of *Nature*, two groups reported that they had added defects to their MgB_2 wires to help trap magnetic eddies called vortices that can course through the material and sap its ability to carry current. So far, eliminating vortices altogether has proven impossible. But researchers know that if they can pin them down and keep them from moving, the wire will still superconduct. To do so, one team, led by physicist Chang-Beom Eom of the University of Wisconsin, Madison, substituted oxygen for some of the boron; the other team, led by David Caplin of University College London bombarded its film with protons.

Iowa's Canfield and others predict more results in the coming months but not necessarily more announcements. "This is where you get to all the patentable stuff," says Philip Sargent, president of Diboride Conductors, a U.K.-based start-up intent on commercializing MgB_2. Sargent insists he's heard of unpublished work describing improvements. But he declines to specify just what those are.

Whether these rumored improvements will be enough to vault MgB_2 over its commercial hurdles is anyone's guess. But not everyone is convinced that the newest superconductor will make it, particularly folks at established HTS companies, such as American Superconductor Corp. (ASC), that are making HTS wire. "It's enough to monitor [their progress] extremely closely," says ASC's chief technical officer Alex Malozemoff. But so far he hasn't seen anything to make him want his company to switch gears. "An army of researchers has pounced on the material and doped it with everything under the sun. But so far the [superconducting temperature] has only gone down," he says.

Perhaps that's because Hermes is just up to his old tricks. Whether MgB_2 makes it to market may depend on how many more impediments the capricious deity throws in the path of superconductivity researchers.

–ROBERT F. SERVICE

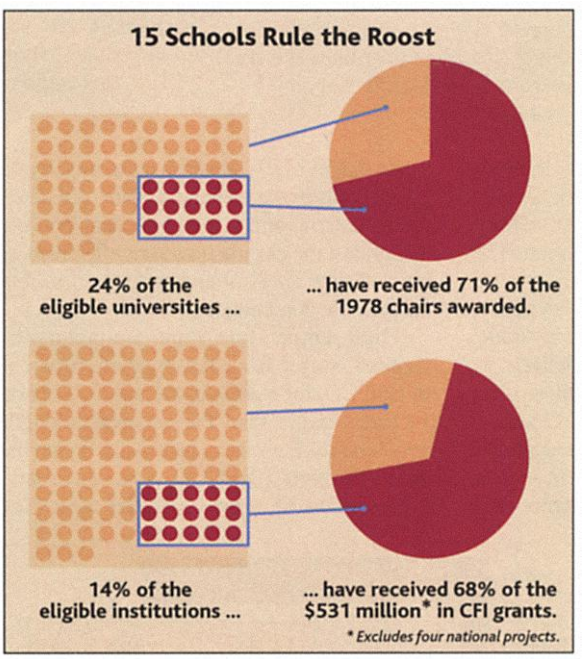
CANADA

New Money Widens Gap Among Universities

New programs are pumping more than a billion dollars into academic research. But a relative handful of universities are getting most of the money

OTTAWA, CANADA—When Robert Birgeneau decided 18 months ago to leave a deanship at the Massachusetts Institute of Technology (MIT) to become president of the University of Toronto (UT), the chance to move up the academic ladder was only part of the reason. Born and educated in Canada, Birgeneau also was attracted by the opportunity to compete for billions of dollars that the government is shoveling into targeted programs aimed at creating an MIT or two north of the 49th parallel. But although Birgeneau and other top academic administrators praise the new programs as a "crowning achievement" of the current Liberal government, some educators worry that the government is purchasing excellence for a few at the expense of the majority of institutions, faculty, and students. A forthcoming government policy paper on innovation promises to provide a forum for this debate.

Three new programs have changed the Canadian academic landscape. The $600 million Canada Research Chairs program was created to stem an ostensible brain drain to the United States and Europe (*Science*, 22 October 1999, p. 651). The Canada Foundation for Innovation (CFI), with an initial endowment of $520 million, is intended to renovate aging buildings, laboratories, and other university facilities (*Science*, 25 September 1998, p. 1933). And the newly restructured Canadian Institutes of Health Research (CIHR), whose budget has doubled in 3 years to $353 million, hopes to spur biomedical advances that will strengthen the nation's economy and improve public health (*Science*, 21 December 2001, p. 2452). Funds for the chairs are awarded on a competitive basis using a formula that favors large institutions with a successful track record in attracting grants, whereas those with medical schools have a decided advantage in competing for CFI and CIHR awards.



Getting richer. The same 15 Canadian universities get the lion's share of infrastructure grants and chairs.

"The combination of [these three programs] was a critical factor in my decision to return," says Birgeneau, who has inherited an institution bursting at the seams as a result of this new federal largesse. The university already has won $53 million for some 120 CFI projects, including a state-of-the-art crystal growth facility. UT also will be able to anoint 270 faculty stars over 5 years, with generous funding for their labs (*Science*, 23 June 2000, p. 2112).

But not everybody is happy with the idea of the rich getting richer (see graphic). "The biggest 10 research universities are now getting close to two-thirds of all the money," says Jim Turk, executive director of the Canadian Association of University Teachers, with UT at the top. That imbalance shatters a cherished Canadian ideal of providing equal access to an excellent education regardless of the nature of the institution, says Turk. Whereas UT will get 270 new chairs, for example, nearby York University, a prominent liberal arts institution, will get a paltry 32.

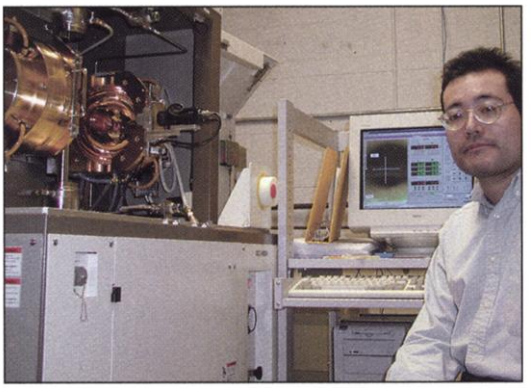
The competitive funding pushes most universities even farther behind in their efforts to keep up with the rising costs of research, Turk says. A recent survey of growth rates among the 113 largest academic libraries in North America, for example, shows that Canadian universities occupy seven of the 11 bottom slots.

The chairs program has also created what Michael Stevenson, president of Simon Fraser University in Burnaby, British Columbia, calls "invidious distinction and irritation" within faculty ranks. And data suggest that it may not even achieve its desired end of deepening the academic research pool by attracting talent from outside Canada or from industry. Some 370 of 448 accepted chairs have been appointed from within institutions, and 29 involved hiring someone at another Canadian university. Fewer than 10% of

SOURCE: CANADA FOUNDATION FOR INNOVATION AND THE RESEARCH CHAIRS PROGRAM

the hires (41) come from abroad, and a scant 2% (eight) made the shift from industry. Stevenson says there is no evidence that the occupants of the new chairs were about to fly the coop, and he frets that the bulk of future appointments will involve more interuniversity poaching. "The net effect will be that we are paying the same people a lot more for no discernible improvement in output," he predicts.

Stevenson also believes that people in the social sciences and some natural sciences are disadvantaged by CFI's requirement that another body put up 60% of a project's cost, because it's generally much harder for natural and social scientists to find external sources of funding. Accordingly, the social sciences have garnered only 2% of CFI funding (a mere four projects), although they represent 53% of the country's faculty members, whereas the 18% in the health sciences have won 45% of the pot. This imbalance has exacerbated resentment among social scientists, says Humanities and Social Sciences Federation of Canada president Patricia Clements: "Of course, there is a division on the campus. While the Minister of Justice was visiting the clean room in the new engineering building, people in the humanities center are phoning the janitor for the fifth time to fix the dripping tap."



Growth industry. Postdoc Shuichi Wakimoto and the floating zone crystal growth furnace, one of several new University of Toronto facilities with funding from CFI.

Birgeneau rejects that gloomy assessment of the programs' impact. Even if tiering occurs, he says, peer review ensures that the money is well spent. In addition, he argues that a rising tide lifts all academic boats: "The fact is that, because of these increased resources, we're attracting better graduate students and providing them with a better graduate education." The result, Birgeneau says, is that even "second-tier institutions" can choose from a wider selection of well-trained faculty members.

But Frederick Lowy, head of Concordia University in Montreal, feels that the gap has grown large enough and that the government now needs to strike "a better balance between capacity building and rewarding of existing research strength." Otherwise, he warns, "those universities without research potential will not be able to provide as good an education as those [that] do."

He and others had hoped to address such concerns during forthcoming national consultations on Ottawa's long-overdue white paper on innovation. But they were delayed after the chief sponsor, Industry Minister Brian Tobin, unexpectedly packed his bags last month. Tobin's successor, Allan Rock, is expected to pick up the project this spring.

–WAYNE KONDRO

Wayne Kondro writes from Ottawa.

MATHEMATICS IN FILM

Beautiful Mind's Math Guru Makes Truth = Beauty

As mathematics consultant to the hit film about a troubled genius, Dave Bayer learned to balance a whole new set of equations

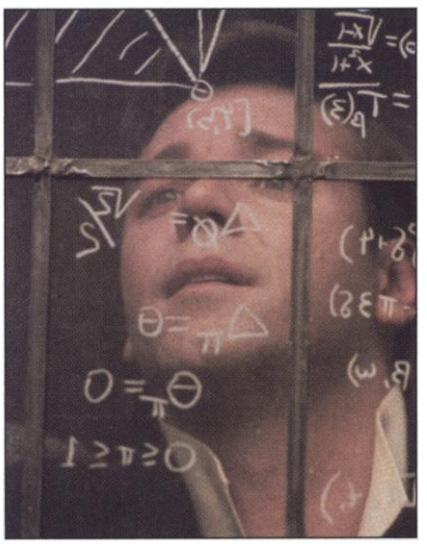
Early in the film *A Beautiful Mind*, Russell Crowe, playing the brilliant young mathematician John Forbes Nash, strides into a classroom at the Massachusetts Institute of Technology to teach his first undergraduate class in vector calculus. The 1950s-era students are wearing coats and ties; Nash, who hasn't even bothered to don a shirt over his undershirt, makes no effort to hide his resentment of them and of his teaching duties. Hurling the assigned textbook into a wastebasket, he writes a series of equations on the blackboard and announces that the rest of the course will be devoted solely to solving the problem they represent—a task, he says, that will take some of them "all your natural lives."

It's a pivotal moment. The student who later rises to the challenge—unsuccessfully—is Nash's future wife Alicia (played by Jennifer Connelly), who will nurse him through 3 decades of mental illness and share his triumph when he receives the Nobel Prize. Like many key scenes in the film, though, the one that launches their journey together mixes fact and invention. Though Alicia Larde did take John Nash's advanced calculus course, he never threw out such a challenge.

So when director Ron Howard needed a mathematical problem for the scene, he couldn't just pluck one out of someone's 50-year-old class notes. Instead he asked Dave Bayer to make it up—to invent the math that Nash *would* have written if such a scene had actually taken place. Some mathematicians or math historians might have balked, but for Bayer—an algebraic geometer at Barnard College in New York City who was moonlighting as *A Beautiful Mind*'s mathematical consultant—it was all in a day's work. "For me, movies are dream sequences," Bayer says. "But even the wildest dream sequences are anchored in reality."

Bayer's task was to forge the anchors. It is a job, Bayer says, that Howard and his team took very seriously. "They have found that real life is much more surprising than anything people can make up," he says. "Audiences can tell when the mathematics is real, and they want it to be real."

If a scientific consultant does his or her job well enough, the viewers won't even notice it. And indeed, the ambitious portrayal of mathematics in *A Beautiful Mind* has done nothing to prevent audiences from appreciating its compelling love story. It has been one of the five top-grossing movies in the United States every week since its release, and on 20 January it won four Golden Globe awards, including best drama.



Obsessive. *A Beautiful Mind* depicts a man immersed in mathematics.

Bayer came to the picture by a circuitous route. In 2000, he had written a review of the Broadway play

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