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

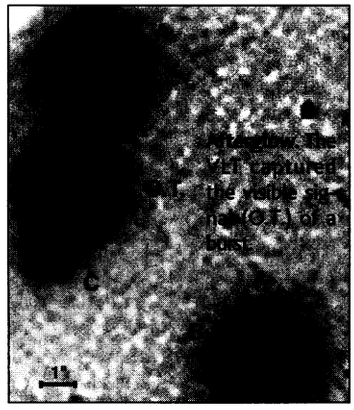
Shaw, "We're only beginning to understand the relationship between soil characteristics and weeds." Once agricultural researchers learn more, dandelions may not be the only weeds subject to this subtle kind of control.

–ANNE SIMON MOFFAT

ASTRONOMY

Giant New Telescope Bags Gamma Ray Burst

Early last week, another of the remote, powerful explosions called gamma ray bursts flared in the southern sky, in full view of the Southern Hemisphere's largest telescope, the new Very Large Telescope (VLT) in Chile. As it faded, the burst's visible afterglow provided what may be the strongest support yet for a budding theory that these mysterious blasts emit radiation in two opposing beams, which makes them visible at great distances when one of the beams happens to be directed at Earth.



The first glimpse of the burst, now named GRB990510, came from two satellites, NASA's Compton Gamma Ray Observatory and the Italian-Dutch satellite BeppoSAX, which caught a bright flash of gamma rays on Monday, 10 May, about 08.49 universal time. Simultaneous x-ray observations by BeppoSAX pinpointed the sky position of the burst near the celestial south pole, and within 10 hours, astronomers had spotted a relatively bright but fading optical counterpart with the 1-meter Sutherland telescope at the South African Astronomical Observatory.

In the past, astronomers have relied on the 10-meter Keck telescope on Mauna Kea, Hawaii, to analyze such afterglows for clues to the distance of the burst. This one was located too far south to be seen from Hawaii. But astronomers can now get a comparable view of bursts in the southern sky with the VLT, commissioned just this spring. Titus Galama and Paul Vreeswijk of the University of Amsterdam, who are coordinating the follow-up observations of the burst, used Antu, the first of the VLT's four 8.2-meter telescopes, to collect a spectrum of the afterglow. The spectral lines had a redshift—a displacement caused by the expansion of the universe—of 1.61, implying that the burst took place more than halfway across the universe.

Theorists believe that gamma ray bursts signal stellar cataclysms—the collapse of a giant star or the collision of a pair of neutron stars. Even so, their brightness at great distances has been a puzzle. The latest burst provides a clue, say astronomer Shrinivas Kulkarni and his colleagues at the California Institute of Technology in Pasadena. A day and a half after the burst, data from a 1.25-meter telescope at Mount Stromlo Observatory in New South Wales, Australia, showed that the visible light from the afterglow started to decrease more rapidly than before—a break that happened simultaneously at different wavelengths, Kulkarni says.

"That's what you expect when a jet [of particles] moving toward you with almost the speed of light is slowing down," Kulkarni says. Such a jet would channel radiation straight down its axis, producing a searchlight beam visible at enormous distances. Although another burst earlier this year had shown similar behavior (*Science*, 26 March, p. 2003), he says, "this burst shows even better evidence for beaming."

–GOVERT SCHILLING

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.

CREDIT: NASA/BEPPOSAX

SOLID-STATE PHYSICS

Picking Up Bits of the Electron's Charge

Although every science student is taught that the fundamental, indivisible unit of charge is that of the electron, physicists are now busying themselves collecting even smaller bits of charge. Two years ago, teams in France and Israel both found that in layers of electrons exposed to high magnetic fields at low temperatures, charge could shatter into "quasi-particles" that had one-third the fundamental charge. In this week's issue of *Nature*, the Israeli team announces it has now spotted one-fifth–charge quasi-particles.

The new results provide further confirmation for the theory put forward in 1983 by Robert Laughlin of Stanford University to explain the fractional quantum Hall effect, a phenomenon in which the tiny units of the quantum world have large-scale effects. Although the theory is widely accepted and Laughlin shared the 1998 Nobel Prize in physics for it, some physicists were not entirely comfortable until a fractional charge was positively identified. Says Laughlin, "I'm very happy" about the new results, "but I am not surprised."

The Hall effect, known since 1879, describes how applying a magnetic field perpendicular to a current-carrying wire creates a voltage across the wire's width, because the field causes the electrons to bunch up on one side. In the 1980s, physicists discovered that when electrons are trapped in a thin layer between two semiconductors at low temperature and high magnetic fields, the Hall voltage across the conductor increases in discrete steps rather than continuously. The size of the steps reflects the discrete charge of the electron or integer multiples of it. But to their surprise, physicists also discovered steps that could only be explained by fractions—or multiples of fractions—of that charge, 1/3, 2/3, 2/5, and 3/7.

To explain those fractional charges, Laughlin proposed that quasi-particles form in the electron layer when the electrons team up with magnetic vortices, tiny whirlpools of magnetism. In very simple terms, the vortices bound to an electron repel other nearby electrons and in effect "shield" part of their electron's charge. This has the effect of making the quasi-particle appear to have only a fraction of the electron's charge. Quasi-particles made up of an electron bound to two vortices would give rise to fractional charges of one-third; and at slightly lower magnetic fields, even smaller fractional charges could appear.

In September 1997, two groups, one led by Mordehai Heiblum at the Weizmann Institute of Science in Rehovot, Israel, and the other led by D. Christian Glattli of France's Atomic Energy Commission in Saclay, announced that they had found direct proof of the existence of one-third fractional charges in a quantum Hall setup (*Science*, 19 September 1997, p. 1766). Now the same team at the Weizmann Institute has refined its technique and spotted the more elusive one-fifth–charge quasi-particles.

To sieve these quasi-particles from the electron layer, they directed the charges toward a very narrow channel. The channel allowed the one-third–charge quasi-particles through, while reflecting a small number of one-fifth–charge particles back. The researchers then detected the reflected quasi-particles and their charges by the impulses they create in a very low noise amplifier. Because the signal generated by the one-fifth–charge quasi-particles is much weaker than that of the one-third charges, the team had to improve its amplifier. "We had to build amplifiers that work at the quantum limit," says Heiblum.

Laughlin is convinced that with further progress in measuring technology, even smaller charge fractions may soon be discovered. "All of these other fractions are just born out of the first one," he says.

–ALEXANDER HELLEMANS

Alexander Hellemans is a writer in Naples, Italy.