SCIENCE FUNDING

Australian Researchers Go for the Gold

Academic scientists are hoping that two new reports calling for increased funding of research and innovation will finally boost a stagnant R&D budget

MELBOURNE, AUSTRALIA—The recent slide of the Australian dollar to an all-time low of US$0.54 may have been a pleasant surprise to the flood of tourists arriving for last month's Olympic Games in Sydney. To Australian scientists, however, it was proof of something they have been saying for years: The country's failure to spend more on research is stifling innovation and dragging down the economy. Last month their proposed solution—a major boost in spending on research and education and an improved climate for commercializing new technology—was embraced by two new reports that take the government to task for underinvesting in the new "knowledge" economy. Researchers hope that the reports, combined with the sinking exchange rate, will finally prompt action.

Australia's economy has been growing at a healthy annual clip of 4% in recent years. But that expansion hides a fundamental weakness that worries global financial markets, says Australian Chief Scientist Robin Batterham, the author of one report, entitled *The Chance to Change*, that argues for a variety of measures to stimulate innovation. "We're perceived by the international community as an old economy," Batterham says, referring to the country's reliance on such low-tech commodities as agriculture and precious metals. "If we don't do something to change that, we're on [the] way to the 30-cent dollar." James Wolfensohn, head of the World Bank, delivered an equally blunt message about the connection between R&D policies and a sliding currency during a visit to the recent World Economic Forum in Melbourne. "There is a lesson in that for Australia," said the Australian-born financier. "You haven't put your money into R&D."

Signs of the problem are everywhere. Australia's overall R&D budget has been stagnant since 1996, at $4.8 billion, and spending by industry—slightly less than half the total—has actually declined by 6% over that period. Government funding of academic research has risen by a meager 2% per year since 1996 and has fallen 13% as a proportion of GNP. Researchers have been forced to cope with soaring enrollments—up 60% in the past decade—that have boosted teaching loads and diverted resources from needed renovations and major equipment purchases. At the same time, however, student interest in such bellwether majors as mathematics and physics is dropping. With funding tied to enrollment, many universities have trimmed faculty slots and cut administrative support in these departments.

Batterham's report to Science Minister Nick Minchin lays out a plan to reverse that slide by creating an "innovation culture." It calls for stronger links between academic and government research labs and industry and a big boost in spending on research, facilities, and education. The government is also mulling over a second report, based on an innovation summit held in February, that puts a price tag of $1.4 billion over 5 years on a similar package of reforms. The idea for a summit was hatched by business leaders, who last week joined the cream of the country's research establishment in sending the government an open letter calling for "early action" toward achieving those aims. In line with the country's near-obsession with the recent Olympic Games, the letter asserts that, "with the right policy framework and encouragement from government, Australian industry, research, and higher education can help deliver the gold-medal performance needed to deliver greater prosperity."

Barking up the wrong tree? Cuts in university research put the squeeze on microbiologist Dee Carter's work with a eucalyptus-borne fungus.

CREDIT: T. BUI/UNIVERSITY OF SYDNEY

Help can't come soon enough for University of Sydney microbiologist Dee Carter, who has just won a 5-year, $300,000 grant from the Howard Hughes Medical Institute for her work on a eucalyptus-borne fungus that can cause meningitis in humans. Although the grant supports her research, it will do little to relieve a heavy teaching load or improve the crowded and dilapidated conditions in her lab, which are so bad that Carter routinely declines requests from her overseas collaborators to visit. "I'm too embarrassed about the state of the lab to invite them over," says the 38-year-old Carter. "For young academics like me it's pretty depressing."

It's no better for veteran scientists like John Cashion, head of physics at Monash University. "It's hard to find time to think," he says about a teaching load that has doubled in 20 years. For Cashion, survival lies in an upcoming amalgamation of his department with materials engineering. But such consolidations can be unsettling to faculty members, say university administrators. "Many of the top people are going overseas," says Garth Gaudry, head of the mathematics department at the University of New South Wales, who is also finding it hard to fill positions in his department.

To be sure, those working in hot areas such as biotechnology or computing have fared much better. The government doubled funding for academic medical research last year, for example, after a report written by industrialist Peter Wills argued that Australia was lagging badly in key fields (*Science*, 21 May 1999, p. 1248). And some universities have overhauled their structures to take advantage of a suddenly booming venture capital industry spurred by an innovation fund that the government created jointly with business in 1997. "One of the big changes is the availability of venture capital in the range of $2 million to $5 million," says Peter Andrews, co-director of the Institute for Molecular Bioscience at the University of Queensland in Brisbane, whose institute has already benefited by spinning off some 17 companies in the last 4 years.

But most researchers are unable to attract venture capital when their work has no immediate commercial payoffs. "We feel like we're being hit from two sides," says Carter. "We can't do the research we would like to because of the demands placed on our time through declining staff numbers, and basic research areas are being ignored in favor of industrial applications." Gaudry notes that a culture of innovation won't flourish unless there is a sufficiently large pool of talent.

The two reports address both problems. They recommend that 2000 new student places per year be created in the physical sciences, the costs of which should be shared between government and business, and that scholarships be given to students who fill 500 of these places. They recommend that the government invigorate first-rate university research by doubling the number of postdoctoral fellowships from 55 to 110, doubling the $132 million budget of the Australian Research Council (ARC), and providing $275 million for academic infrastructure. At present the council funds only one in five proposals, and individual grants cover only 75% of the research costs.

Most academics believe that the recommendations reinforce the earlier Wills report, which made a convincing case for the value of basic research in fostering productivity. And they welcome the strong support coming from industry. "This is the first time we have had such a united front," says Vicky Sara, chair of the ARC. Still, they caution that years of neglect can't be erased overnight. With her department facing another 20% budget cut, Carter is not alone in wondering whether any boost in government funding may be too little, too late. **–ELIZABETH FINKEL**

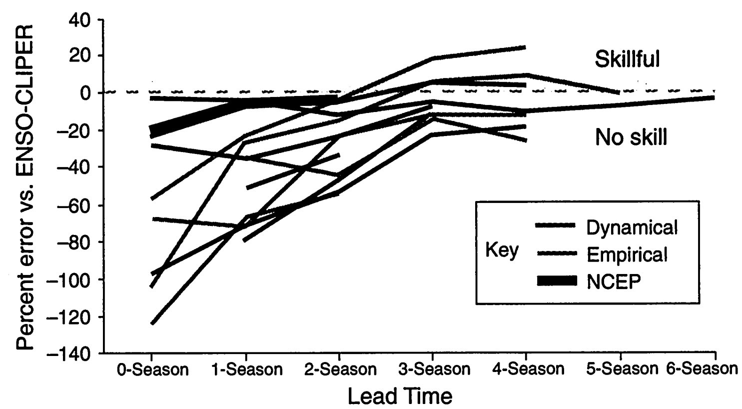
Elizabeth Finkel writes from Melbourne.

CLIMATE PREDICTION

Second Thoughts on Skill Of El Niño Predictions

A few years' perspective on the 1997–98 El Niño and a toughening of standards drops model forecast performance from spectacular to encouraging

What if your high school geometry teacher called you up at grad school to tell you that, on further thought, she was dropping your grade from an A to a C+? That's what researchers are doing to the computer models that forecast a warming of the tropical Pacific early in 1997. Less than a year after the onset of one of the two strongest El Niños of the century, researchers were awarding high marks to models that had anticipated the warming by as much as 6 months, especially the big, computationally expensive models (*Science*, 24 April 1998, p. 522). Now, with the complete rise and fall of El Niño available for grading—and with second thoughts about the standard to which models should be held—researchers have lowered their marks. Some critics have even failed the models.



A cloudy crystal ball. Both cheap and sophisticated El Niño forecast models struggle to exceed a modest standard of skill (dashed line).

SOURCE: C. W. LANDSEA AND J. A. KNAFF, *BULLETIN OF THE AMERICAN METEOROLOGICAL SOCIETY*

In the September issue of the *Bulletin of the American Meteorological Society*, meteorologists Christopher Landsea of the National Oceanic and Atmospheric Administration's (NOAA's) Hurricane Research Division in Miami and John Knaff of NOAA's Cooperative Institute for Research in the Atmosphere in Fort Collins, Colorado, give the models' performance a failing grade. The sophisticated models, it turns out, did a poor job of predicting the 1997–98 El Niño's full course; in fact, they did no better than a rudimentary model that can run on a desktop. "When you look at the totality of the [El Niño] event, there wasn't much skill, if any," says Landsea. Others won't go that far but agree that the models' reputation needs to be taken down a notch or two. "There's no doubt the models were helpful," says meteorologist Neville Nicholls of the Australian Bureau of Meteorology Research Centre in Melbourne, "but certainly they didn't do as well as a majority of my colleagues had thought. We still can't be certain the models have got the problem solved."

In arriving at their much-reduced forecasting scores, Landsea and Knaff make two changes in the way forecast performance was initially evaluated. Instead of focusing on how well a model predicted the onset of El Niño in the spring of 1997, as early analyses had to do, they gauge success throughout El Niño's onset, peak, and decay and into the beginning of La Niña, the cold phase of the cycle in the tropical Pacific that ended this summer. They found that whereas some models, such as that of NOAA's National Centers for Environmental Prediction (NCEP) in Camp Springs, Maryland, did well in predicting the time of onset, all 12 models they assessed underestimated the size of the actual warming by at least 50% in their 6- to 12-month forecasts. And the models that did well with the timing of onset missed on the decay; although the NCEP model continued to call for a gradual cooling through 1998, the tropical Pacific chilled precipitously in May. "If they do well on the onset," says Landsea, "but then bust on how strong it's going to be and bust badly on the decay," the models aren't doing very well.

The NOAA researchers also found that, contrary to initial impressions, the complex computer models, which are similar to ones developed to predict greenhouse warming, fared no better in the longer run than much simpler—and much cheaper—models that are based on statistics. Such so-called empirical models are, in essence, automated rules of thumb that compare sea surface temperature and atmospheric pressure in the tropical Pacific with conditions preceding El Niños of the past 40 years and then issue predictions based on the resemblance. The far more complex dynamical models attempt to simulate, on a global scale, the real-world interplay of winds and currents that leads to an El Niño. "The use of more complex, physically realistic dynamical models does not automatically provide more reliable forecasts," the NOAA researchers write. They don't investigate the reason, but it probably involves the unrealistic way the models simulate the distribution of rain in the tropics. "National meteorological centers may wish to consider carefully their resource priorities. …"

More provocatively, Landsea and Knaff raise the bar high for El Niño predictions. Traditionally in climate work, a forecast would not be considered skillful unless it did better than some simple, barely useful technique. A favorite technique used as a benchmark was just to assume that present conditions would persist through the forecast period. "Persistence is way too easy to beat," says Landsea. "There needs to be a more