own money—the U.S. National Academies of Sciences and Engineering and the Institute of Medicine asked more than 150 researchers to assess the nation's vulnerability to terrorist attack and to identify the technologies, research, and policy changes needed to boost defenses. A 24-member panel, led by former National Cancer Institute head Richard Klausner and science policy specialist Lewis Branscomb of Harvard University, distilled their advice into a 382-page report covering everything from safeguarding nuclear weapons and water supplies to improving air-filtration systems and chemical sensors.

There are seven ways the government can use existing technologies to enhance security, the panel concludes. They include deploying better systems for tracking and protecting nuclear and other materials—such as chlorine gas—that could be used as weapons, boosting the production of bioterror treatments, and improving communications among emergency personnel. A number of these efforts are already under way, the panel noted.

A list of areas in which research is "urgently" needed includes the development of a more resilient electric-power grid, better computerized tools for intelligence analysts and emergency officials, and new methods and standards for safeguarding and decontaminating buildings. The government also should fund more social science studies on how people respond to emergencies, says the report, and recruit "credible" spokespersons to keep the public informed.

Current efforts to coordinate counterterrorism research, the report found, are "not appropriately organized." One improvement would be a high-level research czar at the new department. Another would be the creation of a Homeland Security Institute, an independent nonprofit group that could hire specialists and carry out studies quickly. "The government needs greater access to expertise," says Klausner.

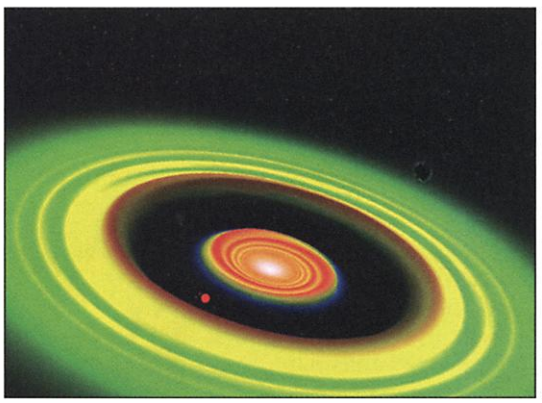
The first response to the report is likely to come from Congress, which is also getting advice from other scientists. The American Society for Microbiology, for instance, last week criticized the Administration's plan to give the proposed department authority over bioterrorism-related research and regulatory programs currently run by the National Institutes of Health and the Centers for Disease Control and Prevention. The extra layer of bureaucracy, the group says, would "create unpredictability … [and] divert monies from research." Both the White House and Congress have promised to complete work on the department before the end of the year.

–DAVID MALAKOFF

EXOPLANETS

Winking Star Unveils Planetary Birthplace

Astronomers want to know how we came to be, how a life-friendly chunk of rock came to form about our star. Lingering clues from our solar system are proving subtle and hard to read (*Science*, 31 August 2001, p. 1581). And disks of dust and gas spinning around other stars where planets might be forming today are still little more than fuzzy, unchanging patches of light in even the most powerful telescopes. But a group of astronomers has stumbled on a newborn star whose protoplanetary disk has fortuitously set up a monitor of its own innermost workings. By simply measuring the star's brightness, researchers are seeing how a protoplanetary disk works. It's the closest, most detailed look at the cauldron of planet formation anyone is ever likely to have.



Planetary pinwheel. Wave crests (red) churned by a growing body may block starlight.

CREDIT: GEOFFREY BRYDEN/JPL/NASA

As astronomers know from observing nascent stars, a star forms in the midst of a ball of dust and gas, the remainder of which can collapse into a spinning disk resembling the rings of Saturn. Planets could agglomerate in such disks, but the disks seen so far have been nearly featureless and unchanging on human time scales, with any protoplanets invisibly small. But in 1997, astronomy students led by astronomer William Herbst of Wesleyan University in Middletown, Connecticut, noticed one new star—just 3 million years old versus the sun's 4500 million years—that faded dramatically every few weeks to 4% of its normal brightness.

Something, it seemed, was periodically blocking the light of star KH 15D in the constellation Monoceros. After a recent international observing campaign organized by Herbst and graduate student Catrina Hamilton of Wesleyan, "now we're sure we can predict what it's going to do," Herbst said last week at the "Scientific Frontiers in Research on Extrasolar Planets" meeting in Washington, D.C.

ScienceScope

Statistical Victory The Supreme Court has successfully waded through another census-related statistical morass. In a 5–3 decision last week, the justices declared that the statistical technique known as "hot-deck imputation" is constitutionally acceptable in creating congressional districts. The ruling protects a mainstay method of the modern U.S. census and slaps down an effort by Utah to claim a seat that had been awarded to North Carolina.

Two years ago, Census Bureau officials announced that Utah was 900 citizens shy of getting a fourth seat as part of the decadal legislative reshuffling. Utah then sued the bureau, contending that its use of hot-deck imputation, which allows counters to fill in missing or inconsistent data, fell afoul of a 1999 Supreme Court ruling that outlawed statistical "sampling" to apportion congressional seats (*Science*, 1 February, p. 783). But a court majority found that the hot-deck method is distinct from sampling, so the census result stands.

Many statisticians say the court did the right thing. A census conducted without hot-deck imputation, they note, would require a statistical assumption, something the court was trying to avoid in the first place.

Name That Ship Canada has agreed to spend $24.5 million to turn an icebreaker into the country's first Arctic research vessel. It's one of nine infrastructure awards, totaling $130 million, announced last week by the Canada Foundation for Innovation to help the nation's scientists participate in international projects.

The retrofit of the 42-berth ship will add current meters, biological sonars, sediment traps, and a multibeam system to scan the bottom of the Arctic Ocean, allowing climate change researchers from around the world to conduct studies. One planned mission will be to assess the ecological impact of a reduction in the McKenzie Ice Shelf. Scientists would also like to rechristen the ship, now named for the famously unlucky Arctic explorer Sir John Franklin, who in 1847 led two ships and a crew of 134 on a search for a Northwest passage but disappeared. "That's why we want to change the name," laughs principal investigator Louis Fortier, an oceanographer at the University of Laval in Quebec.

Other projects include one to transform the Sudbury Neutrino Observatory in Ontario into an international lab for underground science and a beamline at the Spallation Neutron Source being built at Oak Ridge National Laboratory in Tennessee.

Every 48.3 days, the star's light dims steadily over 2.4 days, stays dim for about 18 days, and then brightens back to normal during another 2.4 days. Alternate dimmings progress slightly differently, suggesting that whatever obscures the star, there are two of them circling it every 96.72 days at an orbital distance of 0.3 times the Earth-sun distance, or closer than Mercury orbits the sun.

Herbst and colleagues "are really scratching our heads over this," but it appears that the inner region of this protoplanetary disk, where rocky, Earth-like planets might be forming, is behaving much as Saturn's rings do. Rather than a solid body, the obscuring matter could be the long, low crests of two pinwheel-like waves of gas and dust spiraling outward from either side of the disk, viewed edge-on. As at Saturn, such spiral density waves would be triggered by the gravitational tug of a large mass—a small star, a planet, or a denser clump of disk material—orbiting unseen, starward of the waves.

"It's fascinating," says astronomer Ray Jayawardhana of the University of California, Berkeley. "Already by 3 million years you see clumping. It's all pointing to a lot happening in the first few million years." Most satisfying for astronomers, things are visibly happening even now. A brightening in mid dimming has been weakening over the 6 years of observations, and the dimmings have been getting longer. Such changes in the silhouette of the disk might show theorists why newly formed planets—including most extrasolar planets found so far—seem to have migrated inward toward their stars and why some manage to stop just before being devoured by their parent stars.

–RICHARD A. KERR

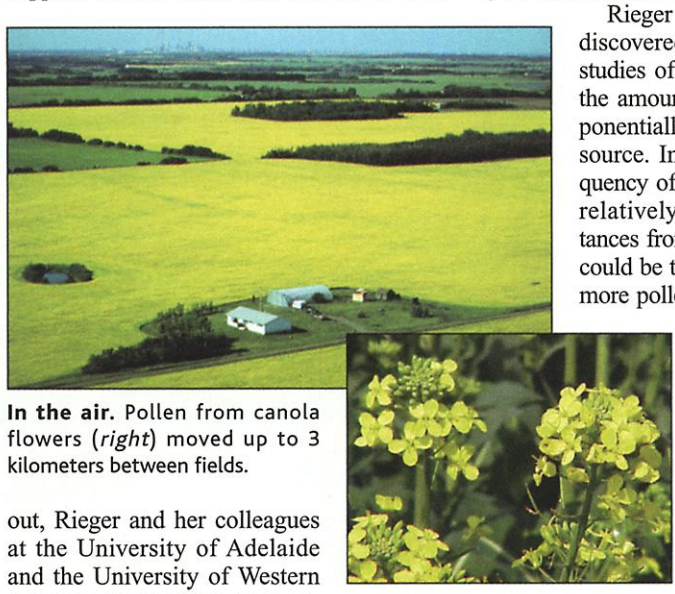
AGBIOTECH

A Little Pollen Goes a Long Way

One of the major concerns about genetically modified (GM) crops is that they might spread their genes to nearby weeds or organic crops. Some governments have responded by recommending that GM crops be planted in isolation, or by setting limits on GM material in organic or conventional crops. But they have had few data to go on. Now a comprehensive study, described on page 2386, provides some hard numbers on the movement of pollen between fields, with implications for regulators. "These are real-world data that can be used for real-world decisions," says Paul Raymer, an agronomist at the University of Georgia, Griffin.

A team led by reproductive ecologist Mary Rieger of the Cooperative Research Center for Australian Weed Management and the University of Adelaide in Australia reports that canola pollen can travel considerable distances but that the amount of gene flow is minimal. Although the findings reinforce the difficulty of growing GM-free crops, they also suggest that the levels of gene diffusion are below European standards for contamination of conventional food.

Over the last decade, a handful of small experiments has indicated that a minuscule amount of pollen from engineered crops can spread up to a few hundred meters. But what happens on real farms was unclear. To find out, Rieger and her colleagues at the University of Adelaide and the University of Western Australia in Nedlands took advantage of a unique opportunity. In 2000, Australian farmers for the first time planted varieties of canola with resistance to acetolactate synthase–inhibiting herbicides. (These crops are not GM varieties but instead were created by mutagenesis.) Working in three states and under various climatic conditions, Rieger's team collected seeds from 63 nearby fields planted with conventional canola.



In the air. Pollen from canola flowers (*right*) moved up to 3 kilometers between fields.

The herbicide-resistance trait spread to 63% of the conventional fields, including some up to 3 kilometers away from the source. The percentage of resistance among seed samples ranged up to nearly 0.2%, but when averaged per field, the highest percentage was 0.07%. The harvests from the vast majority of fields contained less than 0.03%.

The good news is that this level of gene flow for canola is much lower than previous studies suggested. And Rieger says it should be applicable to GM varieties of canola. If so, the contamination of non-GM canola would be less than 1%, which is the cutoff that Australian regulators have discussed as acceptable and that their European counterparts have provisionally OK'd. Rieger says that the lower gene flow should reassure consumers that the chance of transgenes getting into non-GM crops is small.

But the study underlines a clear risk: Once transgenes are introduced, they can't be completely controlled. That's a problem for organic farmers. "It's going to be difficult with any commodity to produce a truly GM-free crop," Raymer says. "Zero tolerance is not going to work." Because of the long distance its pollen travels, canola might not be a good plant to engineer for growing pharmaceuticals or anything else that should stay out of the food supply, notes population geneticist Norman Ellstrand of the University of California, Riverside.

Rieger and her colleagues also discovered a conflict with earlier studies of smaller fields, in which the amount of pollen declined exponentially with distance from its source. In Rieger's study, the frequency of herbicide resistance was relatively steady at various distances from the source. The reason could be that bigger fields produce more pollen, and that increases the likelihood that it will travel far. So size apparently matters: "This research indicates that pollen movement on a large scale cannot necessarily be predicated from small-scale studies," Rieger says.

With these new results in hand, however, researchers should have a better handle on gene flow when canola is modified in other ways, says herbicide physiologist Linda Hall of the University of Alberta, Edmonton. Although pollen from any crop should travel in similar ways, Hall and others note that extrapolation is tricky because crops reproduce in different ways. The flowers of wheat and barley, for example, tend to self-fertilize and are less likely to pick up foreign genes. "Canola is one of the more problematic in terms of gene flow," says plant geneticist Rikke Jørgensen of the Riso National Laboratory in Denmark. "This is a worst-case scenario."

–ERIK STOKSTAD

CANCER RESEARCH

Nanoparticles Cut Tumors' Supply Lines

Tumors hungry for sustenance need new blood vessels to deliver the goods. Cancer researchers have spent years working to starve tumors by blocking this blood vessel growth, or angiogenesis, with mixed success (*Science*, 22 March, p. 2198). Now a team has tackled the problem of choking off tumor vessels from a novel angle: The researchers packed a tiny particle with a gene that forces blood vessel cells to self-destruct,

CREDITS: (TOP TO BOTTOM) ALBERTA AGRICULTURE, FOOD AND RURAL DEVELOPMENT; PAUL RAYMER/UNIVERSITY OF GEORGIA