinois, Minnesota, and Wisconsin, have not done badly, while the University of California and the laboratories it operates at Berkeley, Livermore, and Los Alamos constitute an educational and scientific endeavor so vast that it can more readily be compared to that of a nation like Great Britain than to activities of other American institutions. But for that very reason, gross statistics on federal research funds at public universities can be misleading. In fact, the present rank order of federal research dollars at our 20 leading universities is not significantly correlated with the relative number of doctorates in science these universities award. This is another way of saying that state universities do not participate in these research programs to the extent that their preponderant importance in graduate science education would lead one to expect. This has long been recognized by the Association of State Universities and Land Grant Colleges, which has more than once proposed that some research funds be awarded on a quota system based upon student enrollment or degrees conferred in the sciences. The danger of the present situation is that most students will receive mass-produced, low-priced, and relatively low-quality science degrees at state-operated educational plants, high-quality education being reserved for a minority at a few favored institutions.

Although federal policies have aggravated some of the problems of state universities and liberal arts colleges, clearly the government cannot alone be blamed for, nor alone solve, these problems. State legislatures, state taxpayers, and local citizens bear an obvious responsibility. Thus, the American Association of University Professors' report on 1961–62 faculty salaries observes (*2*):

> Whereas five private independent universities were in the highest [salary] category, no state university reached the very top level.
>
> But even this is not as serious as the fact that almost half of all public universities are in category D on a scale that ranges from AA to F. Only 3 percent of the independent institutions range so low. . . .

There are some institutions where research grants remain unspent, and many more where they are not requested, because faculty members teaching 12 or 15 classroom hours a week cannot find time for anything but their classes, and additional staff members can simply not be recruited at dime-store wages. A wage paid monthly for 9 months in the year does not constitute a professional salary.

The main charge to be leveled against the government is not that it is responsible for the low quality and poor conditions at so many institutions but that, by overemphasizing scientific research, it has devaluated undergraduate teaching and has lowered the status of nonscientific fields and the quality of scientific research itself. In doing so, of course, the government has not acted alone as a foreign force; other powerful social and educational forces have been at work toward the same ends. But the government has been their willing mistress, and if the government and university science are now living in a state of sin, it is, despite occasional bickering, a contented state which two adults have entered upon willingly and which each is reluctant to leave.

Undergraduate Teaching Devalued

Need it be argued that there is at present a devaluation of undergraduate teaching? A Brookings Institution survey of over 3000 faculty members showed that in colleges as well as universities, small and large, in the humanities and social sciences as well as the natural sciences, faculty members at every rank, regardless of how little time they devoted to undergraduate teaching, wished to reduce that time still further, although all groups wished to increase the time devoted to graduate instruction and especially to research (*1*, p. 316). The devaluation of undergraduate teaching that has accompanied the government-primed upsurge of graduate education and research has produced a virtual cleavage in the faculties of larger universities: a fifth of the faculty now teaches only undergraduates, while another fifth teaches only graduate students.

The cleavage between university faculty members and students is more severe. Over half of university scientists know the names of few or no seniors majoring in their department, while a fifth do not even know the names of advanced graduate students. Over half of university faculty members have never had a lower-classman in their homes. How many of our foremost scientists and scholars would speak today as William Osler did in 1892 (*3*), of his "deep autumnal yearning" for teaching, "not unnatural in a man the best years of whose life have been passed with undergraduate students, and who has had temporarily to content himself with the dry husks of graduate teaching"?

Undoubtedly the sheer numbers of

students and faculty and the increase in the size of classes have contributed more to the depersonalization of higher education than government action has. But the government has abetted the process by the lures it extends to research workers and the reduction in teaching hours it has bought for so many faculty members. (One is reminded of the exemption from military service which can be bought in some armies for a fee.) I would not want to be caught telling a group of university faculty that a further reduction in their teaching hours can be bad, although it is evident that *college* faculty members are in greater need of reduced hours, and I do not see how the average of six classroom hours a week for science faculty of all ranks in the spring of 1961 at 12 major universities (it was 4 to 5 hours at three institutions) can be held excessive. But, clearly, graduate students and not undergraduates are the main individual beneficiaries of all the extra time faculty members now devote to research. Admittedly, some people consider the view that meaningful personal contact between teacher and student plays *some* part in the educational process to be not only uneconomic but antiquated. Some people have a wonderful ability to explain why what is, is good. They will doubtless be delighted when higher education is completely taped and programmed audiovisually, and when diplomas, untouched by human hand, are delivered automatically upon receipt of the requisite responses and fees, as divorces are delivered by machine in Reno, 6 weeks after deposit of the requisite silver dollars.

Things have come to such a pass at some of our larger schools that seniors may not know faculty members well enough to give the references required on applying for a graduate fellowship, and special counselors have been designated to talk to them long enough to arrange for this. Eminent professors devote so little time to teaching (or should I say lecturing), and that time is arranged so much to their convenience (their other time being spent more profitably at home, in the laboratory, in attending to private business ventures, or in Washington), that their own graduate students often have considerable difficulty getting to see them. The relation of the government to the university scientists is disturbingly like that of the farmer to the goose that laid the golden eggs.

In one particular the government's responsibility for lowering the quality of instruction is evident. Federal agencies have provided so many of the best graduate science students with fellowships and research assistantships that only the poorer students are content to serve as teaching assistants in undergraduate laboratory sections, and it is widely conceded that laboratory instruction has, therefore, either definitely suffered or, at best, not improved as much as laboratory equipment and graduate science faculties have.

The Humanist Is Not Beaten

The position of the humanist today recalls that of the emancipated Negro on a good plantation. If he works hard, he is fairly well housed and fed, and not beaten; and while this is hardly enough to evoke a sense of elation, where else can he go? Unlike the scientist who can find interesting and well-paid scientific work in government or in industry, the humanist, if he is displeased with his university salary of $15,000 or $20,000, must either remain on the academic plantation or change his profession. Since his dean is aware of this situation, his bargaining power is considerably reduced. Now, the government is not responsible for the American people's dearth of history and their ignorance of the little they have; for the aversion the children of immigrants have shown for their parents' language (be it Germanic, Romance, Slavic, or English) and their inability to relearn it in school; or for the constitutional proscription of a peerage and for a busy, practical people's lack of interest in classical learning and other cultural accoutrements of landed gentry and monastic scholars. But the government is in good part responsible for the prosperity of the academic scientist, and, quite obliviously and unintentionally of course, the humanist's nose has been rubbed in the scientist's success to their mutual discomfiture.

Not only is the scientist younger than the humanist (3 to 5 years younger at each rank, at major universities), because the government has sped him through graduate school, and not only does he teach less (2 hours less on an average), because the government pays him not to teach, but he is paid more for teaching less (at 43 of 56 universities for which information was available, the salary of the philosophy department chairman was less last year than that of the physics department chairman) (*4*). He is paid by the government, besides, for his summers, and often for his assistants, his secretary, his equipment, his publications, his travel—for virtually everything but his entrance into heaven, and that, I suppose, will ultimately become an allowable part of overhead.

One charge commonly leveled against the government is not, I think (or not yet) warranted: that it has induced the best students to go into the sciences, leaving only the second-best for the humanities and social sciences (this, it is often added, is a reason for the turgidity of these fields). This charge suggests, on the one hand, a certain naive conceit on the part of scientists (*obviously* they are brighter than other people, including, presumably, their nonscientific parents and children) and, on the other hand, a low opinion of our brightest youth—the view that their careers are determined not by their heart but by their purse.

It is a charge which the available information on student ability by field simply does not substantiate. The data show the mean I.Q. of recent Ph.D.'s in the humanities and social sciences to be identical with that of the Ph.D.'s in the natural sciences (*5*). What has probably been misleading is the very high ability of graduate students and Ph.D.'s in physics and mathematics. One overlooks two points in jumping from this observation to the conclusion that the government is diverting talent to the sciences: (i) students of physics and mathematics were as bright before the war (that is, before the government paid their way through graduate school) as they are now; and (ii) the ability of students in certain populous sciences heavily financed by the government (most notably, the biological sciences) is well below par for the natural sciences, social sciences, and humanities. Therefore, we must reject the thesis that the government has bought for science an undue proportion of our best brains; its vast expenditures have demonstrably failed even to increase the proportion of either bachelor or doctoral degrees awarded in the natural sciences over the last two or three decades. It is the social and not the natural sciences that have gained from the relative decline in the number of degrees awarded in the humanities during this period.

"Competence" Replaces Merit

The final, and in some ways most damaging, charge to be brought against the government is that excessive appropriations are now diluting the quality of research and that mediocrity (or, in the jargon of Washington, "competence") is replacing merit as the standard of support. "Competence" as a standard may in fairness be contrasted with the standard advanced by the Seaborg panel of the President's Science Advisory Committee (*6*): "In the advancement of science the best is vastly more important than the next best. Mediocre research is generally worse than useless." With some effort, authority can still be arrayed on both sides of this charge, but negative observations about a decline in the quality of government-sponsored research have increased and, I believe, now decidedly outweigh claims that quality has improved. Among recent public critics of the quality of much government-sponsored work in physics may be listed Hans Bethe, Polykarp Kusch, Melvin Schwartz, Roman Smoluchowski, and Alvin Weinberg (*7, 8*); among critics of the quality of biological and medical research are Max Finland, Basil O'Connor, Herbert Ratner, John Russell, and Paul Weiss, not to mention the House Committee on Government Operations, which observed that between 1956 and 1960 the proportion of National Institutes of Health research grants rated by reviewers in the "highest quality" class fell from 40 to 24 percent (*9, 10*).

Let me quote two of these criticisms. Alvin Weinberg, director of the Oak Ridge National Laboratory, remarks (*8*):

> . . . our operating budget for science has increased since 1950 by a factor of almost 5, whereas the number of Ph.D.'s in science and engineering has increased by only a factor of 2. . . . I know of no evidence to show that our people are smarter now than they were a decade ago; we merely heap more money on them, and therefore we use each dollar less efficiently.

And Paul Weiss of the Rockefeller Institute says (*10*):

> . . . biological experimentation, at the height of success, is beginning to drift . . . into habits that threaten to place bulk ahead of brains, and routine exercises ahead of thought. . . . [As] research has grown in volume it also has grown softer by loss of self-restraint, lowered selectivity, blurring of research targets.

Much work of the highest quality is also, of course, being done and, in important fields of science, greatly expanding, although we are too close to judge the long-run trend and the evidence is sometimes contradictory. Thus, Gerald Holton tells us (see *11*) that:

> . . . throughout history, transforming ideas, as well as great ideas only one magnitude less high, have not appeared in science at a rate equal to a fraction of the present rate.

On the other hand, Hans Bethe declares (*12*) that:

> the pace of basic discoveries in physics was far greater in the first thirty years of this century than it has been in the second thirty years. . . . Many very important details . . . have been discovered in this second period, but it is all a lot of detail, important but nothing you cannot summarize in one or two sentences.

The appearance of epochal thinkers like Newton and Einstein cannot be ordained by any program, government or private, because such men represent a unique conjunction of ungovernable talent, opportunity, and possibility. Perhaps the likelihood that Einsteins will arise is greater as enlightened efforts are made to recognize and encourage them; and perhaps not. The outcome may depend more on the nature of the problem, of our society, and of our luck than on the extent of our effort.

Below the pinnacle, it seems clear, there has been an enormous expansion of both high-quality and pedestrian work, and the absolute volume of both is now so great that it is unrewarding to ask (even if it were possible to get an accurate answer) just how the relative proportion today compares with that in the 1930's, in Colonial times, or in ancient Greece. The important question is: Is it really necessary or desirable to sustain so much pedestrian work in order to bring forth the excellent and the good?

The edifice of science, some say, is built brick by brick, and one can never tell in advance the value a humdrum fact may have; therefore, all "competent" science should be supported. This argument is, to my mind, unacceptable as a basis for public policy, for, in principle, it would justify any and every careful inquiry, could readily result in absorption of the gross national product, and equates science with the ditty bag of an idiot.

Desirable Shifts in Expenditures

One need not deny that *some* good may occasionally come from the mounting public investment in second-rate scientific research conducted by second-rate scientists at both first- and second-rate institutions to ask, Is this really the wisest investment that can be made of these large sums? The answer, I think, is "No," and *some* shift in emphasis at the present level of expenditure (and certainly at any higher future level) is in order, away from scientific research and toward scientific education, toward the humanities and neglected sectors of the social sciences, and toward the good colleges.

Over two-thirds of university scientists themselves agreed, in the Brookings survey, that some redistribution of present funds was desirable to "give the humanities somewhat more and the sciences somewhat less, but still the major portion." However, I must in all honesty report that a majority of university scientists reject—or rejected, 2 years ago—my view that federal expenditures should be shifted somewhat toward teaching. Roughly 60 percent of scientists at universities with a large volume of federal research then felt that "the present concentration on research should continue," although scientists at universities with a smaller volume of research were squarely divided between this position and the view that "Federal funds should be more evenly balanced between research and teaching" (*1*, pp. 66, 105).

The perceptible lowering of standards in federal research programs has resulted, in part, from the conscious use of these programs by administrators, scientists, and the Congress as a politically convenient means to aid higher education. We all know the difficulties sectarian interests in education and the Congress have experienced in trying to agree upon desirable legislation. So long as these interests remain unresolved and the nation does not establish satisfactory policies to meet directly our urgent educational needs, so long are we likely to witness efforts to meet these needs indirectly.

It is easier for an observer to advocate a pure course of action than for a congressman, a university president, or a federal administrator or his scientific advisers to pursue such a course under heavy political pressures. I certainly cannot subscribe to the opinion, all too prevalent in some academic cir-

cles (the more uninformed the circle, the more prevalent the opinion), that these men are either villains or fools. In my experience they are generally able, well-intentioned, and politically sophisticated.

Nevertheless, I believe they have been mistaken, and that they risk their long-term interests in pursuit of immediate gain. I would, in particular, charge those scientists who review research proposals and help set prevailing research standards with (for the best of motives) failing to meet their professional obligation to maintain high quality in federal research grants. Nothing would be more effective toward this end than an increased rate of rejection in certain federal programs, accompanied, if necessary (and I believe it would be necessary, initially, in some programs), by the return of unexpended funds to the treasury.

Five years ago a distinguished committee of the National Science Board, composed mainly of presidents of leading private and public universities, enunciated the following as the first principle for federally sponsored research (*13*):

> Problems of Government-university relationships in the Federal support of research at colleges and universities should be explicitly and completely dissociated from the budgetary needs and crises of the institutions and from the general issue of Federal aid to higher education. In the consideration and administration of these relationships there should be no implication that Federal sponsorship of research is a convenient subterfuge for Federal aid to institutions of higher learning.

The more this principle is breached, the more apparent will become its merit in directing us toward two vital but separate national goals: the maintenance and improvement of quality in scientific research and the maintenance and improvement of quality in higher education. To merge these goals out of political expediency is to endanger both.

Summary

The great expansion of federal scientific research expenditures and their concentration at a few leading universities and institutes of technology has brought enormous benefits to higher education, science, and the nation. It has also contributed to a devaluation of undergraduate teaching and to an expansion of mediocre research. Some reorientation of expenditures toward state universities, liberal arts colleges, science education, and the humanities, and a reaffirmation of standards of quality rather than of mere competence in research, are needed.

References and Notes

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7. See *Science, An Interview by Donald McDonald with Hans Bethe* (Center for the Study of Democratic Institutions, Santa Barbara, Calif., 1962), p. 25; P. Kusch, quoted in *Current* (July 1962), p. 52; M. Schwartz, *Am. Behavioral Scientist* **1962**, 35 (Dec. 1962); R. Smoluchowski, in *Proceedings of a Conference on Academic and Industrial Basic Research* (National Science Foundation, Washington, D.C., 1961), p. 38.
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9. See M. Finland, quoted in *Saturday Review of Literature* **1960**, 38 (1 Oct. 1960); B. O'Connor, "Science and government: The perilous partnership," address to the 3rd International Symposium on Immunopathology, LaJolla, Calif., 1963; H. Ratner, *Medicine* (Center for the Study of Democratic Institutions, Santa Barbara, Calif., 1962), p. 11; J. Russell, in *Research and Medical Education*, J. H. Comroe, Jr., Ed. (Association of American Medical Colleges, Evanston, Ill., 1962), pp. 101–04; *Health Research and Training* (Second Report by the House Committee on Government Operations, Washington, D.C., 1961), p. 28.
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11. G. Holton, *Daedalus* **91**, 371 (Spring 1962).
12. *Science, An Interview by Donald McDonald with Hans Bethe* (Center for the Study of Democratic Institutions, Santa Barbara, Calif., 1962), pp. 20–21.
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Child Spacing: The Mathematical Probabilities

The chances of spacing children by the rhythm method are analyzed theoretically and experimentally.

André J. de Bethune

In an address delivered 26 November 1951, Pope Pius XII stated (*1*), "We have affirmed the legitimacy as well as the . . . limits of a regulation of offspring which . . . is compatible with the law of God. One can even hope . . . that medical science will succeed in giving to this licit method a sufficiently secure foundation *(una base sufficientemente sicura),* and the most recent information appears to confirm such a hope." The licit method referred to by Pope Pius XII was described elsewhere by him (*2*) as "the taking advantage of natural temporary sterility *(la mise à profit de la stérilité temporaire naturelle)."*

The hope expressed by Pope Pius XII that natural methods may be given a more secure foundation—that is, made less uncertain, less subject to the vagaries of chance—justifies an investigation into the mathematical probability of the spacing of children for normally fertile couples, particularly for those who choose to use natural methods only.

The spacing of children has itself been approved by Cardinal Suenens, formerly professor of moral theology at the Catholic University of Louvain, who says (*3*, p. 99) that it can "help a mother get used to the duties of motherhood in a more balanced way and aid her in taking on responsibilities with a greater reserve of generosity and, at the same time, more physical strength."

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