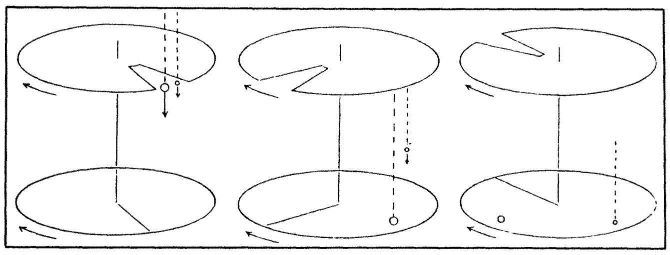
Environment

Sorting drops in a bucket

The acidity of raindrops falling through polluted air seems to depend on their size, according to recent measurements made in New Zealand. This result provides a valuable check on theoretical calculations that attempt to predict how effectively raindrops scavenge pollutants and that model the chemical reactions occurring inside droplets.

These field measurements are made possible by a new instrument that, for the first time, allows the size and acidity of raindrops to be measured at the same time. Previously, researchers could measure the acidity only of bulk rainwater samples or of single droplets of unknown size.

The instrument, as described in the June 26 NATURE, consists of two disks separated by a small, vertical rotating shaft (see diagram). The upper disk has a wedge-shaped opening through which rain passes, while the lower disk is divided into sectors separated by walls. Because drops of different sizes fall at different rates, larger, faster drops tend to fall into sectors that are closer to the sector directly below the aperture. It takes only a few minutes to collect samples large enough for testing.



Adams et al./NATURE

Using this instrument, Stephen J. Adams and his colleagues at the University of Auckland in New Zealand found that the greatest acidity occurs in droplets about 0.5 millimeter across. Because the raindrops were relatively clean to begin with and picked up pollutants as they fell, the researchers conclude that drops with radii close to 0.5 mm scavenge more efficiently than drops of other sizes.

This instrument could open up new areas of acid rain research, says Nurtan A. Esmen of the University of Pittsburgh. For example, the interaction of a gas like sulfur dioxide with a drizzle's small drops may be quite different from its interaction with a shower's mainly large drops.

Mixing silicate dust and sea salt

Particles found in the air, even over ocean regions far from land, often contain a mixture of silicate dust and sea salt. The dust travels long distances from sources on land and the sea salt particles are generated in spray at the ocean surface. A recent analysis shows that the mixing of these substances probably occurs within clouds above the water.

Reporting in the June 27 SCIENCE, Meinrat O. Andreae of Florida State University in Tallahassee and his colleagues suggest that wet dust particles can act as nuclei around which water condenses to form drops. Other dry particles collide with existing drops of water. Because most cloud droplets evaporate rather than fall, anything already dissolved in the water will be deposited as a layer on a particle's surface. This process, along with the coalescence of cloud droplets, happens repeatedly for both salt and dust to create airborne particles that are rich in both silicates and salt.

A similar process, the researchers say, may also lead to the mixing of sulfate-bearing particles with sea salt. That also brings sulfate into cloud droplets where various chemical reactions can take place. Studies of the process may lead to better estimates of how long particles associated with acid rain or radioactive fallout stay in the atmosphere.

Technology

New way to check for irradiation

Now that the U.S. Food and Drug Administration (FDA) allows greater use of ionizing radiation to sterilize and slow the decay of meat (SN: 1/18/86, p. 43), FDA regulators need to be able to tell whether meat has, in fact, been irradiated, and to what degree. Scientists at the National Bureau of Standards (NBS) think they have found a way.

Led by Michael Simic of the NBS Radiation Chemistry and Chemical Dosimetry Group, the scientists have identified an amino acid in the fiber of irradiated meat. The amino acid, ortho-tyrosine, is formed by the interaction of phenylalanine, another amino acid, and hydroxyl radicals, which are produced as ionizing radiation breaks up water molecules. Ortho-tyrosine also occurs naturally in meat, but only in the fluid, not in the fiber, Simic says.

The researchers were pleased to find something in the meat that was produced by radiation but did not turn out to be a harmful by-product of radiation. "It was incredible luck to find something useful, but which also is found naturally in the product," Simic says.

More experiments are needed to tell whether the same amino acid is present in irradiated produce and seafood, Simic says. The next tests are likely to be done on shrimp.

If all goes well, FDA regulators may be able to start using the ortho-tyrosine test by the end of 1986, Simic says.

It will take somewhat longer to figure out whether the amount of ortho-tyrosine in the fiber indicates how much ionizing radiation the food has received, Simic says. The scientists do not know whether the conditions under which meat is irradiated affect the amount of ortho-tyrosine produced, or whether the amount of amino acid declines over time. The FDA sets various limits on the amount of ionizing radiation different foods may have.

Science of strikes and gutter balls

Aerospace engineers who have spent the last few decades perfecting missile launching technology might think their work led only to improved military weapons and spaceships. But it turns out they also have enriched one of America's most popular nonaerobic sports — bowling.

"Bowling has similarities to a missile launch, except we are trying to launch a ball down the lane," says Thomas P. Kicher, who chairs the department of mechanical and aerospace engineering at Case Western Reserve University in Cleveland and who has run a "bowling dynamics laboratory" for the last nine years.

Kicher and his students use the mathematical techniques developed for tracking missiles to chart the paths of bowling balls. First, they shine a series of lasers across a bowling lane, and then they roll a ball down and measure its speed and trajectory. They plug those measurements into the aerospace formula to learn how smoothly the ball rolls. A good roll indicates that the ball is well shaped and balanced.

Kicher has other bowling ball tests. He drops balls onto granite slabs to see whether the balls keep their shape. He oscillates the balls inside a pendulum made of three vertical wires to check that their density is uniform. And he weighs the balls to locate their centers of gravity. Much of the work has been funded by the Brunswick Corp. of Muskegon, Mich.

Perhaps the greatest innovation to come out of the lab is the specially balanced ball, designed by Kicher but conceived by bowling pro Carmen Salvino. Unlike an ordinary ball, which holds a weight near the finger and thumb holes — to make up for the lost mass of the holes — Salvino and Kicher's ball has two weights, one near the finger holes and one near the thumb. "People started using this ball in 1980, and it made a great difference in their games," Kicher says.