Car-emission standards improve rural air

Regulations aimed at curbing pollution from motor vehicles are achieving a key goal, according to a 9-year study in Virginia's Shenandoah National Park. A decline in the ground-level concentration of carbon monoxide in the park shows that rural air over the eastern United States is getting cleaner, scientists say.

Until around 1989, concentrations of the toxic gas were on the rise, in step with increasing numbers of automobiles on the roads. The new study, however, shows that between 1989 and 1997, carbon monoxide declined by 23 percent at a monitoring station in Shenandoah Park. The researchers report their findings in the Sept. 15 GEOPHYSICAL RESEARCH LETTERS.

"It's a piece of good news," says Russell R. Dickerson, a professor of meteorology at the University of Maryland in College Park and codirector of the study. Wind patterns make the atmosphere over Shenandoah representative of rural air east of the Mississippi.

The earlier rise in carbon monoxide distressed scientists for several reasons. Carbon monoxide undermines blood's ability to carry oxygen and may contribute to heart attacks (SN: 10/14/95, p. 247). It also meddles in the chemistry of the atmosphere. Carbon monoxide makes it harder for the atmosphere to cleanse itself of chlorofluorocarbons, which chew at Earth's protective ozone layer. At lower altitudes over cities, carbon monoxide can also increase ozone, the toxic main ingredient of smog.

According to Donald H. Stedman, an atmospheric chemist at the University of Denver, carbon monoxide concentrations in Shenandoah are falling mainly because cars are getting cleaner. Federal standards required manufacturers to build the greener vehicles starting in the 1980s, he says.

Joseph Pinto, an atmospheric scientist with the Environmental Protection Agency in Research Triangle Park, N.C., says the trend at Shenandoah echoes what EPA scientists have been seeing at sites in and around cities nationwide.

Most cities no longer exceed the national ambient-air-quality standard for carbon monoxide—9 parts per million averaged over 8 hours—Pinto says. In 1977, by contrast, at least twice per year carbon monoxide at the average American city climbed above this concentration.

At Big Meadow, the 1,100-meter-high plateau where researchers sampled air, the highest sustained carbon monoxide concentration during the study was about 0.7 parts per million.

Kristen A. Hallock-Waters

Air-monitoring station at Big Meadow in Shenandoah National Park.

The study's intent was not to see if the air away from cities had unhealthy amounts of carbon monoxide, says Pinto. Rather, it was to fill a scientific gap. Scientists couldn't be sure that rural and urban air were benefiting equally from improved car emissions. "It's good to have that confirmation," Pinto says.

Meanwhile, the news from Big Meadow is not all good. Ozone concentrations there have stayed about the same even as carbon monoxide has declined.

Yet Dickerson is optimistic. Nitrogen oxides foster smog production, he says, and their concentrations are expected to decline in response to newly implemented standards for industrial emissions. Smog, too, will wane as nitrogen oxide levels drop, Dickerson says. *—O. Baker*

Massive black holes let there be light

Stars in the night, blazing their light, can't hold a candle to . . . a black hole?

The darkest objects in the heavens may produce a sizable fraction of the light in the cosmos. Two new studies suggest that supermassive black holes, the invisible monsters believed to lurk at the hearts of many galaxies, generate at least 5 percent and perhaps as much as half of all the radiation in the universe.

Because of its huge gravity, a black hole swallows everything around it, including light. Just before the point of no return, called the event horizon, gas spiraling toward the hole attains high velocities and enormous temperatures. Before this hot, high-speed gas accretes onto the hole and vanishes forever, it emits a swan song—intense radiation ranging from visible light to X rays.

This light, researchers say, may illuminate much of the cosmos. Quasars, the brilliant beacons that supermassive black holes create at the core of some galaxies, are thought to shine in this way. Although astronomers have suspected for more than 20 years that black holes make a substantial contribution to heavenly light, "the data are better now, so one can ask sharper questions" and refine estimates, notes E. Sterl Phinney of the California Institute of Technology in Pasadena.

To calculate how much radiation is generated around supermassive black holes, Phinney homed in on patches of sky containing extensively studied quasars and other, more-muted fireworks believed to be powered by black holes. He then estimated how much light in these patches comes from stars and how much from accretion onto black holes. Light from the two sources can be distinguished because quasars appear more pointlike, Phinney notes.

Assuming that the sources of light in the observed regions are representative of the entire universe, Phinney estimates that black hole accretion accounts for 5 to 20 percent of the light in the cosmos. Stars would produce the remaining light. He reported the finding earlier this month at a workshop on black holes at the European Southern Observatory in Garching, Germany.

In another study, Andrew C. Fabian of the University of Cambridge in England estimates the contribution of black holes to cosmic radiation based on the average density of supermassive black holes near our galaxy and the intensity of the sky's X-ray background. Neither stars nor the known population of quasars can account for the background, and Fabian argues that it's produced by a vast population of quasars that have not yet been detected because they lie behind a veil of dust. "For every ordinary quasar, about 10 more obscured ones are needed," he says.

According to this model, 10 to 50 percent of the light in the universe comes from accretion onto black holes, he reported in mid-September at a meeting on X-ray astronomy in Bologna, Italy. Astronomers had previously come up with estimates of only a few percent because they based their calculations on the relatively few quasars seen in visible light, Fabian says.

Looking for hidden quasars isn't easy. Dust absorbs both ultraviolet and visible light and reradiates it as far-infrared radiation. Astronomers, however, have few high-resolution telescopes to detect this wavelength band. NASA's Space Infrared Telescope Facility, scheduled for launch in 2001, should provide "the ultimate check on Fabian's model," Phinney says.

Aside from illuminating the universe, a population of previously unknown quasars could complicate galaxy formation, Fabian speculates. For example, quasar winds might blow gas out of young galaxies. Such winds might also hinder the growth of the slender arms and disks of spiral galaxies, notes Roger D. Blandford of Caltech. *—R. Cowen*