Environment

New process cleans NO_x-ious air

Nitrogen oxides (NO_x) are a major contributor to acid rain and smog ozone (SN: 4/30/88, p.276; 9/17/88, p.180). While many commercial technologies exist to scrub sulfur oxides (SO_x) from the gas stream exiting a fossil-fueled power plant's flue, available options for NO_x scrubbing are limited and expensive. But a new process developed at Argonne (Ill.) National Laboratory can remove more than 70 percent of the NO_x from coal-stack gases without affecting the ability of conventional flue-gas scrubbers to remove more than 90 percent of SO_x. And preliminary estimates suggest the cost of this NO_x removal will be just half to one-tenth that of currently available NO_x-limiting technologies.

The new process adds a reagent — such as the metal chelator, ferrous EDTA — to the SO_x-removal solution used in conventional stack-gas scrubbers. The reagent reacts with NO_x in the exiting gas stream, forming a weak nitroso-compound. The technique relies on a synergism between SO_x and NO_x removal, explains John Harkness, leader of the Argonne team that developed the additive. Nitric oxide (NO) in the waste stream weakly links to the ferrous EDTA. That EDTA "becomes a carrier, transferring NO to the sulfite formed when sulfur dioxide from the waste-stream goes into solution."

This same NO-trapping by sulfite happens naturally in existing SO_x scrubbers. However, Harkness says, the trapping rate normally is too slow to do much good. By acting like a catalyst, the new reagents boost the trapping rate dramatically. Argonne has just signed a licensing agreement with Dravo Lime Co. of Pittsburgh — a major SO_x-scrubber maker — to further develop this NO_x add-on technology.

These turtles freeze, but that's okay

Residents of northern climes will note that few reptiles share their environment. Those that do generally take elaborate measures to deal with frigid temperatures — such as hibernating underwater or in deep underground dens. But the young painted turtle has evolved a simpler strategy: It freezes.

Researchers removed 13 hatchlings from their winter nests and transported them in a bed of sphagnum moss to nearby Carleton University in Ottawa, Ontario. There, they froze a box of four hatchlings to 24.8°F, and two more hatchlings to 12°F. After 24 hours, all hatchlings were thawed back to 32.6°F. The entire 24°F batch survived, even though on average 52 percent of the body water in each froze solid. Just one turtle frozen to the lower temperature survived. Survival seems to depend on how much body water freezes: Anything much above 54 percent appears lethal, the researchers say.

Freezing doubled blood levels of glucose, tripled liver glucose levels, tripled blood glycerol levels and increased amino acid levels in blood 2.25-fold over those of nonfrozen hatchlings taken from the same nests. The researchers suspect that glucose and glycerol, which can limit the amount of freezing, helped the frozen animals survive. Taurine, an amino acid that appears to limit freezing in bivalves (SN: 7/4/87, p.9), also may have played a role, they say. However, high levels of these chemicals apparently don't entirely explain the animals' survival, the researchers add, since painted turtles observed after spring freezes have survived "despite low levels of cryoprotectants."

While four frog species share a similar tolerance to freezing, the painted turtle is the only reptile and "the highest vertebrate life form known to tolerate the natural freezing of extracellular body fluids during winter hibernation," write Kenneth B. Storey and his co-workers in the November 1988 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol. 85, No. 22). An understanding of how these animals survive could suggest techniques for cryopreserving human organs (SN: 8/29/87, p.138).

Space Sciences

Trashing Earth's radiation belts

The clutter of human debris circling the Earth — inoperative satellites, spent rocket casings and many tinier bits — has raised concern about its possible hazard to other orbiting objects, such as space stations and even the shuttle. But that is not its only effect. Andrei Konradi at NASA's Johnson Space Center in Houston notes that the growing amount of space trash may noticeably reduce the number of charged particles in Earth's Van Allen radiation belts.

What Konradi calls the "shell" of debris absorbs high-energy protons that spiral in toward the debris along the lines of Earth's magnetic field, so that "in the next decades we can expect a measurable decrease in [the protons'] fluxes," thus reducing the flow of charged particles in the radiation belts.

In 1986, the "debris environment" between Earth's surface and an altitude of about 1,500 miles had a total cross-sectional area roughly equal to three football fields, Konradi reports in the Dec. 2 SCIENCE. The increase in the area of the debris is difficult to predict, but Konradi assumes Soviet launch activity will stay at about its present level, while the lower amount of U.S. activity increases slightly for a time and then spurts. "By 2010," he writes, "it is expected to increase by about a factor of 8."

At present, he says, Earth's atmosphere is about 10 times as effective as the debris at shortening the length of time protons remain trapped in the radiation belts as they flash back and forth from pole to pole along the magnetic field lines. By 2010, however, at least as calculated between altitudes of about 300 and 1,000 miles and during the minimum in the sun's activity cycle, debris will be as good as or better than the atmosphere at shortening the particle lifetimes in the radiation belts, Konradi concludes.

Minor planet rediscovered after 77 years

An asteroid discovered in 1911, but not identified in subsequent observations over more than three-quarters of a century, has been found again.

Called HAPAG (an acronym for the name of a German-American steamship line), it was first spotted by Johann Palisa, who holds the record for visual discoveries of asteroids — 121 — according to Brian G. Marsden of the Harvard Smithsonian Center for Astrophysics in Cambridge, Mass. Now an object discovered on Nov. 8 by two amateur Japanese astronomers, T. Hioki and N. Kawasato, turns out to be HAPAG. Calculations by Syuichi Nakano, working at the Harvard Smithsonian Center, have revealed not only that the newly found object and HAPAG are one and the same, but also that HAPAG appears on several photographic plates taken in the 1950s and 1980s, though it was not identified at the time.

More than 50,000 asteroids have been tentatively recorded, but about 15,000 of those represent repeat observations of the 3,936 whose orbits are known well enough to warrant giving them permanent numbers. Of the 3,936, only two have been lost and never seen again since they were discovered and named, Marsden says. Of those lost and found again, HAPAG probably spent the third longest time as a lost object, he adds.

Pioneer 6 revisits Earth

The Pioneer 6 spacecraft, launched into a huge, sun-circling orbit on Dec. 16, 1965, has finally been affected by Earth again. On Nov. 26, 1988, the craft's orbit carried it close enough to its home planet that its trajectory was altered by Earth's gravity. As Pioneer 6 passed within 1.16 million miles of Earth — nearly five times the distance of the moon — the change lengthened its "year" from 311 days to 317. Two of the craft's six scientific instruments still return data, aiding studies of the solar wind and other phenomena.