On the radioactive road

Oak Ridge National Laboratory

Interior of van looking toward the rear. The quadrupole mass spectrometer is on the right; a work bench with microscope, vortex mixer and centrifuge is on the left.

In order to measure trace quantities of uranium and plutonium in the environment, scientists at the Oak Ridge National Laboratory have taken their instruments on the road. They converted a van into a mobile analytical lab and in the process pioneered a new use for recreational vehicles. The Office of Safeguards and Security at the Department of Energy funded the project.

David H. Smith of the Analytical Chemistry Division at Oak Ridge says the laboratory is the first of its kind to make onsite measurements of ratios and concentrations of radioactive isotopes. Smith, along with Joe Walton and Henry McKown, demonstrated the mobile lab at a recent conference on Analytical Chemistry in Nuclear Technology in Gatlinburg, Tenn.

Besides environmental monitoring at nuclear installations, the lab will also aid in keeping track of radioactive materials at plants to ensure all material is accounted for. In the past, reported discrepancies in plutonium stores, for example, may have resulted from inadequate and faulty measuring techniques.

The chief instrument in the van, occupying one of the sleeping areas, is a quadrupole mass spectrometer weighing 150 kilograms. The spectrometer can measure concentrations as low as 1 part per billion uranium and 0.01 part per billion plutonium in water. As little as 0.01 nanogram of the elements gives a detectable signal. The mobile lab can process 15 samples in an 8-hour day.

To make the van more like a chemical lab, the carpet was removed, and a stainless steel hood was installed over the gas stove. Although the spectrometer can handle untreated samples, sometimes chemical separations are necessary. The stove becomes the handy Bunsen burner while chemicals, such as acids, are stored well-protected in the bathtub.

Some of the comforts of home are not missing. Air conditioning is necessary because of the heat generated by the spectrometer's vacuum pump and filament heater. If necessary, the two technicians required to operate the lab can sleep over the cab of the van. □

Why women PhDs advance more slowly

Discrimination "against women as a class or as individuals" appears the most likely explanation for the wide differentials segregating men from women, in the scientific professions, with regard to salary and academic rank. At least that's the finding of a statistical analysis that Nancy Ahern and Elizabeth Scott conducted for the National Research Council of the National Academy of Sciences. It examined how well-matched samples of men and women PhDs fared, relative to each other, in climbing the pay scale and academic ladder.

Explanations other than discrimination have been posed for the well-documented differences in pay and academic rank between men and women scientists in academia. Among them: relative to men, as a class women tended to face a greater constraint on career mobility if they married; they entered the better-paying scientific disciplines in smaller proportions; they were more likely to interrupt their careers for child bearing and rearing (thereby losing years of experience); and they had acquired their degrees in large numbers only recently (so that young—and hence lower paid—professionals dominated this subgroup of scientists).

But, report Ahern and Scott, "We found that such explanations do not agree with our findings."

Their data showed women are at least as mobile as men, regardless of whether they marry or have children. Fewer than half of all women with PhDs have children, and of those, only 10 percent with small children drop out of the labor force. Finally, even when women were matched to men by scientific sub-field, by years of experience, by years since graduation and by prestige of the department in which they were employed, their average salaries lagged behind those of the men. For example, among those who earned their PhDs after 1975—the group where differentials proved smallest — women's salaries trailed men's from $400 (2 percent) in math to $3,300 (15 percent) in chemistry and $2,100 (10 percent) in the biological sciences. □

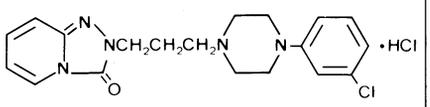
Cheer up, without side effects

A new set of drugs to treat depression is about to burst onto the pharmaceutical scene. While being enthusiastic about the drugs' effectiveness, scientists are puzzling over their mechanisms of action. Most antidepressants currently in clinical use are from a family of chemicals that was found effective in the 1950s. They are called "tricyclics" because a row of three rings provides the basic chemical structure. Tricyclics can have many disturbing side effects, including dry mouth, blurred vision, constipation, weight gain and abnormal heart rhythms. The new drugs, which are not tricyclics, appear to be free of these effects.

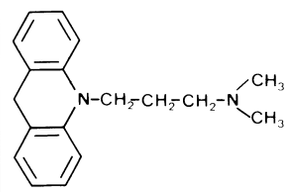
The new drugs seem to share some actions with the tricyclics, which facilitate action of the neurotransmitters serotonin and noradrenaline by inhibiting their reuptake by nerve cells. At the meeting in Los Angeles of the Society for Neuroscience, scientists from several drug companies reported investigations of the action of novel antidepressants. Barrett R. Cooper of Wellcome Research Laboratories in Research Triangle Park, N.C., says that one antidepressant, currently in clinical trials, inhibits the uptake of the neurotransmitter dopamine in rats. He also finds evidence that the drug, called bupropion (Wellbutrin™), elevates serotonin and noradrenergic neural activity. Cooper says that since all three chemicals are theoretically implicated in human depression, he would like to see clinical evaluation of the activation of the three neural system compounds by bupropion in depressed patients.

Another antidepressant in clinical trials

NOVEL ANTIDEPRESSANT: TRAZODONE



TRICYCLIC ANTIDEPRESSANT: IMIPRAMINE



is trazodone (Desyrel™). Duncan P. Taylor of Mead Johnson Pharmaceutical Division in Evansville, Ind., says this drug blocks serotonin uptake very selectively. Over a four-week period, administration of the drug to rats also produced a significant loss of serotonin, but not other, receptors. Taylor suggests the loss of serotonin receptors is responsible for the drug's clinical antidepressant action.

The most important difference between the tricyclics and the new generation of antidepressant drugs, which includes mianserin (Organon), iprindole (Wyeth), zimelidine (Astra), fluoxetine (Lilly) and viloxazine (ICI), is the absence of side effects. Taylor says the tricyclics' side effects are largely due to their binding to a variety of receptors, including those for the neurotransmitter acetylcholine. Some of the novel antidepressants are expected to reach the U. S. market in the next two to three years. □

Third interferon cloned

The last of the three types of human interferon has been produced in bacteria, yeast and mammalian cell culture through recombinant DNA methods, David Goeddel of Genentech, Inc. reported in San Francisco at the International Congress for Interferon Research. The new product, immune interferon (also called gamma interferon), was identified by its anti-viral activity, acid and detergent sensitivity and inactivation by antibodies to the natural human material, which is produced in the body by white blood cells. The laboratory-produced interferon is much needed in research because immune interferon, the smallest of the three types, has been the most difficult to isolate. Previous studies using limited amounts of material suggest immune interferon is more active in fighting cancer cells than are the leukocyte and fibroblast forms. Goeddel reports there is a single human gene for immune interferon, and the gene appears to have a signal sequence and at least one intervening sequence. The Genentech research on immune interferon is funded by the Japanese companies Daiichi Seiyaku Co., Ltd. and Toray Industries, Inc., which will share exclusive rights for the product in Japan. □

'Giga-seal' view of membrane channels

A new technique that allows scientists to analyze single channels in cell membranes is rapidly spreading from one physiology laboratory to the next. Developed last year by German scientists Erwin Neher and Bert Sakmann of the Max Planck Institute for Biophysical Chemistry in Göttingen, the method was in use in 10 laboratories six months ago and is used in 30 to 50 labs currently, Neher estimates. After its description in Los Angeles at the recent meeting of the Society for Neuroscience, the technique's use is expected to spread even more rapidly. It may soon replace the long-time reliable tool of neurophysiologists, the intracellular electrode, for examining how ions pass across cell membranes and how hormones, neurotransmitters and drugs modify these currents.

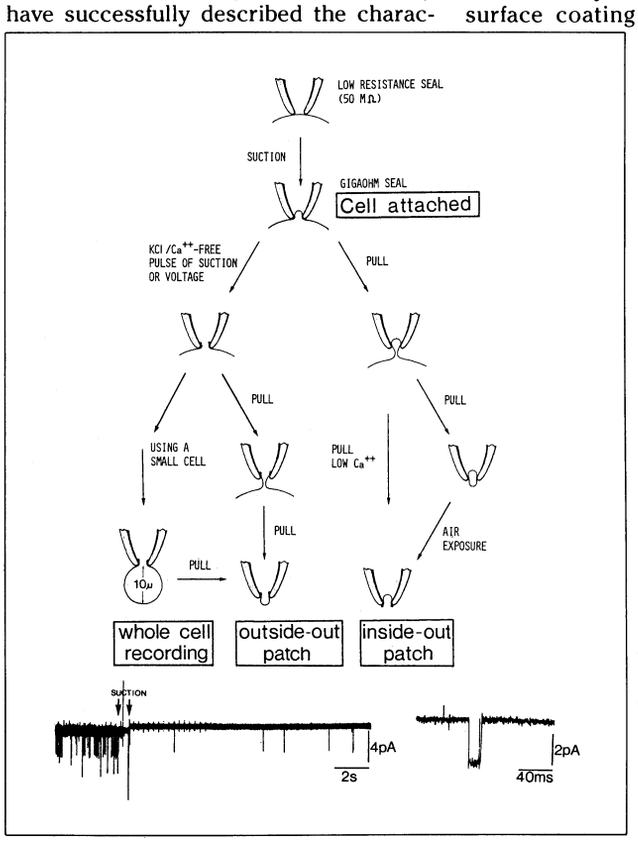
A tight seal between a membrane and the tip of an electrode is the basis of the new technique. A small, heat-polished glass pipette is placed against the outside of a cell membrane and suction is applied to pull the membrane slightly into the pipette, which is used as an electrode. The contact has a very high resistance, 10 to 100 gigaohms, and so the scientists call it a "giga-seal." The tight seal produced by suction reduces the background "noise" of electrical recordings, increasing the sensitivity of the technique by a factor of 100 to 1,000, Neher says.

With the giga-seal, Neher and colleagues have observed 10 to 15 types of membrane channels open and close. They have successfully described the characteristics of the calcium-dependent potassium channel, a pore found in many cell membranes but whose characteristics have baffled electrophysiologists. Anyone who does electrophysiology should be able to pick up the new technique, Neher told SCIENCE NEWS, and he expects the scientists to find it simpler than now-standard procedures.

Because giga-seals are mechanically stable, they can be used to isolate patches of membrane for electrical study, as well as for examining membranes of an intact cell. By simple manipulations Neher can obtain a membrane patch a few microns square either inside-out or outside-out across the electrode tip. With these preparations scientists can have the membrane separate solutions of any composition they choose. They then can record the current passing through its channels.

"As a byproduct of our technique, we found a very gentle way to penetrate cells," Neher says. "For intracellular recording we make a seal, then break the patch and so have access to the inside of the cell." This procedure is easier than penetrating the cell with a microelectrode, because it does not create a leak. "You can use cells as small as you want," Neher says. "You can easily record from a cell 10 microns in diameter."

A requirement for smooth surfaces is the major limitation of the technique. The electrode tip must be flawlessly clean, solutions must be filtered and some cells must be enzymatically treated, removing surface coating material, to provide a smooth membrane. "We have obtained giga-seals on nearly every cell type we have tried," Neher and collaborators say in a recent article in PFLUGERS ARCHIV (Vol. 391, p. 85, 1981). Successful preparations already include more than 20 cell types. Among them are neuroblastoma and leukemia cell lines, spinal cord cells, cerebellar cells and fibroblasts in tissue culture; blood cells; cells from adrenal gland, heart, liver and pancreas; and enzyme-treated muscle fibers and ganglion cells. □



Sensitivity of signal is improved by slight suction (applied at center of top row of recording). Opening and closing of single channels can be detected (bottom row, larger scale than above).