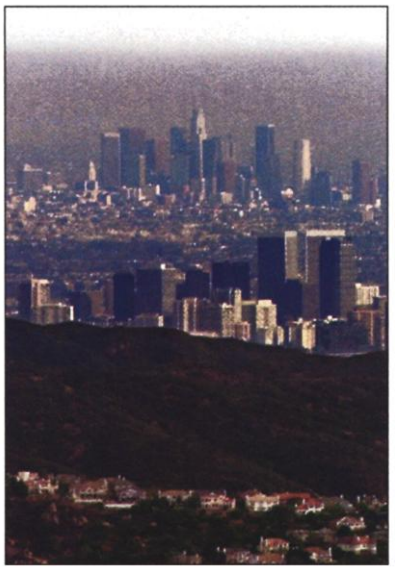
AIR POLLUTION

Small Particles Add Up To Big Disease Risk

Breathing polluted air may be nearly as bad for you as living with a cigarette smoker. A new study, the most extensive of its type, shows that long-term exposure to tiny particles of air pollution increases the risk of dying from heart or lung disease or lung cancer by about the same amount as long-term exposure to secondhand smoke. Although the mechanism by which the particles cause disease is still up for debate, the latest study supports existing U.S. air-quality standards that have been attacked by industry and state governments.

A number of studies have shown that more deaths from heart and lung diseases occur on days with high concentrations of fine particles. These particles, byproducts of burning wood and fossil fuels, are smaller than 2.5 micrometers across, or less than 1/40th the width of a human hair. Landmark studies in 1993 and 1995 suggested that heart and lung diseases could be caused by chronic exposure to fine particles, but some scientists argued that the findings were unreliable because researchers hadn't sufficiently accounted for the individual risk factors and differences among communities (*Science*, 4 August 2000, p. 711).



Breathtaking. Fine-particle pollution in places such as Los Angeles ups one's risk of lung cancer and other diseases.

To gain a better understanding, environmental epidemiologists Arden Pope of Brigham Young University in Provo, Utah, George Thurston of New York University (NYU) School of Medicine, and Daniel Krewski of the University of Ottawa tracked people over a longer time and controlled more extensively for individual risk factors. The team compared data on particulate and gaseous air pollution with data on the cause of death among 500,000 people followed for 16 years by the American Cancer Society. After compensating for smoking, diet, obesity, and other risk factors, as well as possible regional differences, the researchers found that every 10-microgram increase in fine particles per cubic meter of air produces a 6% increase in the risk of death by cardiopulmonary disease, and 8% for lung cancer.

Reporting in the 6 March issue of the *Journal of the American Medical Association*, the team found that the risks are highest in Los Angeles, which averaged 20 micrograms of fine particles per cubic meter in 1999 and 2000. Chicago clocked in at 18 and New York City at 16. But small cities are not necessarily safer, Thurston points out: Huntington, West Virginia, has higher average fine-particle concentrations than New York because of its proximity to coal-fired power plants. Douglas Dockery, an environmental epidemiologist at Harvard University who helped design one of the original studies linking long-term particulate exposure to heart and lung disease, says the study's key contribution is highlighting the role of particulates in lung cancer.

It's logical that fine particles would cause heart and lung problems, Thurston says: "The particles are loaded with carcinogens, and they reside in the lungs for a long period of time." Researchers are still trying to pinpoint the most lethal particles, however, and sort out how they cause disease. They may lodge in the lining of the lungs, inflaming them and contributing to infection. Fine particles can also generate highly reactive oxygen-containing chemicals that can trigger inflammation and allergies and might damage the heart. And the smallest of the fine particles can pass from the lungs into the bloodstream, where they can travel to other sites and wreak further havoc.

As with cigarette smoke, many different compounds and mechanisms are probably involved, says Morton Lippmann, an environmental health scientist at NYU School of Medicine and director of one of five centers set up by the Environmental Protection Agency (EPA) to study the health effects of fine particles. "We don't know why some people get serious heart problems and others get lung disease," he says. "But that's not an excuse not to regulate fine particles."

In 1997, EPA established standards for fine particles under the Clean Air Act. It set the annual average at a maximum of 15 micrograms per cubic meter of air, with a 24-hour maximum of 65 micrograms per cubic meter. Several industry groups and three states challenged the standards, which were upheld last year by the Supreme Court after a lengthy legal fight. Meanwhile, EPA has collected 3 years of data on fine particles and hopes by the end of the year to designate which cities are not meeting the standards. Even then, however, it could be a decade or more before states implement plans to clear the air. –SOLANA PYNE

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ASTRONOMY

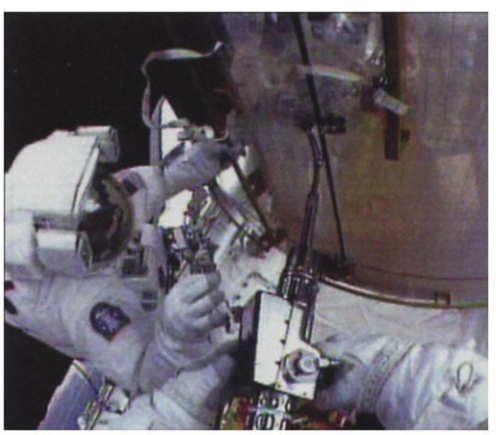
Two Satellites Get New Lease on Life

Last week proved a happy one for astronomers whose orbiting instruments are hard to reach. While spacewalking astronauts won headlines for refurbishing the Hubble Space Telescope, ground controllers quietly revived a valuable ultraviolet satellite —given up for dead last December— without ever leaving their seats.

Astronauts successfully replaced solar arrays, added new instruments, and installed a new power unit on the aging Hubble during five demanding forays into the open space-shuttle bay. The crew then released the telescope, which faces several months of testing before it can again start collecting data (*Science*, 22 February, p. 1448).

Meanwhile, the Far Ultraviolet Spectroscopic Explorer (FUSE) is already transmitting scientific data after a team on the ground pulled off what Paul Hertz, FUSE program director at NASA headquarters in Washington, D.C., labels "a miracle." FUSE was launched in 1999 on a 3-year mission to examine conditions shortly after the big bang, including the properties of gas clouds that form stars and planetary systems and the dispersal of chemical elements in the universe. The mission, which includes Canadian and French participation, was extended for 2 more years after revealing, among several findings, that the Milky Way galaxy sits in the middle of a tenuous bubble of gas with temperatures of about 1 million degrees (*Science*, 25 January, p. 616).

Disaster struck in December 2001, how-



Better than new. Shuttle astronauts upgraded instruments on the Hubble Space Telescope.

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