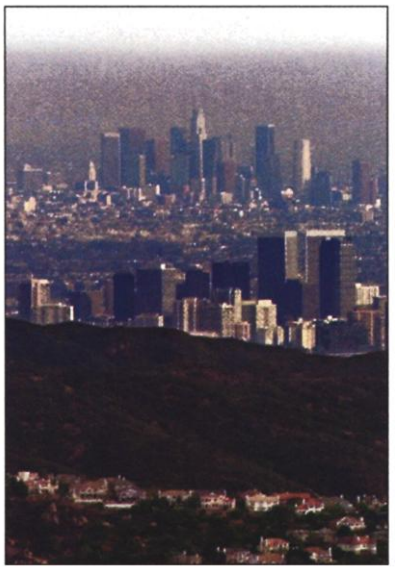
AIR POLLUTION

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

Solana Pyne is a writer in New York City.

ASTRONOMY

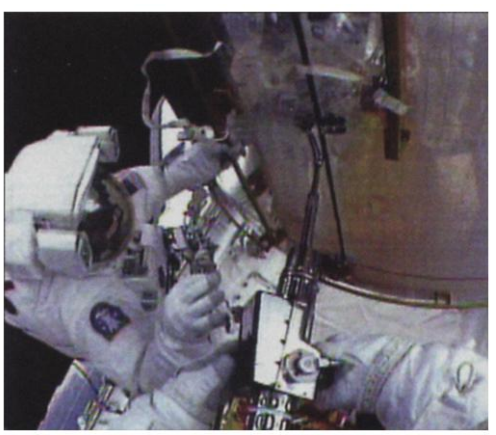
Two Satellites Get New Lease on Life

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.

CREDITS: (TOP TO BOTTOM) MARK J. TERRILL/AP; AP/NASA TV

ever, when the second of four key guidance systems failed. "I would have bet good money that it was the end for the mission," says Hertz. But a team of engineers and scientists from NASA, industry, and Johns Hopkins University used electromagnets in the satellite and Earth's own magnetic field to keep the spacecraft oriented. Engineers had theorized that they could use a magnetic field to steer a satellite, but the approach had never been tried. "I am thrilled that the FUSE team proved me wrong," says Hertz.

The team is still fine-tuning the new guidance system, which allows controllers to lock onto guide stars for accurate pointing. In the meantime, researchers are thrilled that an old friend has regained its good health. "I am very excited to have FUSE back," says George Sonneborn, a project scientist at NASA Goddard Space Flight Center in Greenbelt, Maryland. **–ANDREW LAWLER**

SPAIN

New Cancer Center Makes a Big Splash

BARCELONA—When Mariano Barbacid returned home in 1998 to establish a cancer research center, his compatriots lauded him as a lodestar for a wayward scientific community. In a few weeks, Barbacid will march his growing staff at the National Cancer Research Center (CNIO) from temporary quarters into a new $32 million facility in the heart of Madrid. Supporters commend Barbacid for putting together an impressive team that, they say, will anchor CNIO in the world's firmament of stellar cancer centers. Others, however, complain that CNIO has had an unfair advantage in winning government support and worry that it could devour scarce resources.

Barbacid built his reputation at the U.S. National Cancer Institute (NCI) branch in Frederick, Maryland, where in 1982 he led one of three teams that independently reported the first isolation of a human oncogene. Promised a free hand in creating Spain's own NCI, Barbacid left a management position at the drug giant Bristol-Myers Squibb and moved back to his birthplace.

Once home, Barbacid lured back several top Spanish researchers from elsewhere in Europe. Last year, for instance, he recruited Luis Serrano, head of the Department of Structural Biology and Biocomputation at the European Molecular Biology Laboratory in Heidelberg, Germany, to start a similar department at CNIO that will focus on drug design. CNIO now employs 130 scientific staff members, a figure that will swell to 450 after the move.

The new center starts life with a silver spoon. Among its high-tech accoutrements, CNIO can generate its own DNA chips, each studded with more than 7000 genes, that researchers will use to study how to design treatments based on tumor gene expression patterns. CNIO will also maintain the National Tumor Bank Network, a young project that so far has accumulated a stockpile of 3000 tumor tissue samples.

Although researchers are pleased at the new peak on their country's research landscape, some are bothered by the shortcuts taken to get there. The center was conceived without input from the scientific community or from Parliament, says medical oncologist Francisco Real of the Municipal Institute of Biomedical Research in Barcelona, and Barbacid himself boasts that Prime Minister José Maria Aznar has personally guaranteed CNIO's progress free of stumbling blocks.

Waiting game. Mariano Barbacid and his team are weeks away from moving into their new National Cancer Research Center.

CREDITS: CNIO

The health minister, Celia Villalobos, persuaded a trade group representing 300 drug companies to donate $26 million a year from 2001 to 2004 to help fund, among other projects, CNIO and a second new facility, the Spanish Cardiovascular Research Center. In return, says molecular biologist Pere Puigdoménech, director of Barcelona's Molecular Biology Institute, the government pledged not to cap drug prices over the next few years.

The government has promised to foot 60% of CNIO's $28 million annual budget —a hefty share of the $140 million that Spain spends each year on biomedical research. Most of the rest, says Barbacid, will come from competing successfully for public grants. However, some researchers outside Madrid feel they are operating at a handicap. "Our capacity to compete with him will always be lower," says oncologist Josep Baselga of the Hospital Vall d'Hebrón in Barcelona. For that reason, Baselga argues, Barbacid has a responsibility to Spain's cancer research community at large. Acknowledging that debt, Barbacid says he hopes several more topflight cancer centers will be built outside Madrid to even out the playing field. **–XAVIER BOSCH**

Xavier Bosch is a science writer in Barcelona, Spain.

NEUROSCIENCE

Neurons Weigh Options, Come to a Decision

Some decisions you can make in a snap. For others, you have to weigh the options and mull them over for a while. Monkeys in a new study wrestled with the latter type of task while researchers measured a sequence of neural activities involved in making such a decision.

Previously, neuroscientists had observed operations necessary for some types of decision-making. For instance, they can monitor neurons encoding sensory information, comparing stimuli, and preparing commands to move. In the 14 March issue of *Neuron*, a team reports tracking a crucial step: neurons' ability to keep a trace of recent events in memory while making a comparison. Ranulfo Romo and colleagues at the National Autonomous University of Mexico in Mexico City observed the complete unfolding of a decision-making process as reflected by the activities of neurons in a brain region called the medial premotor cortex (MPC).

"It's the first time somebody has done that," says Michael Shadlen of the University of Washington, Seattle. "To make a comparison you have to hold the first stimulus in memory somehow, and this [study] involves this very special step."

The MPC is primarily involved in preparing body movements, but Romo and other researchers have suggested that it is also involved in sensory processing and is capable of holding fleeting memories. Romo and his colleagues suspected that this combination of powers would enable the MPC to participate in making decisions. To test this idea, the researchers applied a vibration to monkeys' fingertips for half a second using a pencillike probe. They waited 1 to 3 seconds and then applied a second vibration at a different frequency. The animals learned to press a button to indicate which of the vibration frequencies was higher, and researchers tracked the firing of single neurons in the trained monkeys' MPCs as the animals mulled over which button to push.