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Finest Science Not Always Found in the Fanciest American Universities

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October 18, 1987 | David Eli Drew | *David Eli Drew, professor of education and public policy at the Claremont Graduate School, is the author of four books about science, technology and education.*

CLAREMONT — Recent controversies about federal science funds for university research have become highly visible--and acrimonious. Debate about who should get support and why, long the province of a carefully developed system of peer, or merit, review, have been the subject of special task-force reports, congressional hearings and cover stories. Examples of the controversies include:

--A $25-million center for earthquake research was won by a consortium of universities from upstate New York (an area not known for frequent earthquake activity). The losing coalition of Southern California universities, led by Caltech, vigorously protested. Among other objections, losers claimed that the winning proposal lifted, virtually word-by-word, several pages from previously published writings of one of the California scientists.

--Superconductivity research published in the last year may well be the most important discovery in physics in decades. The practical implications of these findings are judged by experts to be staggering. The researcher who made a major discovery is employed by the University of Alabama, Huntsville, where, one wag suggested, many national science policy observers "really aren't sure the faculty can read and write."

--A growing number of second- and third-tier universities, feeling iced out of the competition, hire lobbying firms, companies that pride themselves in assisting universities to circumvent peer review by getting facilities and other awards listed as line items in otherwise unrelated congressional legislation.

Rhetoric has become overheated, ranging from allegations that pork-barrel science will eradicate merit to claims that only a few universities in this country have scientists qualified to conduct cutting-edge research.

This is not an isolated academic tea-party discussion about who gets how many crumbs from the funding pie. (Although it has been suggested that academic politics get unusually vicious because the stakes are so low.) The consequences of this debate will be of fundamental importance for the technological strength of our economy.

Most science-policy analysts agree that the chain of technological innovation goes something like this: Federal funding leads to basic research which leads to applied research which leads to development, production and dissemination or marketing. This is, admittedly, a simplified version of the process. But most technological innovations begin with basic research and most of the nation's basic research is done in our universities. Federal science-funding policy, then, is an issue that cuts to the heart of our competitive stance as a nation.

The controversies swirl around an assumption and a fact. The assumption is that the only basis for awarding federal science funds is merit. Simply put, we want to fund the best scientists doing the most creative projects. Most policy-makers and analysts agree that this is the only defensible policy. And we believe that there is no justification for end runs around peer review, like those executed by lobbyists. If a new medication turns out to have devastating side effects, we don't want it to be because second-rate researchers got funded under pork-barrel rules. Nor do we want it to be because a second-rate researcher at one of the country's leading research institutions beat out a better researcher with more creative ideas who happened to be employed at a rural state university. Evidence indicates that the latter threat is more likely than the former.

That's the assumption. The fact is that a huge proportion of federal science funds go to the leading institutions. More than 40% of such funds are awarded to the leading 20 universities each year. This has been true for decades; the struggle about precisely this issue delayed creation of the National Science Foundation, the principal agency funding university research.

Proponents of the present concentration of funds argue that NSF and other federal agencies must base decisions solely on the excellence of proposed research. If the best researchers--and the best ideas--happen to be in a few leading institutions, then there is no question where science funding should be directed.

Proponents of a greater geographical dispersion of funds argue that potentially creative scientists are not being trained or nurtured in sparsely developed regions, that there are significant benefits to a local region from having centers of scientific excellence, that progress in basic research to some degree is dependent upon a synergistic reaction with industrial R&D and some industries thrive in regions that do not have a leading university. Good science, they insist, may be overlooked under current funding procedures.

There has been perennial debate about the dispersal of federal science funds. One reason is that the debate is largely political. Federal science funds are authorized and appropriated by congressional committees, whose members often come from states other than Massachusetts, New York and California (the states with the lion's share of federal funding). But it is not simply a political question, a case of "pork-barrel science." The legislation creating the National Science Foundation underscored, as has all policy since then, the basic funding criterion of excellence. But it also recognized and endorsed the notion of "geographical equity," and the foundation has created a series of programs and policies aimed at building and maintaining strong science programs at non-elite institutions across the country.

In the work that led to a book, "Strengthening Academic Science" (Greenwood/Praeger), I focused on the impacts of academic demographics on the productivity of young scientists. Researchers conducted field visits in each of seven states that competed for funding in NSF's Experimental Program to Stimulate Competitive Research. Those seven states rank at, or close to, the bottom in annual federal science funds awarded: Arkansas, Maine, Montana, North Dakota, South Carolina, South Dakota and West Virginia.

The visits provided an opportunity to interview hundreds of scientists and science managers about barriers to the successful development of a research career. We also analyzed survey data retrieved from 60,000 university researchers; we examined the recent dispersion of many of the nation's outstanding scientists, particularly young scientists, to peripheral higher education institutions, largely as the result of a shrinking academic job market. Once in the faculties of these institutions, they found it virtually impossible to develop productive research careers. In the latter part of the 20th Century, scientific progress is greatly determined by institutional environments and is no longer strictly the result of individual creativity (if it ever was). We concluded:

--A growing army of highly capable "forgotten scientists" are employed in U.S. peripheral universities.

--Relatively small, specific changes in federal and institutional policy could stimulate significant productivity by these people.

--The key single ingredient in the management of these scientists, and other university scientists, is vigorous, creative leadership.

While the institutional concentration of federal funds has remained relatively constant, the academic marketplace has changed drastically during the past 15 years. Young Ph.D.s who once would have gone to Yale or UC San Diego now are scratching for jobs at less distinguished institutions. And their research skills are decaying. Frank Darknell, a sociologist at Cal State Sacramento, has suggested that the medieval concept of rustication would describe the plight of these academics. In the Middle Ages, rustication was what happened to clergymen trained at the centers of theological inquiry (the analog to scientific research in those days) who lost their skills in intellectual inquiry when sent to pastoral assignments, where there was no one with whom they could communicate about such issues.

The increasing employment of highly skilled, highly trained young researchers at second- and third-tier universities has dramatically changed the academic landscape. What federal and institutional management, evaluation, and planning activities could allow the nation to realize the research potential of these young investigators, particularly given the vast sums spent by the government educating them?

One successful scientist, Richard A. Muller, in a 1980 issue of Science, wrote: "It is difficult to judge the performance of scientific funding agencies, for, like physicians, they often bury their mistakes. . . . In 1978 I was given the Alan T. Waterman Award of the National Science Foundation and the Texas Instruments Foundation Founders' Prize for research that had initially been rejected for funding by the National Science Foundation, the Department of Energy, the National Aeronautics and Space Administration and the Department of Defense."

Our research suggested some specific ways to improve the system. These included recommendations for strengthening peer review. Merit review, as in Churchill's description of democracy, may be imperfect but it is better than any other system available.

All science funding, federal or otherwise, represents risk capital. No investment in research--basic or applied--is guaranteed to yield results. Yet present funding policies are tantamount to assuming that the horse first out of the gate is bound to win the race.

Some dramatic breakthroughs were associated with experimental-program funding--all the more surprising considering that the amounts invested were modest ($3 million per state distributed over a five-year period). Examples include the pioneering superconductivity research mentioned earlier.

Our funding system has been responding too slowly to shifts in the distribution of scientific talent. In that sense, any argument that forces a painful but necessary re-examination of the funding process is healthy.