(formerly just the Office of Toxics). This year, NSF and EPA decided to join forces by signing an agreement to collaborate. "We had more money, and they had more of a constituency," Hancock says. "It's a mutual love affair," he says, which he expects will yield more and more environmental chemistry.

The color of money

If a soon-to-be-released NSF report titled "Challenges and Opportunities in Environmental Chemistry" has any impact, the greening of academic chemistry's research culture should accelerate markedly in coming years. A draft of the report obtained by *Science* reads like a call to arms to chemists. "To meet the challenge—to understand the environment in all its chemical complexity, and to minimize the environmental impact of chemical technology—will require the best minds in chemical science," the draft states. Among the general challenges described in the report: finding cleaner combustion processes that extract more automotive miles out of fossil fuel while generating little or no smog-producing nitrogen oxides; designing polymers and other materials with "molecular suicide switches" so that microbes might better be able to degrade them after their useful lifetimes; finding CFC replacements; and developing catalysts that can destroy chlorocarbons such as PCBs. To support all this, the 16-member panel that prepared the report recommends establishing a federally funded $30-million-a-year Environmental Chemistry Initiative to fund at least 100 individual investigators, up to 10 problem-focused groups, and up to four national research centers.

But a new national infrastructure for environmental chemistry by itself won't be enough to overcome the old aversion to green. The environmental movement is barely 20 years old, and chemistry's culture can be slow to change. Plenty of chemists studied biological molecules even in the 19th century, for example, but it took the discovery of the structure of DNA in the 1950s to spur the culture change that has made biochemistry part of chemistry's everyday lexicon.

In the case of environmental chemistry, generational change may prove the key impetus, Spiro says. One telling sign comes from the American Chemical Society's division of education. They recently approved an "environmental track" for undergraduate chemistry curricula. And Spiro of Princeton and Molina of MIT report that students have been pushing faculty to get more environmentalism into courses. "The tail has been wagging the dog," Spiro says. Or, to put it another way, some green seedlings may soon be overshadowing chemistry's old growth.

–Ivan Amato

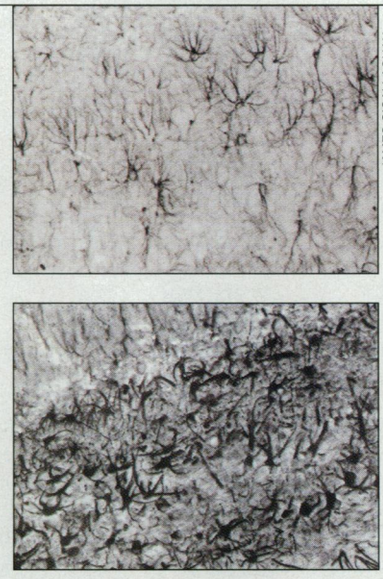
NEUROTOXICOLOGY

New Marker for Nerve Damage

When rats are fed a certain nerve-damaging chemical, they waltz in circles in their cages, performing a grotesque imitation of Fred Astaire dancing with his shadow. But the effects of the chemical, β,β-iminodipropionitrile (IDPN), are not limited to the brain centers that control movements. Neurotoxicologists have recently discovered that IDPN is toxic to nerve cells in the cerebral cortex and other brain areas where it had not been previously thought to act. This surprising finding is among the first fruits of a new type of biochemical assay that uses a biological marker to detect neurological damage. The new technique is causing much excitement among toxicologists because it's the first tool to be developed in years that can help scientists screen chemicals for neurotoxic effects in animals.

As a report from the National Research Council pointed out last year, there's a great need for such a screen; an estimated 70,000 chemicals in commercial use haven't yet been tested for neurological effects (*Science*, 28 February 1992, p. 1063). To help remedy that situation, the Environmental Protection Agency (EPA) last year began recommending that companies include the new assay, which measures the levels in brain of a protein called glial fibrillary acidic protein (GFAP) in the batteries of animal tests they use to assess the potential health effects of commercial chemicals. And Monsanto and Eastman Kodak recently began to move in that direction by assigning staff to explore the use of the assay in their in-house testing programs. "It's premature to use it routinely as a screen," says Monsanto neurotoxicologist Abby Li. Nevertheless, she says it holds great promise as a measure of damage to the central nervous system. Eventually, neurotoxicologists hope, the GFAP assay may also provide insights that can help them develop "biomarker" assays of, for example, blood, urine, or cerebrospinal fluid that can help them determine whether people have suffered damage from neurotoxicants.

Research on the GFAP assay dates back to work done in the mid-1980s by neurotoxicologist James O'Callaghan and colleagues at EPA's lab in Research Triangle Park, North Carolina. Aware that brains cells known as astrocytes grow larger in response to neurological damage, the EPA group looked to see if any of the astrocyte protein concentrations went up in brain tissue from mice and rats exposed to neurotoxicants. Among the substances they tested were the recreational drug methamphetamine and the environmental pollutant methylmercury, and they also looked at the effects of other insults to the brain, such as stab wounds. The result: GFAP levels increased in precisely those brain areas thought to be damaged by the chemicals. Even more intriguing, O'Callaghan says, is the recent finding that the GFAP assay can detect nervous system damage missed by standard histological screens. Although researchers suspected, for example, that IDPN damages the olfactory bulb of rats, they could find no damage with a variety of standard assays. But when they measured GFAP, they found that this region had indeed sustained damage. (The results were published in the December issue of the *Journal of Pharmacology and Experimental Therapeutics*.) Another surprise was the finding, in press in the same journal, that IDPN was doing major damage to the cerebral cortex.



JAMES O'CALLAGHAN

Bad sign. GFAP staining picks up 10 times more astrocytes after neurotoxicant damage *(below)*.

Neurotoxicologists now hope that the GFAP results can help them find a similar human biomarker that would reveal exposure to neurotoxicants. Currently they have only a handful of such biomarker assays, including the test for elevated blood lead levels and another that measures blood concentrations of the enzyme acetylcholinesterase, which decreases after exposure to organophosphate pesticides. But researchers would like more generic biomarkers that could pick up damage from a wide range of chemicals. Because the brain is a complex melange of cell types and neurotransmitters that neurotoxicants can damage in many ways, that could be a problem. "It's not going to be easy to develop generic markers for broad classes of neurotoxicants," cautions Hugh Tilson, director of EPA's neurotoxicology division. Nevertheless, the GFAP work indicates that it can be used to detect damage from different chemicals. So, Tilson says, it may well be possible to push the field in that direction.

–Richard Stone