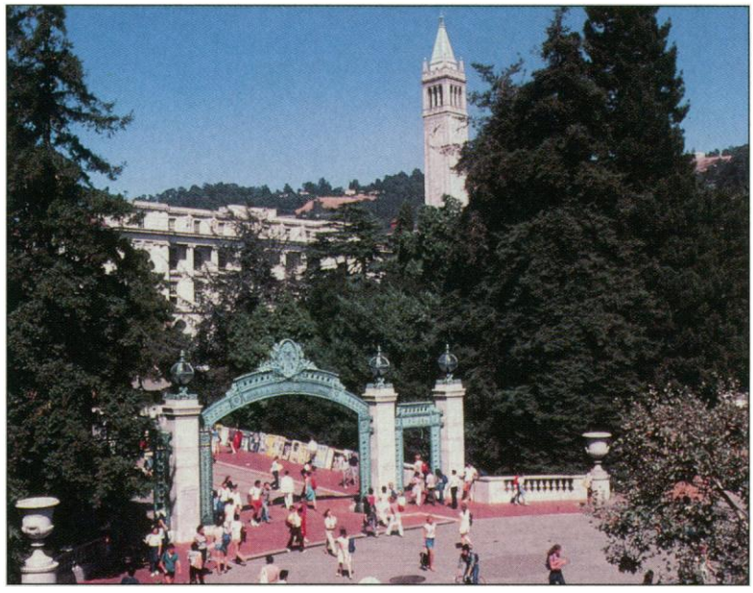
Cracks in the Ivory Tower

Research universities seek to redefine themselves in response to an unprecedented combination of budgetary and social pressures



UC BERKELEY

Accelerated erosion? State universities like UC Berkeley are facing cutbacks as state governments struggle to find ways to balance their budgets.

It was grim last year at the University of California (UC). The administration froze salaries, raised student fees by nearly 40%, and encouraged 600 senior faculty to take early retirement. This year could be even worse. Although UC employees have been getting real paychecks (unlike the IOUs that other California state employees have received), cost-of-living raises are out the window, student fees rose another 20%, and enforced furloughs are looming. "We lost two young faculty members this year, and we would desperately like to replace those two people," says Don DePaolo, chairman of geology and geophysics at UC Berkeley. "In better times, we might have prevented both people from leaving." It's no better at the environmental toxicology department at UC Davis. Five years ago there were 13 academic positions: Today there are seven. "The rest of the positions were basically lost in the budget reductions," says Al Donner, director of external relations for the division of agriculture and natural resources for UC.

California represents perhaps an extreme case—its budget for the academic year that is about to start hasn't even been settled yet—but it is symbolic of the pain being felt in universities across the country, both public and private. State governments, hit by the recession, are cutting back their commitments to higher education: For the first time in a decade, total state funding for universities declined last year. Congress is on the verge of approving budgets for the National Science Foundation (NSF) and the National Institutes of Health (NIH)—the two agencies that support the bulk of academic research—that will not even keep pace with inflation, while at the same time the federal government is threatening to change the ground rules for reimbursement of research costs.

On top of these fiscal pressures, the universities are grappling with credibility problems. After decades of being held in almost unquestioned high regard by the public and their elected representatives, universities have recently seen their public image bruised by misconduct investigations, indirect cost abuses, and soaring tuition fees. It's hardly surprising that, as campuses begin to fill up this fall, university administrators are wondering what their future holds. "We're looking at a profound sea change in the environment for higher education, both private and public," says John Wiesenfeld, Cornell's vice president for planning. "Understanding those changes and the implications of those changes are really what we are now in the process of starting to do."

For many, the trends can only spell bad news. Daniel Tosteson, dean of the Harvard Medical School, says research universities are "rare" and "fragile institutions" that require special conditions to flourish. "Right now," he warns, "these conditions are in jeopardy" because the trust that has held together the partnership among academics, industry, and government agencies since 1945 is being "eroded." And Charles Vest, president of the Massachusetts Institute of Technology (MIT), also speaks about the "tension" arising from a growing sense of disappointment and mistrust between government and research universities that has resulted in "fighting and bickering" that has "strained" their traditional partnership in the past few years. "America's research universities today rest on unstable and shifting ground," Vest told a White House panel in May.

The universities' concerns have recently caught some high-level attention in Washington. They are being investigated by several groups, the most important being the White House science policy office. Its director, Allan Bromley, has commissioned two reports—one to be written by the President's Council of Advisers on Science and Technology under the leadership of Harold Shapiro, president of Princeton University, and Peter Likins, president of Lehigh University, and the other by a federal interagency panel chaired by Deputy Secretary of Education David Kearns. (Because Kearns has been ill, the panel is currently being cochaired by NSF director Walter Massey and NIH director Bernadine Healy.) A third task force, under Roland Schmitt, president of Rensselaer Polytechnic Institute, will present its views to the National Science Board. All are due this fall, after the election. Nobody is expecting a universal solution from these panels. The problems the universities face are diverse and the solutions are likely to be equally diverse.

Economic realities

The number one topic on the agenda is money. According to the American Council on Education, a lobby group in Washington, D.C., the slack economy has taken a heavier toll on public than on private universities in the past year. Most states, the council notes, have cut funding for higher education. The result, as reflected in the council's recent "Campus Trends" survey with responses from more than 400 universities, is that 47% of the public 4-year colleges and 14% of private universities had flat or declining budgets in 1992 (see p. 1197). The survey also found that 30% of public 4-year institutions, and 20% of independent schools, were expecting to reduce the size of the faculty in the next year, while 69% and 55%, respectively,

planned to speed up the pace of retirement. A majority of the state schools, meanwhile, said they intended to increase class size in introductory courses, impose a freeze on regular faculty hiring, and hold off on expenditures for buildings and equipment. Independent schools were less inclined to take these steps, but more than half of them said they planned to increase fees charged to students.

What's unusual about the present climate, says Eugene Sunshine, vice president for administration at Johns Hopkins University, is that "all of our traditional sources of revenue are under stress." Local funding is falling off: Maryland drastically cut its support for universities this year, not only reducing its funding for the state system but also trimming Johns Hopkins' projected income by $4 million to $5 million. Endowment income is "wonderful," but "you cannot solve your problems on the back of fundraising," Sunshine says, especially since the rate of return on investment is now low.

In the past, Hopkins, like most other universities with teaching hospitals, has benefited from increased professional charges to patients at the medical school, but that source is leveling off as regulators impose caps on reimbursement rates. And student tuition, another large source of income for universities, is also unlikely to bring in much more money. Tuition, which has been running way ahead of inflation at private schools, "is not something you can raise easily under any circumstance," Sunshine notes, "but to raise it to cover research is really impossible." "We're running out of elasticity in tuition," says Samuel Thier, president of Brandeis University. According to Thier, private universities realize they will lose students if they attempt to raise tuition in any substantial way, reducing rather than increasing their revenues.

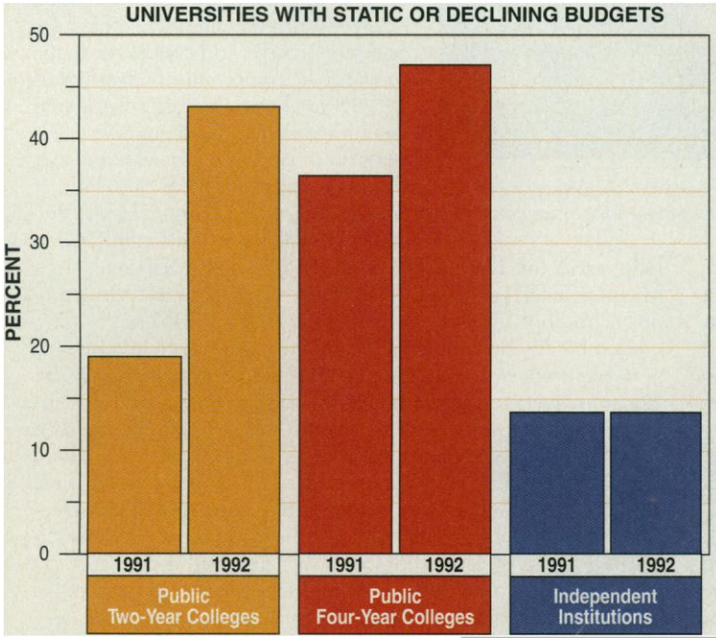
As university administrators struggle to cope with these financial stresses, they have mostly tried to protect their science departments. The University of Maryland at College Park decided in June to eliminate one college and seven academic departments, but the basic sciences were spared. At Yale, a plan to restructure the university would have hit engineering and sociology, but a faculty outcry put that plan on hold. Research is unlikely to be spared entirely, however. Many people don't realize it, says University of Maryland chancellor Donald Langenberg, but the "conduct of research at a research university is not a money-making business." While sponsors like the federal government pay a "reasonable share" of costs, administrators like Langenberg insist that they don't cover full costs, so that universities must tap other sources to support their graduate schools. "You could probably save a lot of money by cutting out research," Langenberg observes, adding quickly that it "would be unthinkable" to do that. But, he says, "if you have an absolutely outstanding music department, and a pretty mediocre physics department, then you better start thinking about trying to preserve the former and take bigger nicks out of the latter."

"I sold some bonds to pay for those buildings. If I don't get that covered through my indirect cost rates, I'm in trouble."
–Eugene Sunshine

No relief from Washington

University research is, in fact, facing an immediate threat from Washington: pressure to cut the federal budget in the 1993 fiscal year, which begins on 1 October. After several years of real growth, both NSF and NIH, which together currently fund approximately $6.5 billion of campus research, are facing at least a year, and possibly more, of extreme belt-tightening. The reason? Congress this year declined to cut politically popular programs to fund big increases in science, and it also seems certain to maintain funding big-ticket items like the Space Station that are threatening to eat into support for university research. In fact, says Representative George Brown (D–CA), chairman of the House science committee, despite the likelihood of little or no growth in either NIH or NSF's budget, "they didn't do too badly" compared with other federal agencies. Brown says there may be some "modest improvements" in the budget outlook for 1994, but if Congress and the White House decide to get serious about tackling the deficit, "things would get much worse."

University administrators are also worried about potential threats to the way uni-



SHORT-TERM IMPACT	
Increased fees that students pay	65%
Achieved greater efficiency in some operations	58%
Held off on expenditures for buildings and equipment	57%
Reallocated resources productively	46%
Reduced library acquisitions	40%
Increased class size in introductory courses	37%
Imposed a freeze on hiring in regular faculty positions	35%
Reduced administration staff	35%

LONG-TERM IMPACT	
Increased reliance on tuition revenues	50%
Reallocation of resources among departments	48%
Labs and equipment will be more dated	47%
Deferred maintenance will grow	46%
Slower expansion of new technology	44%
More programs will be revenue-generating	37%
Slower growth than planned	35%
More institutional funds for student aid	27%

Crisis response. A survey of 411 universities, conducted in the spring of 1992 by the American Council on Education (ACE), found a growing fraction expected no change or a decrease in their operating budgets in 1992 compared with 1991 *(above left)*. The tables, above right, list the most frequently cited short- and long-term impacts that university administrators expected from these financial pressures; percentages refer to the proportion of respondents who cited each particular impact. [Source: "Campus Trends," ACE, July 1992.]

versities are reimbursed for the research they conduct. Johns Hopkins' Sunshine points in particular to two federal government actions. One is the NIH policy of "downward negotiations"—a euphemism for an arbitrary takeback from an approved and funded grant. He hopes the habit isn't going to spread to other agencies. The other is the still-unresolved question of how the government will reimburse universities for the "overhead" costs associated with facilities where scientists conduct federally sponsored research.

This policy is governed by the Office of Management and Budget (in a document called Circular A-21), which OMB is planning to revise by October. For researchers, the government's willingness to pay these overhead costs has had a positive impact. Not only has Hopkins been an exciting intellectual home, it has been a spacious one as well. In the late 1980s, the medical school embarked on an aggressive building campaign, and even junior faculty have received ample lab space to pursue their research. But financial managers are worried because—among other reasons—cost accounting rules that favor investment in new facilities may be phased out. This subsidy for depreciation and debt on buildings, Sunshine argues, was meant to be a substitute for direct federal grants for construction, and he says it has worked well. But he notes that private universities like Hopkins have accumulated a significant amount of debt, and now they must pay up. "I sold some bonds to pay for those buildings," based on the assumption that government cost rules would allow the debt to be subsidized, Sunshine says. "If I don't get that covered through my indirect cost rates, I'm in trouble."

Some universities are already in trouble. After a punishing series of hearings before Representative John Dingell (D–MI) into alleged indirect costs abuses, Stanford University put off grandiose building plans for its west campus. And MIT astrophysicist Bernard Burke says universities are looking to cut their indirect costs in a multitude of small ways. He cites a recent example in his lab, where he added several computer work stations and found that the power lines running into the lab needed to be upgraded to accommodate the increased load. "Who pays for upgrading the service?" Burke asks. "Traditionally that's an overhead cost," but the university is trying to stick him with the bill, making him pay it from his research grant.

A strained partnership

As the universities grapple with these financial pressures, they are finding that they are laboring under a handicap: The national attitude toward higher education—particularly toward the elite private universities—has soured. As tuition rates have risen sharply, a swelling chorus of critics is charging that the quality of university education is being neglected.

The critics include scientists such as chemist and former Rice University president Norman Hackerman, who charge that too much emphasis is being placed on faculty research responsibilities and not enough on their obligation to teach undergraduates (see box, p. 1200). Although there are signs that administrators are responding to the demand for higher quality instruction—UC, for example, has adopted a policy that will give renewed emphasis to excellence in teaching when making faculty evaluations—Hacker-

And the States Shall Rise Again?

As state governments around the country cut back their budgets for higher education, you might guess that all the public universities are reeling. But talk to some public university leaders and you'll find surprising optimism. Don't be fooled by appearances, they argue: Although state schools may be hit harder by financial problems now, private universities will be more adversely affected over the long term by fiscal constraints. In particular, these optimists suggest that public universities will emerge in a better position to expand their share of the research pie in years to come.

GENE BEDNAREK

Cold comfort. Florida hopes to snag more labs like this new low-temperature physics center.

Perhaps the most outspoken proponent of this theory is John Lombardi, president of the University of Florida. Lombardi has been on both sides of the private-public fence. Before coming to Florida in 1990 he was provost and vice president for academic affairs at Johns Hopkins University in Baltimore. Lombardi argues that states that have traditionally been strong supporters of higher education will step up funding again as soon as their current fiscal problems are eased: "If you were to say, 'California is a basket case,' you miss the point. California has a long tradition of investing in higher education, and after they get through sorting out the mess they have now, they'll probably continue that." The same, he says, is true for Florida. Many private universities, on the other hand, are carrying big debt burdens from recent building sprees, which will hamstring their finances for a long time to come, Lombardi argues.

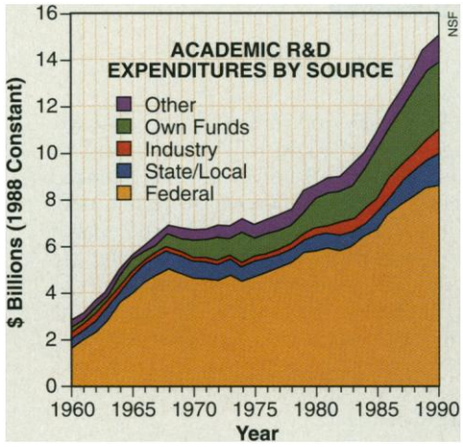
Lombardi's optimism may stem in part from the fact that Florida managed to escape drastic cuts earlier this year. At one point, the prospects did not look good. The state legislature clashed with the governor over the state budget and in the ensuing gridlock it appeared that the university would have to trim as much as $66 million from its $380 million budget. Lombardi threatened to lay off faculty and support staff and cancel academic programs. A compromise budget signed in July just before Florida's fiscal year began avoided those draconian measures. Lombardi also has evidence that Florida, despite its fiscal problems, is serious about supporting research: The state ponyed up $58 million in 1990 to help wrest the National Science Foundation's National High Magnetic Field Laboratory away from the Massachusetts Institute of Technology (*Science*, 21 September 1990, p. 1367).

Lombardi's most provocative argument is that once state support gets back on track, state schools will climb further up the ladder as major research universities because they can offer funding agencies more bang for the buck. To put it simply, research costs less at public institutions. For one thing, their buildings are mostly financed by state funds, while the private schools have mostly gone heavily into debt and are hoping to pay off construction costs in part through the overheads charged to research grants. Moreover, claims Lombardi, "in the public sector we don't build any buildings with marble and mahogany and large office spaces...because we've got 400,000 legislators and regulators—nit-pickers—working over our capital plan." The result: Public universities generally have lower indirect cost rates than privates. Florida's rate, for example, is 44%, while at Johns Hopkins it is

man argues that they will have to do more to overcome disaffection among the public who, after all, are paying the universities to educate their children.

But even if universities are able to polish their educational image, they may have more difficulty smoothing over their troubled relations with the government. Tosteson of Harvard frets that the universities are being treated more and more like "vendors competing for federal largess," rather than partners working in tandem with agencies like NIH and NSF to accomplish a common objective. This submissive role is one the universities have partly brought on themselves, says Hannah Gray, president of the University of Chicago. In an address to the American Association for the Advancement of Science meeting in Chicago earlier this year, she said that by agreeing to serve as the nation's predominant research facilities, they willingly became entwined in the "greater centralization and regulation that accompany the federal funding system."

The financial support is welcome, but some of the recent side effects are not, according to



The golden years. Support for academic research rose sharply in the 1980s, but it may be headed for at least a temporary drop in 1993.

geneticist Frank Ruddle at Yale. He finds that research on mammals—and on primates in particular—is becoming "prohibitively" expensive because of the ever-increasing stringency of requirements for animal care. The effect will be to increase costs for the scientist and discourage the use of animals—just at a time when many biologists are eager to run animal tests of new gene constructs that hold promise for treating Alzheimer's disease, AIDS, and cancer. Other federally mandated programs are also putting a squeeze on research. Institutional review boards, financial reporting requirements, laboratory waste and radioactive isotope disposal policies, and new rules mandating equal access to facilities for people with disabilities are all adding to universities' costs.

But there are greater risks in the trend toward bureaucratization of the universities, Gray warned. It's possible that "hard times" and the desire to have "universities concentrate on solutions to the nation's economic woes" could bring a mandate from Washington to "act as social agencies." Indeed, this has already happened in the Senate this year, where the appropriations committee instructed NSF to set the universities to work on improving U.S. economic competitiveness. If the impulse to treat university research as a commodity isn't checked, Gray warned, academics can expect that government will attach "more pow-

currently 65% and expected to rise.

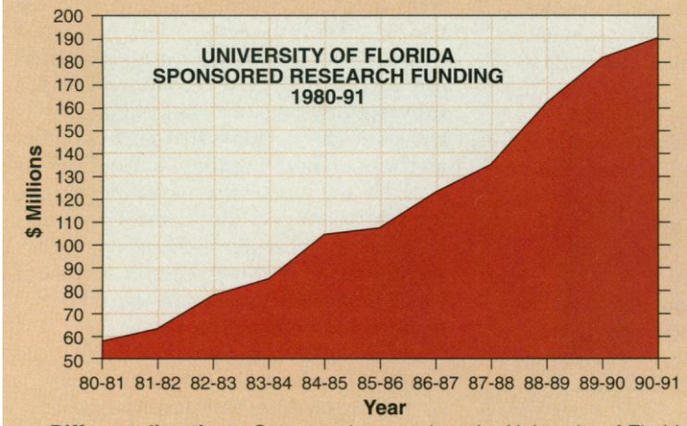
So far, funding agencies like NIH and NSF have made decisions about who to support strictly on the basis of merit. But for two equally meritorious projects, these agencies are under pressure to support the one that will cost the government less.

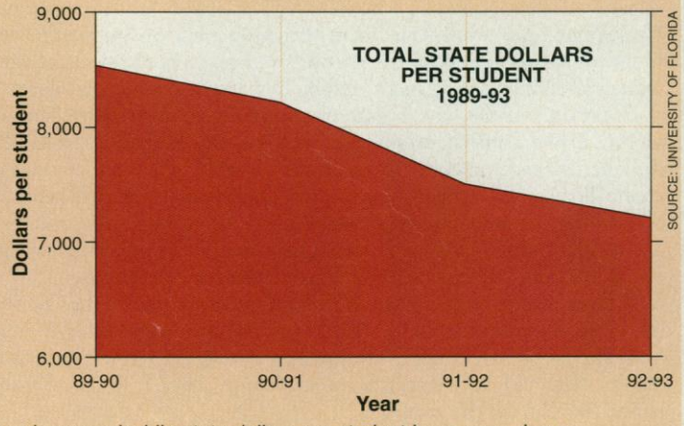
Like Florida, many other state university systems have seen their research dollars grow while state support shrank, but they are less certain that these trends can continue. Take Rutgers University in New Brunswick, New Jersey. According to Joe Seneca, vice president for academic affairs, in 1988 the university received $67 million in research support. By 1992, that number had grown to $110.5 million. Over that same time period, the state budget actually fell, from $226 million to an anticipated $224 million in the current fiscal year. But Seneca says the university made a conscious decision to protect its research activities when other areas were taking cuts and that will be hard to sustain without renewed state support. "We expect the state support to stabilize in real terms," he says. "Obviously, that depends on an improving economy. That's been somewhat of a receding horizon in the last few years."

Richard Atkinson, chancellor of the University of California, San Diego, is also not entirely convinced by Lombardi's arguments. "One can make an equally strong case that support for public universities is eroding and that privates have a certain flexibility that the publics do not have," says Atkinson. The average public university, for example, depends on its state government for more than 40% of its operating income, while private colleges have a more diversified funding base.

But Lombardi says big state schools have a not-so-secret weapon that will force state governments to maintain a reasonable level of support even in hard times: students. Florida's 35,000 give a lot of momentum to the university's budget because, as Lombardi puts it, "nobody is going to allow you to stop teaching those students."

–J.P.





Different directions. Sponsored research at the University of Florida has increased while state dollars per student have gone down.

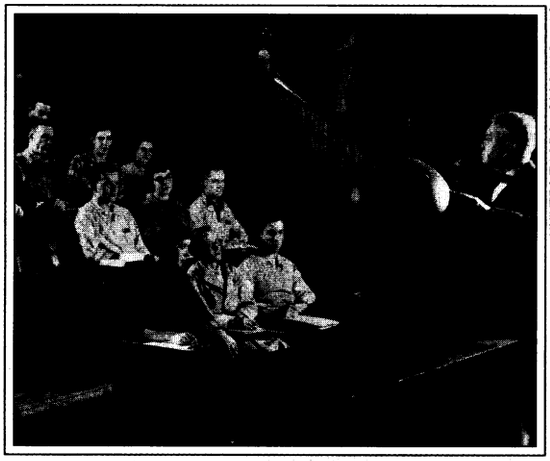
Teaching vs. Research

Norman Hackerman, ex-president of Rice University and former chairman of the National Science Board, has become a "grenade thrower" on the subject of the need for better teaching (as opposed to merely better research) at U.S. universities, according to a government aide who heard him speak recently. Hackerman knows the terrain well. He's a research chemist at the University of Texas who won an early federal research grant in the 1940s from an agency then known as the Office of Inventions, later the Office of Naval Research. Back then, he says, the reason for providing research funds to professors was to maintain faculty members at the "peak of their creative powers," in the hope that this would "induce the same thing in their students." The government's goal was to improve education, he claims, and "the bonus was the science that was produced." Today, the objective of federal support is to produce science, "and the education is looked on as a bonus. That's all wrong," Hackerman argues.

"The current process leads to a belief that you shouldn't deal with people who are more ignorant than you are—that if you don't have the absolute best students in front of you, you're wasting your time." This is perverse, Hackerman says. He thinks it's essential that faculty reach out to the other 99.9% of the students, who are, after all "the ones who support us." He hears "constant complaints" that faculty members regard education as a chore; "they're off in all directions seeking support and fame," ignoring the "reason for them being there."

Richard Atkinson, chancellor of the University of California (UC) at San Diego, shares Hackerman's concerns. "We have let the concern for undergraduate teaching drift," he says. In the days when he was an undergraduate, says Atkinson, "the superstars of the faculty taught the big undergraduate classes.... At the University of Chicago I took undergraduate chemistry from [Nobel laureate] Harold Urey."

But Atkinson warns that there is a faulty argument being advanced by research universities about their role as educators. "If the research universities want to argue that they are the ones to provide the best quality undergraduate education, then they are going to endanger their future existence," he says. The reason? "It says to all the other schools, 'If you're not doing research, you're not providing a quality education'...and that is a great mistake that we've perpetuated."



UNIVERSITY OF CHICAGO ARCHIVES

The way it used to be. Nobel Prize–winning chemist Harold Urey lectures at the University of Chicago.

The underlying problem is that the system is overwhelmingly geared to reward research. "The best teacher in the world is known only to the perimeter of his campus," Hackerman says, "while a mediocre researcher is known around the world." He would like to see every major proposal for a center or large science project accompanied by a campus "educational impact statement" telling how it would benefit students.

Some universities have begun to take their teaching requirements more seriously. Last month, David Gardner, president of UC, announced that he was implementing several of the changes recommended by a university-wide task force chaired by UC Santa Cruz chancellor Karl Pister on faculty rewards. The report called for balancing "the contributions of teaching, research, and public service" in evaluating faculty, and rewarding faculty who act in a mentoring or advisory capacity to students. The university will also consider student evaluations of teachers when weighing faculty for promotions.

Atkinson says he is confident that universities around the country are beginning to pay more attention to their teaching responsibilities. But so far, that may not be the view from the faculty trenches. "They're just paying lip service to teaching," says a young faculty member from a research-intensive university. It may be a while before publish or perish passes from the scene.

–E.M and J.P.

erful strings to funding for research, to the manner of its distribution," and even to the selection of the research itself.

Charting a new course

Ask just about any researcher or university administrator what remedies are needed to cure the ills now afflicting the academic enterprise, and after the inevitable "more money" you will get a wide range of answers. That's not surprising, since the problems vary according to types of institution, and even among apparently similar schools. There is a growing sense, however, that the remedies will largely have to be found within the universities themselves.

Certainly the federal government is unlikely to ride to the rescue with large infusions of cash. Indeed, it is in the process of redefining what its responsibility to university-based research should be. "It was accepted for years that the federal government would pay the full cost of research to universities," says NSF's Massey. "That was fine as long as there was enough money and there was general agreement to do that. But in the last several years, the resources haven't grown as fast as the needs, and there hasn't been the common understanding to guide allocation of resources."

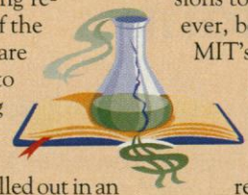
So universities will have to find their own way. One simple proposal comes from Robert Rosenzweig, president of the Association of American Universities, the Washington voice of 56 top research schools. Calling for "intellectual honesty," he said he would urge universities to "come clean" about what they really do and don't do. They are excellent at "honing the intellect to its highest level," Rosenzweig argued, but they are not so good—despite the wishes of many politicians—at creating local prosperity. His prescription: drop the economic sales pitch that many people have used as a means of winning political support for basic research. Rather than promote higher education as a boon to local industry, he would endorse education for its own sake. If there are still too many competitors for scarce funds, according to this remedy, the solution is to apply tougher standards through peer review and reward only the best.

But this recommendation may strike others as self-serving. "We have become too defended in our positions and we're not looking carefully enough at what our innovative responsibilities are," says Brandeis president Thier. Thier argues that the structure of universities may be too rigid to keep pace with changes in science, let alone the changes in the world. Thier's suggestions for short-term remedies—some of which Brandeis is considering—would be bitter medicine for many schools:

- Cut the size of the faculty, and reduce the number of programs the university offers.
- Share facilities with nearby schools.
- Require faculty to teach more courses, relieving some of the pressure to raise tuition

A Threat to Graduate Research

A change being contemplated in the rules governing reimbursement for graduate student tuition has some of the country's top research universities up in arms. They are charging that the federal government, in an effort to simplify its bean counting, could end up discouraging research by graduate students yet save no money in the process.



At issue are the complex accounting procedures spelled out in an infamous government document known as circular A-21. A-21 contains the rules governing what expenses universities can legitimately claim as indirect costs, and what must be charged as direct costs against a faculty member's grant. A-21 says graduate student tuition is a direct cost. But faculty members, especially those at the elite schools with high tuition, say that accounting scheme presents them with a dilemma. Do they fulfill their educational mission and use some of their precious grant money to train relatively inexperienced graduate students, or do they pay a bit extra for postdocs, who would be more productive in the lab's research? California Institute of Technology's vice provost David Goodstein says that most faculty at his school would "tilt" toward bringing in a postdoc if they had to follow A-21's tuition prescription.

To prevent that from happening, Caltech and several other schools had convinced the government to grant a waiver from A-21 rules, permitting them to charge graduate student tuition to an employee benefit pool, spreading the burden of payment across all researchers and employees at the university, and lowering the direct cost to any one investigator. Under this cost-sharing arrangement, even the labs and faculty members who have few, if any, graduate students ultimately pay part of the tuition bill.

A White House task force that is looking into possible revisions to A-21 is contemplating ending these exemptions, however, because they can result in some inequities. For instance, MIT's Lincoln Laboratory, which depends heavily on funding from the Department of Defense (DOD), relies mainly on postdocs and technicians. Its DOD grants, therefore, end up subsidizing MIT's 2200 or so graduate students, most of whom are involved in nondefense research. Why should DOD pay a share of the tuition of students not directly contributing to Lincoln Lab research?

MIT, Caltech, and the few other schools receiving the waiver acknowledge this logic, but respond that the government, as a whole, benefits from the indirect payment method by encouraging graduate research. After MIT inaugurated this accounting method in 1983, for instance, the number of graduate research assistants rose dramatically from 1500 then to 2200 in 1991. Officials at these schools, therefore, are battling not to lose their waiver. "Nothing would dispirit the faculty more," Caltech's president, Thomas Everhart, recently warned a panel of presidential science advisers. Tony Potami, the University of Minnesota's vice president for research, says: "We will erode graduate education in this country." In addition, the schools point out that their indirect payment method does not cost the government extra money.

In the final analysis, the task force must decide between a logical cost-accounting scheme—directly charging graduate tuition to a research grant—and a more convoluted, and potentially inequitable, method that encourages graduate research experience. "We're far from any conclusion," task force executive secretary William Raub told *Science*. Raub's panel is due to produce a new draft of A-21 in early October.

–J.T.

to cover teaching costs.

- Limit or abandon needs-blind admission policies—in other words, include the ability to pay as a criterion in accepting students (an option Thier says is not being contemplated by Brandeis).
- Expand master's degree programs. These generate revenue, since students in these programs typically pay full tuition.
- Make a better case to the corporate sector and the public that universities are worth supporting.

The crisis may produce as many different solutions to the problem as there are types of university. Some schools may focus on achieving excellence in a particular niche. Others may build upon their core mission and retreat from specialized ventures. And perhaps some entirely novel solutions will come up as well—like the electronic university predicted by Donald Langenberg—a community of scholars without a campus, linked by computer networks.

For some researchers, the troubles of universities have had a dispiriting effect. Entomologist Thomas Eisner at Cornell says he has had to help graduate students come up with low- or no-cost research projects. True, good research can be done with very little money: "With a calculator and a spider you have a lifetime of research studying webs," he says. But he worries that rigid departmental structures and funding agencies' fickle devotion to "fashionable" research topics make it "hard to paint a glorious future" for those contemplating an academic career.

But pharmacologist Paul Talalay of Johns Hopkins opts for a longer vision and does not think that "our future is behind us." "Universities are amongst the most stable of human institutions," he says, calling attention to the fact that the great European universities have been around for a millennium or more. "The current crisis is a small ripple in the ocean of time," he says.

Cornell's Wiesenfeld, an administrator who still manages to do NSF-sponsored research in chemistry, also remains optimistic about the future. "We will survive, and the good universities will prosper, he says. "But they will be very different from the universities of the 1970s and 1980s."

–Eliot Marshall & Joseph Palca

With reporting by Marcia Barinaga.

THE RESEARCH TOP TWENTY

	1980	1990
1.	Johns Hopkins	Johns Hopkins
2.	MIT	MIT
3.	U Wisconsin, Madison	U Michigan
4.	UC San Diego	U Wisconsin, Madison
5.	U Minnesota	Stanford
6.	Stanford	Cornell
7.	U Washington	U Minnesota
8.	U Michigan	Texas A&M
9.	Cornell	Penn State
10.	Columbia	UC Los Angeles
11.	Harvard	U Washington
12.	U Pennsylvania	UC San Francisco
13.	UC Berkeley	UC San Diego
14.	UC Los Angeles	UC Berkeley
15.	U Illinois, Urbana	U Texas, Austin
16.	U Texas, Austin	U Illinois, Urbana
17.	U Southern California	Harvard
18.	UC San Francisco	UC Davis
19.	Penn State	U Arizona
20.	Texas A&M	U Pennsylvania

SOURCE: NATIONAL SCIENCE FOUNDATION

Where the money goes. The leading university recipients of federal research dollars. (Public institutions are shown in red, private colleges in blue.)