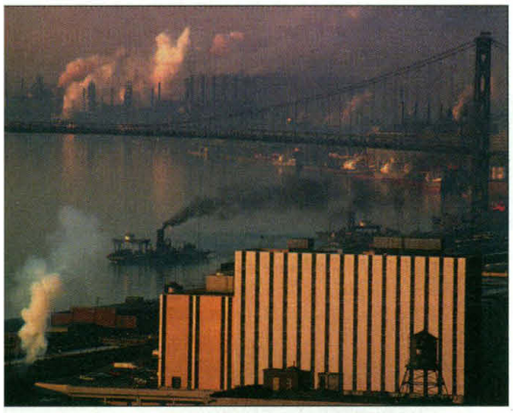
in U.S. estuaries. But when experts from several dozen agencies began in the last decade to plot a strategy for restoring the Everglades' natural plumbing, they discovered that phosphorus's impact on the ecosystem is dwarfed by the effect of dredging canals and other large-scale physical disruptions of water flow.



The sky's no longer the limit? In new approach to risk, EPA would look beyond single pollutants in Detroit air, for example.

The EPA's tunnel vision in the Everglades is just one example of how the agency sometimes fails to look at the bigger picture when assessing risk, says Mark Harwell, an ecologist at the University of Miami. But that may soon change. Earlier this month, a blue-ribbon panel released a draft report calling on EPA to broaden its outlook by assessing whole suites of chemicals and other threats to health and ecosystems, not just single pollutants. "This really calls for a big change," says Joan Daisey, a physical chemist at Lawrence Berkeley National Laboratory in California and one of 49 members of an EPA Science Advisory Board (SAB) panel that spent 3 years on the report.

In a 1990 report, the SAB urged the agency to set priorities by ranking risks according to scientific reviews rather than mandates from Congress and lawsuits. Laws often focus on single pollutants in specific media, such as air or water, and EPA has tended to hew to the boundaries set by the legislation, despite having leeway to take a broader approach to analyzing risks and crafting policy. Many scientists argue that EPA's ability to improve environmental quality through this pollutant-by-pollutant tack is diminishing, much like a curve nearing an asymptote, says Harwell, a report author.

To help steer the agency toward a more wide-ranging approach to environmental threats while carrying out mandated legislation, EPA Administrator Carol Browner and Congress in 1995 asked SAB to update its risk report. The panel's latest offering, called Integrated Environmental Decision-Making in the 21st Century, has a two-part remedy for EPA. Half the prescription is to probe the breadth of risks to human health—suspected carcinogens and hormone mimics in drinking water, say—or to an ecosystem. The other half is to investigate a "broader range of risk reduction options," which boils down to providing a larger menu for regulators: from strict caps on industrial emissions to guidance on how the public can voluntarily avoid certain risks.

The report lauds a few good models, such as a 1996 law that instructs EPA to assess the health risks of pesticide combinations. New efforts, the report states, could include examining the range of pollutants of particular risk to city dwellers, or helping an industry devise a better strategy for reducing overall risk from its emissions. The report offers EPA a load of suggestions on the finer points of this new direction: The agency should invest more in gathering data on the universe of potential risks and in the social science expertise needed to figure out how best to address them, for example, and work more closely with other agencies on issues that tend to fall between the cracks, such as the threats to ecosystems from tampering with water flows. EPA officials declined to comment on the report, which still must undergo peer review.

The SAB's recommendations are a tall order for an agency still groping for a system with which it would routinely use the best science in setting policy. And the report is no panacea. "It's not as big a step as I think it could have taken," says economist Paul Portney of Resources for the Future, who wanted to see some examples of how EPA might weigh a range of health threats—for example, whether the cheapest way to cut overall risks from air pollution might be to tackle nitrogen oxides rather than particulate matter. But most agree that the report will help to set EPA on a path toward heeding science more regularly. "This is the kind of thing the scientific community has been calling for," says Bailus Walker, a toxicologist at Howard University in Washington, D.C. "It's good to see the SAB is giving it a nudge." **–JOCELYN KAISER**

AUSTRALIA

Budget Backs Report On Boosting Biotech

MELBOURNE—With 4 years as research director of California Biotechnology under his belt, Australian molecular biologist John Shine returned home in the late 1980s hoping to apply his knowledge of the burgeoning biotech industry to a start-up company based on the cloning of a key brain neuropeptide receptor. But the company, Pacific Biotechnology, couldn't survive in Australia's notoriously conservative investment climate: Within 3 years it had folded from a shortage of capital, one of several essential steps in a process of turning academic breakthroughs into products.

Last week the Australian government announced a new budget that scientists say signals its desire to change that climate. Its plan to more than double spending on basic medical research over 6 years—to $235 million by 2004–05—mirrors a recommendation last December by a high-level review panel looking at ways to improve the country's competitiveness in health and medical research. In addition to the government's speedy adoption of one of the report's three recommendations, other parts of the budget address its call to strengthen health management. Scientists are optimistic that support for the third leg of the stool—reform of tax laws to encourage venture capitalism—is not far behind. And they give much of the credit to the review panel's chair, businessman Peter Wills, and to Health Minister Michael Wooldridge.

"They are the two big W's," says Shine,

Research bonanza. Peter Wills led a review of Australia's biotech policies that has boosted spending on such activities as genome sequencing at Brisbane's new Institute of Molecular Biosciences.

who is now director of Sydney's prestigious Garvan Institute. "Wills and his committee did an outstanding job of painting a picture of the economic value [of investing in biotechnology], and we had a committed [health] minister. If either one hadn't been there, we would have lost the opportunity."

The review, which Wooldridge commissioned, described the need for a comprehensive strategy to create a robust health-care and biotech industry. It called for boosting the size and duration of grants from the National Health and Medical Research Council (NHMRC), as well as raising salaries and allowing researchers greater mobility. It

CREDITS: (TOP) FARRELL GREHAN/PHOTO RESEARCHERS; (BOTTOM LEFT TO RIGHT) IMBB; THE UNIVERSITY OF QUEENSLAND

said there was no mechanism to set priorities in public health research, and it urged a reduction in the capital gains tax, at 48% one of the world's highest. The resulting lower return stifles investment in companies like Shine's, leaving him to resurrect his research at the Garvan Institute and to seek help from global giant Bristol-Myers Squibb in preparing the drug for market. "If we'd had the high-risk venture capital, we'd be looking at a 10% royalty on the final drug instead of 1%," he says.

Although the government has not formally responded to Wills's review, it is clear that officials have embraced many of its tenets. Apart from the bigger budget, Treasury Minister Peter Costello announced plans to transform the NHMRC from a voluntary group with a tiny staff to an organization with a full-time leader who also advises the government. A global search will be held for a high-profile chief executive. In addition, the government named Wills to lead a new committee to implement his recommendations. Elsewhere in the budget, the government commits $13.4 million to operate a new genome research facility that will allow Australian researchers to participate in the international mouse sequencing project and other major efforts, as well as to identify disease genes in Australian pedigrees.

Such government largess does not extend to all fields, however. Indeed, nonmedical university-based research is slated to drop 5.5% in the next 2 years as part of a 2.3% drop in overall spending in higher education. "This policy is undermining the government's entire innovation strategy," says Australian Academy of Science president Brian Anderson. Pointing to an allocation of $11.7 million for a national biotechnology strategy to cover crops, animals, and humans, Anderson argues that, "for that to produce practical outcomes, you've got to put universities in a stronger position." Advocates of university research note bitterly that the government has not yet responded to a high-level report on higher education released more than a year ago, while Wills's review has apparently been embraced barely 5 months after its submission. Even some of the increases ring hollow: A promised $60 million for university infrastructure, for example, merely brings things back to 1996 levels, Anderson notes.

Despite those concerns, researchers across fields applaud the windfall for medical research as an example of what Australia must do to thrive in today's knowledge economy. Says Wills, "This [is] a historic commitment. ... Now we will be working to get that all in place and start the process."

–ELIZABETH FINKEL

Elizabeth Finkel writes from Melbourne.

ECOLOGY

New, Nonchemical Pest Control Proposed

In a springtime ritual as old as the suburbs, millions of gardeners are spraying 2,4-D and other herbicides to cultivate perfect lawns, free of dandelions and other weeds. Rarely do those gardeners realize that they are usually applying more herbicide per square meter than farmers treating their fields. Now, research by a team led by ecologist David Tilman of the University of Minnesota, St. Paul, points to a new, more environmentally benign strategy for controlling pesky weeds that may help suburban lawn growers kick their chemical herbicide habit.

In the spring issue of the quarterly *Ecological Applications*, Tilman, with Elizabeth Tilman (his daughter), also at Minnesota, and two researchers in the United Kingdom—Michael Crawley of Imperial College, Ascot, and A. E. Johnston of the Rothamsted Experiment Station in Hertfordshire—report that dandelions have an Achilles' heel: a high need for the mineral potassium. As a result, a lawn planted with grasses that don't need much potassium, such as bent grass, foxtail, and fescue, can be kept lush and green while dandelions remain in check, as long as potassium fertilizer isn't added. "I like the idea; it's novel, it should be pursued," says Cornell University agricultural scientist David Pimentel. This strategy might also work to manage weeds on farms, he adds.

The Tilmans first suspected that low potassium might limit dandelion growth in 1992. While visiting the Rothamsted Experiment Station, they noticed many dandelions growing on experimental plots that had received high potassium applications, while adjacent plots without such fertilization had few of the weeds, even though they were naturally seeded by the neighboring, prolific dandelions. This suggested that dandelion abundance depends on potassium fertilization and, presumably, on the outcome of competition for potassium with other species. Analysis of Rothamsted data further supported this idea, which the researchers subsequently tested in the greenhouse and, in 1996, on lawns in north Minnesota. Both studies confirmed their theory.

In the greenhouse, the team planted dandelions and five kinds of grasses, then analyzed the tissues of the plants. They found that dandelions had by far the highest potassium content, suggesting that these weeds have a hearty appetite for potassium. They also found that in plots given a low-potassium fertilizer, the biomass of dandelions, fescues, and orchard grass dropped, but the dandelions had the greatest reductions—down to 81% of their biomass in plots given the complete mineral treatment. In addition, when the group studied 19 lawns that had not been fertilized, treated with herbicide, or hand-weeded for 7 years—a tough set of criteria to fulfill in suburban America—they found that the density of dandelions per square meter correlated with the tissue potassium content of the weeds, a further indication that dandelions need ample potassium to thrive.

Based on these results, David Tilman suggests one step gardeners could take right now. Many common lawn fertilizers contain a healthy dose of potassium, encouraging the growth of dandelions and, subsequently, the use of 2,4-D and other chemical herbicides to kill them. For many lawns, a fertilizer of ammonium sulfate or ammonium phosphate only would be better, he says. One exception, however, would be for lawns of Kentucky bluegrass, which is almost as greedy for potassium as dandelions are.

Weed check. Few dandelions grow on plot given no potassium fertilizer (left), while they thrive on the high-potassium plot (right).

CREDIT: MICHAEL CRAWLEY/IMPERIAL COLLEGE

Still unclear is how widely applicable the strategy of controlling weeds through nutrient limitations will be. Gardeners don't just worry about dandelions, after all. They also have to deal with other weeds, such as crabgrass, and it remains to be seen whether potassium limitation will help control these lawn invaders. And although Pimentel suggests that manipulating competition for nutrients might also help control weeds on farms, he says it may work best when farmers want to favor just a few plant species. Fields in which different crops, usually with complementary nutritional needs, are rotated and pastures with 10, 20, or more different plants will be tougher to manage.

Still, field researchers believe the current work is worth following up. Says Mississippi State University weed scientist David