SCIENCE NEWS of the week

New Process KOs All NO_x

Pollution control engineers have had a difficult time and only limited success in battling nitrogen oxides, or NO_x. Produced by combustion, these gases play a major role in the formation of both smog ozone and acid rain. But a scientist has invented a chemical process that is "capable of completely removing NO_x from the products of combustion," according to a newly published paper by researchers at Sandia National Laboratories in Livermore, Calif.

The anti-NO_x discovery, by Sandia's Robert A. Perry, is an offshoot of his research into the fundamental chemistry of hydrocarbon combustion. The new finding involves mixing combustion gases with isocyanic acid (HNCO), a gas formed when the nontoxic cyanuric acid, or $(HNCO)_3$, is heated. In a series of rapid chemical reactions that have not yet been fully characterized, the HNCO will mix with nitric oxide (NO), for example, forming elemental nitrogen gas, carbon monoxide, carbon dioxide and water vapor. In a laboratory test with the exhaust from a small diesel engine, the HNCO treatment was capable of removing more than 99 percent of the nitrogen oxides present in the untreated exhaust, according to a report by Perry and Dennis L. Siebers in the Dec. 18 NATURE.

This process "will work, as far as we know, for any process that uses hydrocarbons for combustion," Perry says. And unlike the limited (and far less efficient) anti-NO_x systems now available, he says, this one can work in the presence or absence of oxygen. It also does not appear to be affected by the presence of sulfur contaminants in the fuel that is burned, whereas anti-NO_x systems employing catalysts frequently are.

Still, there are several important engineering questions to be answered, Perry says, such as whether the process will operate fast enough to fully eliminate the NO_x produced in a large exhaust stream, whether devices that employ it can be made small enough to fit on a car and whether systems incorporating these devices can be produced inexpensively enough to encourage widespread use.

Perry expects to resolve many of these questions within a year. He says a commercial prototype device — probably initially designed for diesel engines — might be available within five years.

Ordinarily, the Department of Energy (DOE) would own patent rights to any technology invented at one of its labs. But hoping to speed the commercial development of this process, DOE officials have formally announced an unusual decision in which Perry will be allowed to keep the rights to his invention. As soon as he can obtain the money to start his own firm, Perry says, he will leave Sandia to develop devices that employ this process, which he calls RAPRENO$_x$, for Rapid Reduction of NO_x.

Harry H. Hovey Jr., director of New York State's division of air resources, characterizes the process as "exciting." "If such a device is workable and economically feasible — two big ifs — it would help in the acid deposition problem in the East," he says, "because NO_x is inherent to that process." Probably just as important, he says, is NO_x's role in smog formation and the ozone problem plaguing all major U.S. metropolitan areas (SN: 6/28/86, p.405). "Without the NO_x," Hovey told SCIENCE NEWS, "there's a very good likelihood we could meet the ozone standard."

Linas P. Gobis, an environmental engineer with the Motor Vehicle Manufacturers Association in Detroit, says that because "NO_x is one of the hardest emissions to lower," this process could also prove very important to the diesel industry.

— J. Raloff

AIDS studies suggest new directions, therapies

The variability of the AIDS virus — from its genes to its effect on people — sometimes seems matched only by the diversity of approaches that can be taken toward its study. Three new reports suggest a variety of actions for the virus or for the body's reaction to it; each of the three could lead to new therapeutic tacks.

The reports detail a newfound importance for immune system suppressor cells in controlling human immunodeficiency virus (HIV), a suggestion that the virus sparks an autoimmune attack, and the discovery of a small protein that blocks the virus's binding site on its target cells. How the three sets of findings mesh with one another remains to be seen.

Jay A. Levy and his colleagues at the University of California at San Francisco came up with what is perhaps the most paradoxical finding of the three — that *suppressor* immune cells, rather than effector cells that initiate and direct immunity, are key to fighting off HIV infection. Boosting suppressor cells could prevent or help counter infection, they suggest.

Levy and his colleagues studied the blood of three healthy homosexual men who had antibodies to HIV but from whom no HIV could be cultured. When the researchers grew the men's white blood cells in the laboratory and removed the suppressor cells, called CD8 cells, they found biochemical signs of the virus's presence. When they added the suppressor cells back to the culture, signs of the virus disappeared. They also found that a person's own suppressor cells protected his cells better than other people's, and that the more CD8 cells, the stronger the effect. They report on the results in the Dec. 19 SCIENCE.

That suppressor cells could hold in check an immunosuppressive virus is not as counterintuitive as it sounds. Further experiments indicated that the CD8 cells may be releasing a factor that squelches replication of the virus, Levy and his colleagues report. The discovery also suggests an explanation for why some people infected by the virus don't develop the syndrome: It could be that their suppressor cells are more active.

Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, commented in a prepared statement, "It's an interesting study of potential importance in understanding the mechanism of how the body defends itself against replication of HIV. We look forward to further studies confirming this observation and delineating the precise mechanism of the suppressive effect which was noted."

Levy says he'd like to try growing CD8 cells from AIDS patients' blood samples and giving them back to the patients in higher doses, after he first determines the desired levels of suppressor cells. Too many suppressor cells could have a damaging effect. "We've got to be very careful before we go to clinical trials," he says. If all goes well, such trials could begin within the next six months, he estimates.

Meanwhile, other San Francisco researchers have come up with a theory for how the virus wreaks its havoc. According to John L. Ziegler of the Veterans Administration Medical Center and Daniel P. Stites, who was also an author of the CD8 study, HIV may cause the body to attack itself. While the idea of AIDS as an autoimmune disease has been proposed before, these researchers suggest a precise mechanism for how the virus could induce the attack.

The problem, they say in the December CLINICAL IMMUNOLOGY AND IMMUNOPATHOLOGY, could result from a similarity between the "hook" the virus uses to grab its target — immune effector cells called CD4 or T4 cells — and an unrelated protein on other white blood cell types that tells the immune system that these cells are "self" and shouldn't be rejected.

According to Ziegler and Stites's hy-

pothesis, when an infected person makes antibodies to the HIV hook, these antibodies would also attach to the "self" areas of white blood cells, blocking their function or leading to their demise. The scientists' conclusion explains why, as observed in AIDS patients, the virus can infect only 0.01 to 0.1 percent of its CD4 cells yet still devastate the immune system.

The hypothesis also implies that immune system suppressants like cyclosporine could prevent the deadly white blood cell loss. Cyclosporine has been tried by French researchers in AIDS patients (SN: 11/9/85, p.293), but the researchers have not yet published their results. There may be nothing left to restore by the time a person has AIDS, Ziegler says, but he and his colleagues are beginning a preliminary trial of cyclosporine in humans. They are also looking for the hypothesized antibody that reacts with HIV and with white blood cells.

The CD8 and autoimmune theories are not mutually exclusive. "It could be," says Levy, "that the suppressor cell, by blocking the virus, would also prevent the production of autoantibodies." The autoantibodies could be a secondary effect that makes things worse, he suggests.

The third study, like the other two, has treatment implications. Using a paradigm set up for studying brain neuropeptides and their receptors, researchers found a short peptide on the HIV envelope protein that binds to brain cells in HIV infection. By adding just the peptide to a cell culture line, Candace B. Pert and Joanna M. Hill of the National Institute of Mental Health and several other government researchers were able to block entry of the whole virus, they report in the current PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol. 83, No. 23). Analogs of the peptide also worked.

Pert's group plans to try injecting a long-lasting analog of the peptide in humans with AIDS in early 1987. For people already infected, says Hill, the peptide could block infection of new cells. Though the peptide would be blocking a receptor that presumably has a function besides serving as the HIV attachment site, the researchers aren't expecting that the blockage will cause serious side effects and have seen none in animal trials. —*J. Silberner*

Hydrothermal discoveries from the deep

Since undersea "chimneys" were first discovered to be spewing out hot, mineral-laden water from the ocean floor (SN: 1/12/80, p.28), scientists have come to suspect that they are as important a source for ocean chemicals and heat as are land-based processes. This idea was fortified last week as researchers reported on hydrothermal venting at a variety of sites in the Pacific and Atlantic oceans. They presented their findings in San Francisco at the joint meeting of the American Geophysical Union and the American Society of Limnology and Oceanography.

One of the most exciting recent finds was made by the National Oceanic and Atmospheric Administration (NOAA) research ship *Discover*, which lived up to its name last August during a cruise over the Juan de Fuca spreading ridge, 400 miles off the coast of Oregon. *Discover's* towed instruments detected a new kind of hydrothermal plume that was much hotter, larger, shorter-lived and more symmetrically shaped than the plumes that normally emerge from seafloor vents. According to Edward Baker of NOAA's Pacific Marine Environmental Laboratory in Seattle, this plume — which was apparently released over a few days — contained 100 cubic kilometers of water. The amount of heat and chemicals in the plume was equivalent to that emitted by as many as 2,000 "black smoker" vents in one year.

Computer models suggest that the plume could have been formed by a long crack — about a kilometer long by one-third meter wide — that for a few days issued a "black curtain" of hot water and minerals, says Baker. Because of the plume's large size and its placement over the Juan de Fuca ridge — part of the 60,000-kilometer-long, seam-like network of spreading centers that churn out new seafloor worldwide — researchers suspect it was released during a small episode of seafloor spreading.

"Certainly there have been underwater volcanic eruptions, but we've not observed anything like this on a ridge crest before," says Stephen Hammond, director of the NOAA VENTS Program in Newport, Ore. Most geologic evidence for seafloor spreading is in the form of records of processes that act over millions of years, he says. The new plume offers a glimpse at seafloor spreading on the scale of days. "Since we really don't know the time rates of seafloor spreading," he adds, "this may be a very key observation."

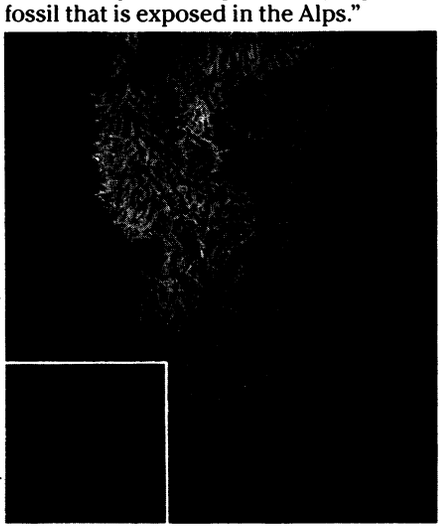
Researchers at the meeting also highlighted studies of vents on the Mid-Atlantic Ridge, which spreads much more slowly than its Pacific cousins. Last summer, with the help of the submersible *Alvin*, they found that the water chemistry and heat from Atlantic vents are similar to that emerging from vents along the East Pacific Rise.

"That's very unexpected," says Peter Rona of NOAA in Miami. "We thought these vents would be completely different, since they're on a slow-spreading ridge . . . which is a kilometer deeper and supposedly has a different kind of magma chamber under it."

Rona's group has also discovered two large mounds of polymetallic sulfides — compounds of potential economic importance that are deposited on the ocean bottom when the hydrothermal plumes hit the cold seawater. One mound, still being deposited, contains 4.5 million tons of sulfides and is the size and shape of the Houston Astrodome, says Rona. The group also found a much larger, inactive mound that they think was built up over tens of thousands of years.

The implications of this find, says Rona, "are that slow-spreading ridges may be more effective at concentrating larger sulfide deposits than are fast-spreading ridges, where the crust moves away much sooner from the heat source driving hydrothermal circulation."

The recent *Alvin* dives in the Atlantic gave biologists a closer look at Atlantic vent communities, including a newly discovered genus of shrimp found swarming around "black smoker" chimneys. Perhaps the most intriguing biological mystery in the vent area, however, was the finding of thousands of highly symmetric, Chinese-checkerboard-like patterns on the seafloor, which were first photographed several years ago. Rona thinks the pattern may be either an animal itself or the burrows made by an animal. He says the patterns are "dead ringers for a 70-million-year-old [*Paleodictyon*] trace fossil that is exposed in the Alps."



NOAA/Woods Hole Ocean. Inst./MIT

Treasures from the Atlantic vents include these newly identified shrimps. Biologists are unsure what food source sustains so many shrimp gathered around this hydrothermal chimney. The inset shows one of the thousands of checkerboard-like patterns on the seafloor, which may be living animals or their burrows.

Scientists took two core samples of these Atlantic patterns during the recent *Alvin* dives, but Rona says the biologists have not yet opened them. This part of the deep Atlantic, he says, may be a stable sanctuary for what may turn out to be the first living examples of an animal long extinct on the rest of the planet.

—*S. Weisburd*