SCIENCE NEWS of the week

Clouds and Fog: Key Acid Rain Actors

Four years ago Delbert Eatough and colleagues from Brigham Young University in Provo, Utah, conducted a California field trip to study the sulfur chemistry of emissions from an oil-fired power plant on the Pacific Coast. Interested in the formation of acid rain, they sought to track the conversion of sulfur dioxide (SO_2) to sulfuric acid as it occurred over time in the airborne plume of pollutants emitted by the power plant.

But a fog got in their way. Almost every day. And what resulted, Eatough explains, "is the first really straightforward measurement of the [sulfur dioxide to sulfuric acid] conversion rate of a plume in a cloud- or water-based system." Moreover, this serendipity put the researchers in a position to quantify what many scientists had been coming to expect (SN: 8/28/82, p. 138): that clouds substantially accelerate sulfuric acid formation over what would otherwise occur in cloudless, daytime conditions.

In their paper in the November ENVIRONMENTAL SCIENCE AND TECHNOLOGY, the Brigham Young team, together with John Cooper of NEA Inc. in Beaverton, Ore., report that fog conditions accelerated the conversion rate of SO_2 to sulfuric acid 10-fold — to 30 percent per hour. In fact, Eatough told SCIENCE NEWS, "I think what's becoming very clear is that in-cloud conversion processes for SO_2 to sulfuric acid are quite important and may predominate in controlling the acidity of rain."

What drives the rapid sulfuric acid formation that his team recorded in fog? Because they have to be able to operate at reasonably high acidity, Eatough says, there are probably only two likely conversion mechanisms: The SO_2 can be oxidized either by hydrogen peroxide (H_2O_2), or by reactions that occur on fresh carbon particles. (Oxidative reactions are ones in which electrons are shared by the participating molecules.) In part because he's not sure the carbon-based oxidative reactions have the capacity to fuel the conversion rates he's measured, Eatough favors the prevailing wisdom that hydrogen peroxide is largely responsible.

The key unanswered question now is where the hydrogen peroxide comes from and how fast it forms. It can be produced by photochemical processes in the atmosphere, notes Eatough, adding that new, unpublished data also report its presence in smokestack emissions. Understanding how it gets into clouds and how much is there is important because, unless the SO_2 can escape the cloud, the availability of hydrogen peroxide may be the primary factor determining if and when the sulfuric acid production process ever shuts off.

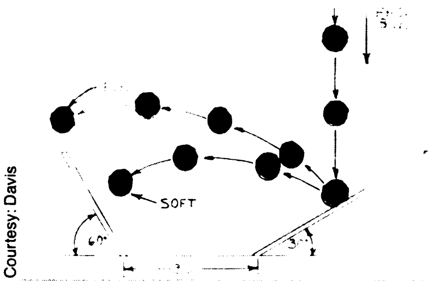
Any acid formed will ordinarily be subject to neutralizing by bases — especially ammonia — in the atmosphere. But Eatough says that in clouds, particularly ones associated with precipitation, acid molecules generally don't have time to neutralize before they rain out.

Another recent study that suggests how clouds may be complicating acid rain chemistry was reported in the Sept. 7 SCIENCE by Christian Seigneur and coworkers at Systems Applications Inc. in San Rafael, Calif. Their computer simulations of the atmospheric chemistry for transforming sulfur dioxide to sulfuric acid and nitrogen oxides (NO_x) to nitric acid showed that reductions in the source pollutants will not lead to equal reductions in the acids they form when in-cloud processes are involved. For example, depending on the season, a 50 percent reduction in SO_2 will reduce the sulfuric acid formation within clouds by only 22 to 26 percent — and will have essentially no effect on nitric acid production. Moreover, a 50 percent cutback in NO_x levels only will reduce cloud-mediated nitric acid by 32 to 41 percent, but will *increase* sulfuric acid production 30 percent. —*J. Raloff*

Berry good? Bounce speaks for itself

Few realize the barriers a cranberry must hurdle before this fresh fruit can make its way to the Thanksgiving dinner table. But Denny Davis knows. And it was his concern that in jumping these hurdles, many initially firm cranberries risk unnecessary bruising. So he assigned five of his engineering students at Washington State University in Pullman the task of devising a better berry culler. A patent is now pending for the fruits of their labors, a process that probably will be field tested at one of Ocean Spray Inc.'s commercial cranberry processing plants next season.

Fresh cranberries should be firm and red. Today the good are sorted from the bad by the way they bounce off a board (see diagram); those that bounce high enough to clear a fence are judged firm. A berry must clear a series of fences before it is accepted for marketing as fresh fruit, Davis says.



Courtesy: Davis

The new technique, largely the brainchild of student Frank Younce, instead bounces individual berries off the vibratory paper surface of a standard radio speaker. Behind the paper are a piece of metal and a magnetic coil. A berry's impact vibrates the paper, causing the metal core to move through the magnetic coil, generating a voltage, Davis explains. Soft berries are identified by the time it takes them to displace the speaker coil; the voltage waveform they generate takes longer to achieve its peak amplitude.

An air gun shoots the soft berries into a "bad berry bin" — perhaps for use in making juice. Though green berries are not only firm but also potentially useful, they do not appeal to consumers. So the new system sorts them out by passing berries between two green-sensitive photodiodes. Davis says the commercial industry currently seems most interested in this system as a grader for mechanically rating the quality — and price — of a grower's product. —*J. Raloff*

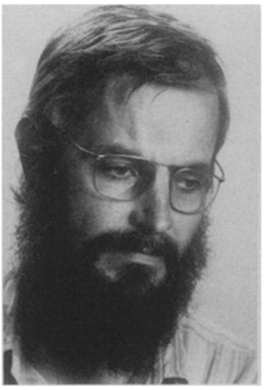
1984 Lasker Awards go to five scientists

In a reprise of the 1984 Nobel Prize in physiology or medicine, this year's $15,000 Albert Lasker Basic Medical Research Award was bestowed to three researchers for work resulting in monoclonal antibody technology. In addition, a Lasker Clinical Research Award went to Paul C. Lauterbur for nuclear magnetic resonance (NMR) studies, and Henry J. Heimlich received a Lasker Public Service Award for his eponymic anti-choke maneuver; both those awards are also $15,000 each.

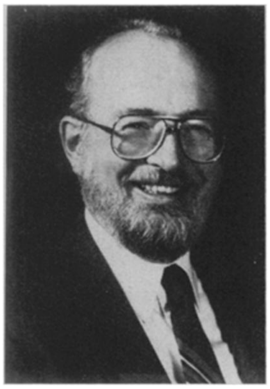
Michael Potter of the National Cancer Institute in Bethesda, Md., César Milstein of the Medical Research Council in Cambridge, England, and Georges J.F. Köhler at the Basel Institute of Immunology in Switzerland were acknowledged this week for laying the groundwork for hybridoma technology, in which cells are manipulated to supply monoclonal antibodies — identical antibodies produced from offspring of a single cell. Milstein and Köhler shared a Nobel this year with Niels K. Jerne of the Basel Institute (SN: 10/20/84, p. 245).

In the 1950s, Potter described a mouse

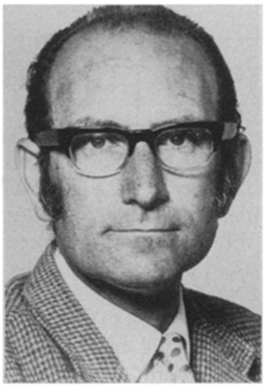
Courtesy: Lasker Foundation



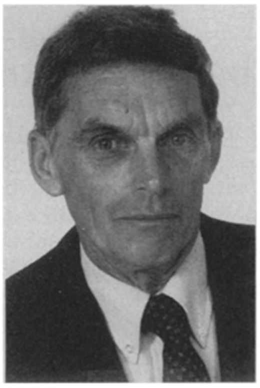
Köhler



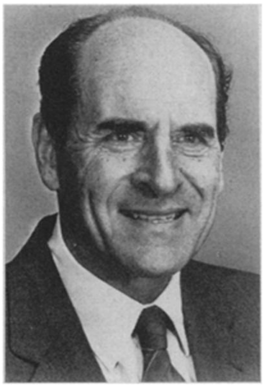
Lauterbur



Milstein



Potter



Heimlich

cell tumor that produced antibodylike molecules, and later found that some of these tumors produced a single kind of antibodylike molecule. Milstein and Köhler brought the concept into the realm of mass production with a seminal paper published in 1975 describing the fusion of a normal antibody-producing cell with a malignant one, resulting in a dedicated antibody-producing factory with the immortality of a tumor cell.

Using a normal cell gives control over the product — a mouse can be immunized with a specific substance, and when its antibody-producing cells are fused with malignant cells, hybridomas producing monoclonal antibodies against that substance can be selected.

In one of the understatements of modern science, Milstein and Köhler noted at the end of their paper that "such cultures could be valuable for medical and industrial use." Monoclonal antibodies are becoming widely used in medical diagnostic tests (SN: 5/7/83, p. 296), with people now talking of a billion-dollar market.

Lauterbur's award was also for a finding that turned out to have great clinical significance. Lauterbur, of the State University of New York at Stony Brook, figured out how to convert NMR data into a three-dimensional picture. While NMR had been a powerful spectroscopic tool for biologists and chemists, divulging the concentrations of compounds in molecular environments such as the body or a solution, it was Lauterbur's work that turned the process into an imaging system that gives clearer, more detailed pictures of the human body than X-rays or CT scans and allows clear visualization of soft tissue and bone marrow.

Heimlich, of Xavier University in Cincinnati, received his award for a finding that was immediately practical. In the early 1970s, he became aware of the large number of choking deaths. He checked the medical literature and found that what *shouldn't* be done when a person is choking is to slap them on the back, reach in and dislodge the object, or shake the person upside down — exactly what was commonly recommended. He reasoned that compressing the air in the lungs would dislodge an object, and after successfully testing the procedure on animals he published his findings in 1974, describing how a quick upward thrust to the diaphragm dislodges an object.

Heimlich is now working on a new means of providing oxygen to people with chronic lung disease. Currently, many people with diseases such as emphysema, pulmonary fibrosis and black lung disease are tethered by a tube in their nose to an oxygen tank. Heimlich's new system incorporates a small catheter inserted through the neck into the trachea. The process uses less oxygen, and is more easily portable and far less noticeable. He expects to publish soon on initial trials in 150 people. — *J. Silberner*

Trickle-down effects of carbon dioxide rise

As carbon dioxide levels go up, so will the global temperature. That's the longstanding prediction — dubbed the greenhouse effect — affirmed by a 1983 National Academy of Sciences report (SN: 10/22/83, p. 260). But the total repercussions of the atmospheric carbon dioxide rise — triggered by fossil fuel combustion — are less certain and still under analysis. Two recent studies have looked at two environmental factors likely to be affected by the increase: river water supplies and insect appetites.

River levels in certain areas could rise dramatically in a carbon dioxide-enriched atmosphere, according to a report in the Nov. 1 NATURE, because of more runoff from soils. When carbon dioxide levels rise, plants tighten their leaf pores and transpire less, so they don't draw as much water from the soil.

Sherman B. Idso of the U.S. Water Conservation Laboratory in Phoenix and Anthony J. Brazel of Arizona State University in Tempe included a measure of this effect in their calculations of runoff into 12 Arizona streams. They estimated the amount of vegetation near the drainage basins, then calculated its effect on runoff if carbon dioxide levels were doubled. Even when Idso and Brazel included the drying effect of a "greenhouse" temperature increase, they figured that stream flows could increase 40 to 60 percent because of reduced plant transpiration.

This estimate contrasts with the one included in the 1983 report that calculated about a 50 percent *decrease* in western river water supplies in general. That study, says coauthor Paul E. Waggoner of the Connecticut Agricultural Experiment Station in New Haven, showed the influence on rivers of higher temperatures and less rain that would accompany the greenhouse effect. For the Colorado River, which receives most of its runoff from snow-covered mountains and is a major water source for the West, there is little effect from plant transpiration, although, Waggoner concedes, greener river basins might be altered to a greater degree.

Idso and Brazel write that the amount of vegetation — and however it might change in a high carbon dioxide atmosphere — is difficult to measure exactly. According to a forthcoming report in the December ENVIRONMENTAL ENTOMOLOGY, yet another factor to complicate that measurement might be insect feeding. Caterpillars, it seems, will eat more leaves from plants grown in high carbon dioxide atmospheres.

Boyd R. Strain of Duke University in Durham, N.C., and colleagues grew soybeans in greenhouses with different concentrations of carbon dioxide, then fed the leaves to larvae of a soybean pest. They found that the insects ate 80 percent more of leaves grown under the levels of carbon dioxide (about 600 parts per million) projected for the next century.

The reason, according to the study, is less nitrogen. Given lots of carbon dioxide, plants will photosynthesize more, but this dilutes the amount of nitrogen per leaf—a necessary nutrient for any organism — so the caterpillars eat more. "This suggests," the authors write, "that the increased levels of plant productivity at higher carbon dioxide concentrations may be offset by higher herbivory [insect feeding] and could even be reduced below the current levels." — *C. Mlot*