Tackling smog ozone: Tougher than thought

When President Bush proposed his clean air legislation last month, he focused on pollution-control methods that use currently available technology (SN: 6/17/89, p.375). But a new analysis indicates smog ozone may be more difficult to reduce than he and others realized.

This week, the congressional Office of Technology Assessment released a report stating that with existing methods, only half the cities now exceeding the Environmental Protection Agency's ozone standards can achieve a safe smog level by the year 2000. Controlling ozone "will be a real tough job, so we need to start [developing innovative ozone-reduction approaches] today," says Robert M. Friedman, the report's project leader.

Taking a deep breath can prove stressful for many an urbanite on a smoggy afternoon. Ozone-laden air can trigger at least a tinge of chest pain or a cough, especially in people who are exercising. About half the U.S. population lives in areas where smog ozone exceeds the EPA's safety ceiling of 0.12 parts per million on at least one day of the year (SN: 6/17/89, p. 375).

The need for better smog-control strategies is underscored by new evidence of ozone's lung-damaging potential, presented last month at a meeting of the Air and Waste Management Association in Anaheim, Calif. Researchers from the University of Arizona in Tucson reported that the higher the ozone concentration (which varied between 0.021 and 0.1 parts per million in the Tucson study), the more it depresses a person's respiration rate over a one-day period.

The observed human effects appear reversible, says study leader Michal Krzyzanowski. But another research team at the conference described potentially permanent damage in rats, whose lung membranes thickened after 18 months' exposure to daily smog-ozone levels similar to those a person would breathe in a high-ozone city. The rats' lungs did not return to normal after a four-month recovery period, although a longer breath of fresh air might prove the changes reversible, says study author Gary E. Hatch of the EPA in Research Triangle Park, N.C.

Ozone forms when volatile organic compounds and nitrogen oxides meet in sunlight. Automobile exhaust and evaporated solvents, as well as natural vegetation and other sources, can release the volatile organic compounds. Nitrogen oxides come mainly from fossil-fuel combustion. Past control efforts have focused on human-produced organic hydrocarbons, in part because restricting their production appeared less expensive than controlling nitrogen oxides. But recent scientific evidence indicates that limiting nitrogen oxides may be a more effective approach to reducing smog ozone (SN: 9/17/88, p.180).

The new government report suggests several target areas for smog-ozone strategies:

- Stricter regulatory controls on nitrogen oxide emissions from motor vehicles and electrical and industrial boilers could reduce these pollutants by more than 20 percent in some areas, especially rural ones (SN: 7/8/89, p.22).
- Regulators need to encourage development of new products and processes to reduce the need for ozone-contributing solvents, about half of which can't be controlled with existing methods.
- Alternative motor vehicle fuels such as methanol and compressed natural gas, though costly, might contribute as much as 90 percent less ozone than gas-powered vehicles.
- Cutting automobile use through mandated staggered work hours, incentives for carpools and more efficient public transportation could also substantially lower smog levels. — *I. Wickelgren*

Meteorite may carry organic Martian cargo

Amidst major ifs, a trio of space scientists reports that a meteorite discovered 10 years ago in Antarctica may have come from Mars bearing a smidgen of the kind of carbon-containing material thought necessary for the emergence of life. Though falling short of proving the presence of such organic material on Mars, the new evidence resurrects that possibility, which experiments during the 1976 Viking mission to Mars had all but killed.

"We want to draw attention to a very interesting meteorite with strange, unusual and unexpected things in it," says Ian P. Wright, leader of the research team at the Open University in Milton Keynes, England. In their analysis of a 5-milligram sample of the roughly 8-kilogram, football-sized meteorite designated EETA 79001 — which many scientists suspect originated on Mars — the researchers found two distinct reservoirs of carbon-containing material. One consists of the mineral calcium carbonate and the other appears to contain still-unspecified organic (nonmineral) compounds.

The researchers discovered the two pools of carbon by measuring the ratio of stable carbon isotopes — carbon-13 to carbon-12 — in the meteorite sample as combustion liberated these elements. Various natural processes, such as mineralization or metabolism, produce carbon-containing products with somewhat characteristic isotope ratios. Heating the meteorite sample in stepwise fashion burns off the mineral and organic carbon components at different times, yielding carbon dioxide for isotope analysis, Wright says.

Using a mass spectrometer, he and his co-workers found that most of the carbon in the meteorite sample came off between the temperatures of 450°C and 700°C and that this fraction was enriched in the heavier carbon-13 isotope. Wright reads this as a sign that the heat decomposed carbon-containing minerals, or carbonates. The mass spectrometer also detected carbon coming from a smaller sample component that burned at lower temperatures and that was depleted in carbon-13. "This was from the combustion of organic materials," the researchers claim in the July 20 NATURE.

"The work has demonstrated that there is an organic component there," comments space scientist James L. Gooding of NASA's Johnson Space Center in Houston. But, he says, the big question remains: Did the organic carbon come from Mars?

Although Wright says "the evidence is stacked solidly for a Martian origin" of EETA 79001 and a handful of other meteorites of Mars-like composition (SN: 10/18/86, p. 246), some doubt will linger in the absence of independent confirming evidence from, say, a Mars rock-collecting trip.

Even granting the Martian origin of such meteorites — as many scientists do — the organic matter Wright detected still could derive from whatever cosmic cue ball — a comet, for example — jolted the Martian surface and sent EETA 79001 on its way to Earth. Geochemist John F. Kerridge of the University of California, Los Angeles, leans against this interpretation, noting that the sample's carbon ratios don't seem to reflect a cometary source. Instead, he says, they could indicate contamination with organic carbon from Earth.

Wright argues that the meticulous handling of EETA 79001 "militates against a wholly terrestrial origin" of the organic matter. As for the Viking Lander's failure to detect organic carbon on Mars, Wright notes that it examined only surface material and not samples like EETA 79001, which presumably represent deeper Martian crust.

"There is a remote chance that we're looking at some [extraterrestrial] fossil life form," Wright cautiously told SCIENCE NEWS.

Kerridge thinks it's too early to reconsider the life-on-Mars issue. "The implications [of the British study] really are quite considerable, particularly in light of the Viking data," he says. "But I'd like some other line of evidence to support this before saying there really is organic matter on Mars." — *I. Amato*