BIOMEDICAL RESEARCH

NCI Cuts Contracts to Fund More Grants

Richard Klausner, director of the National Cancer Institute, is planning a dramatic shift of funds out of NCI contract research and into extramural grants. At the same time, Klausner told *Science*, NCI hopes to create a new appeals process to give scientists who narrowly miss winning an NCI grant a quick second shot. Klausner will take these proposals to the National Cancer Advisory Board (NCAB) at its next meeting, scheduled for 27 February. If the board gives its approval, the first benefit grant-seekers will see is a huge boost in the "payline" for R01 applicants—the percentage of investigator-initiated proposals that win funding. It is expected to rise from last year's level of 15% to about 23% in 1996.

To finance this policy change, Klausner has asked other programs at NCI to make sacrifices. The upheaval began last year, according to NCI Deputy Director Alan Rabson, when Klausner undertook a comprehensive review of NCI programs. It resulted in a firm request from Klausner that contract managers reduce their budgets by 10%. Rabson says these cuts are now being made, and they will affect many functions, including NCI's contract research operation in Frederick, Maryland. NCI budget officer John Hartinger calculates that about $25 million to $30 million will be drawn from contract research accounts in 1996 and put into extramural "research project grants." In addition, NCI is benefiting from a congressional windfall this year that provides a 5.7% overall budget increase, higher than the 4.2% raise the Administration had sought. The net effect, Hartinger says, is that NCI will be able to pump an additional $70 million into grants this year.

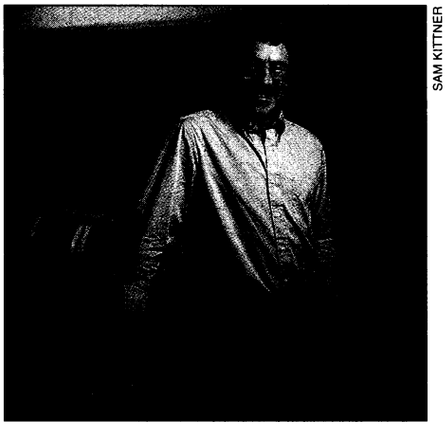
While most of the newly available funds will be put directly into grants, Klausner says that some will be set aside in a discretionary account to be used to fund exceptional cases. The plan, Klausner explained, is to permit anyone who is rejected but whose peer-review score comes within four points of the payline (anyone whose proposal ranks at least in the top 27%) to request an "accelerated executive review." For patient-oriented research, the appeals process will be even more generous: Anyone who comes within 10 points of the payline (in the top 33%) may ask for a second, high-level review.

NCI will entertain "a very simplified response which details a point-by-point" answer to criticisms spelled out in the "pink sheet" of reviewer comments. Institute staff will evaluate these petitions and pass them to NCI's executive committee, which Klausner chairs, for a final decision. This offer is "not a guarantee that grants will be funded," Klausner notes, but something akin to a letter from an editor saying a manuscript may be accepted if the author successfully responds to the reviewers' comments.

Klausner hopes these appeals will take a matter of weeks, rather than the 9 to 18 months that applicants now have to wait when they resubmit a proposal. "This wait has become extremely destabilizing, particularly for patient-oriented research, where the queue for getting funded can actually make the difference between whether a project happens or doesn't happen," he says, adding that the "message we're trying to send [is that] we recognize that the lifeblood of this research is investigator-initiated research."

Klausner's funding tilt is certain to win plaudits from the extramural scientific community, and the NCAB is expected to endorse his proposals. NCAB Chair Barbara Rimer, an oncologist at Duke University Medical School, says she feels that this is "exactly the direction" that an independent review (the Bishop-Calabresi report) urged NCI to take last year (*Science*, 26 May 1995, p. 1121). Rimer adds: "There isn't anybody in the field—except maybe the contractors—who would find a problem" with the new strategy. When it comes up at the NCAB's meeting, Rimer says, "I think some members may stand up and cheer."

–Eliot Marshall



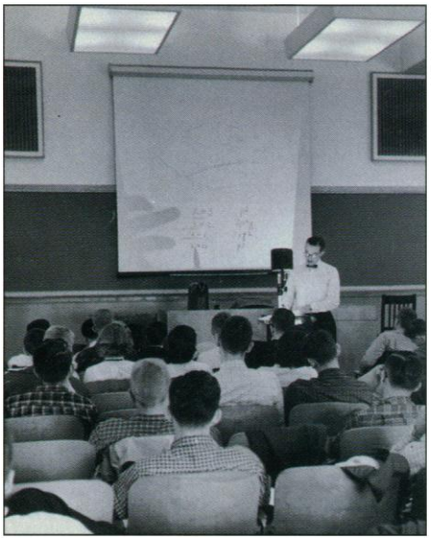
SAM KITTNER

Prime mover. Klausner's plans will boost NCI's payline and speed up some resubmissions.

SCIENCE EDUCATION

Calculus Reform Sparks a Backlash

"To every action, there is always opposed an equal reaction," wrote Isaac Newton some 300 years ago. The author of the *Principia* was referring to mechanical motion, but his law also applies to a conflict raging today over another of his inventions—calculus. A nationwide effort to reform calculus teaching has recently spawned a backlash, and although at this point the critics don't quite equal the reformers' force, they are certainly opposed, contending that the new courses water down the subject and coddle students with computers. In general, reform has gone too far toward making calculus look easy, says George Andrews of Pennsylvania State University: "It's not a balanced approach."



MIT MUSEUM

Calculus unplugged. Critics say students worked harder in the 1950s.

Not surprisingly, reformers roundly deny such charges, saying that thanks to their efforts, students are learning more and liking it better. Still, it's clear that the spate of criticism is slowing the pace of reform, as many math departments take a wait-and-see approach to changing the way they teach. Yet despite the divisive debate, both sides agree on one point: The reform movement has had a healthy effect on mathematicians' attitudes toward teaching.

Over the last 10 years, calculus reform has moved from the margins of the mathematical community to a position of prominence, thanks to big grants from the National Science Foundation and encouragement from textbook publishers eager to sell more books. But while reform has been claiming the spotlight, the backlash has been brewing behind the scenes, with clashing opinions in hallways and on-line discussion groups. It finally went public last month, at a standing-room-only panel discussion at the winter meetings of the American Mathematical Society and the Mathematical Association of America, held in Orlando, Florida.

Andrews, who took the con position, sees

disaster looming. The "success" of the new efforts has been due mainly to the enthusiasm of the reformers, he says—and once the novelty wears off, what's left will be bad mathematics poorly taught. He and other critics are particularly worried by what they see as an overdependence on computers and calculators. The prospect of students who need a calculator to divide by 10 is real, Andrews says: "There is a sizable percentage of [students] who cling to these machines like drowning men to rafts and are unable to perform even the simplest arithmetic computations [without them]."

In a critique reminiscent of the wider debate about academic standards, Andrews charges that reformers have failed to confront what he sees as the real problem: students who don't study. In fact, because the new classes aim to make calculus more appealing, he says they risk teaching to the lowest common denominator. He and others say that the first wave of reformed textbooks have "dumbed down" the subject, downplaying technical mastery of integrals and derivatives, and abandoning proofs altogether. He thinks math departments would do better with a consistent policy for assigning homework than by overhauling the traditional calculus course.

Indeed, John Polking of Rice University—who considers himself "neutral" in this debate—notes that the textbook-adoption committee at Rice has so far rejected all new-style texts as inadequate. The chief target for much of the criticism is a text produced by the Harvard Calculus Consortium, which critics say sacrifices rigor for a warm and fuzzy approach. Ultimately, say mathematicians such as Hung-Hsi Wu of the University of California, Berkeley, such texts will leave students confused and uncertain about the logical connections among ideas in the course.

Reformers, of course, see things differently. While cautioning that "it's too soon" to judge whether calculus reform is truly working, Morton Brown of the University of Michigan says that his school's experience shows definite improvements in students' learning. In fact, he says, this brand of new math is actually increasing students' work time, not decreasing it. As for dependence on calculators, "We spend a lot of time making sure that the students do not simply plug in black-box solutions," Brown says. "If they do that on the test, they get zero credit."

The dumbing-down tag especially rankles reformers. "I deeply resent, and categorically deny, this implication that the calculus reform represents any dilution of homework or dumbing down of the course," says William McCallum of the University of Arizona, who is associated with the Harvard project. "One of the things that interested me most about calculus reform was the challenge of coming up with real homework problems that asked the students to think. I think this is one of the great achievements of the movement."

As the charges and countercharges fly, it's clear that a definitive evaluation is badly needed, says Polking. But that's easier said than done. For one thing, there's no agreement on what it means for reform to succeed. Criteria range from student attitudes toward calculus, to the grades they get in later courses, to the number that go on to major in mathematics. Even the obvious criterion—that students emerge with a better understanding of calculus—is elusive, notes Andrew Gleason, one of the Harvard project leaders. "What does it mean to understand calculus?" he asks. "We had session after session debating this question."

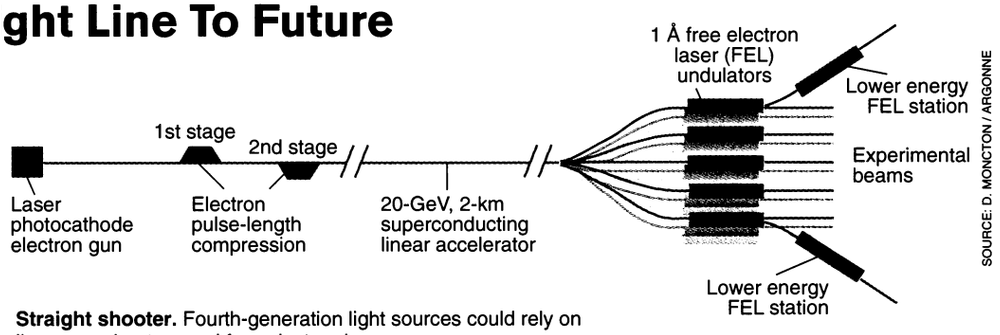
No matter which side prevails, all parties agree that the debate itself shows a healthy degree of concern for teaching. A decade ago major mathematical meetings all but ignored issues of pedagogy, while in Orlando there were more than 50 sessions on education. The reform movement, backlash and all, has "given the teaching of calculus a much greater emphasis in all of our institutions," notes Polking. "That's definitely progress."

–Barry Cipra

X-RAY SOURCES

Linacs Offer Straight Line To Future

GRENOBLE, FRANCE—The current family of electron storage rings in Japan, Europe, and the United States is giving researchers new insight into the structure of matter, but they are essentially old tools. Although these third-generation machines are bigger and more costly than their predecessors, they produce their intense x-rays by the same basic method: They accelerate electrons and force them into a circular path with powerful magnets.



Straight shooter. Fourth-generation light sources could rely on linear accelerators and free-electron lasers.

But last month, an international community of x-ray scientists meeting here* decided to stop going around in circles. They agreed that the fourth-generation machines to be built sometime in the next 20 years should generate x-rays by a different strategy. The new facilities would use linear accelerators (linacs) to accelerate the electrons, then feed them into free-electron lasers (FELs) to produce shorter, more intense pulses than anything now available or in the works.

Reaching consensus on this novel approach surprised those attending the workshop. "Nobody really expected this outcome," admits Guy Luijckx of NIKHEF, the Dutch National Institute for Nuclear and High-Energy Physics. "It was remarkable." The idea of using linacs and FELs builds upon theoretical work at the Stanford Linear Accelerator Center and at DESY, Germany's particle physics laboratory near Hamburg—work that Herman Winick of SLAC says was seen by some researchers as "a solution looking for a problem. ... But when we asked users if they would be interested in this degree of coherence, higher brightness and peak power, and shorter pulses," he says, "their answer was a resounding yes!"

The current generation of x-ray sources accelerate electrons to energies ranging from 6 billion to 8 billion electron volts as they speed around circular racetracks. The circulating beams pass through devices called wigglers and undulators, where they swerve back and forth through gauntlets of magnets. In doing so, the electrons generate intense, pencil-thin beams of x-rays. The shorter, narrower, and more intense the x-ray pulse, the sharper the resulting image. And the pulse size, in turn, depends on the size of the electron bunches in the accelerator. "We want to decrease the bunch size in all three dimensions," says Jörg Rossbach at DESY. "The linac is the natural solution."

One advantage of linear accelerators is their ability to create bunches of electrons with pulses as short as 100 femtoseconds and much less than 1 millimeter in length, compared to the 10 picoseconds' duration and

* Workshop on Fourth Generation Light Sources, organized by the Beam Dynamics Panel of the International Committee for Future Accelerators, Grenoble, 22 to 25 January.