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 It can be produced by photochemical processes in the atmosphere, notes Eatough, adding that new, unpublished data also report its presence in smokestack emissions.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.

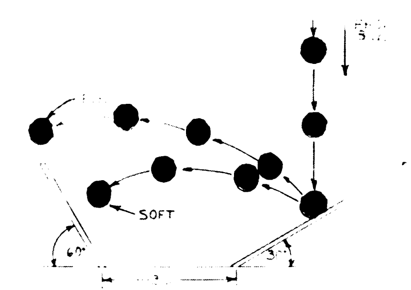
Another recent study that suggests how clouds may be complicating acid rain chemistry was reported in the Sept. 7 SCIENCE by Christian Seigneur and co-workers at Systems Applications Inc. in San Rafael, Calif. Their computer simulations of the atmospheric chemistry for transforming sulfur dioxide to 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.

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



Courtesy: Davis

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