to lingering pollution. Other analyses insist that many of the "excess" deaths in early 1953 were caused by influenza, a view that the government has always supported. The debate reveals how much is unknown even today about the effects of smog, which continues to menace big cities, particularly in developing countries with weak air-pollution laws.

Even in a city legendary for its "pea-soup" fogs, the Big Smoke is the stuff of legend. In early December 1952, an area of high pressure settled over London. Residents kept piling sulfur-rich coal into their stoves to keep warm in the near-freezing temperatures. In the still air, the smoke from these stoves and from coal-fired power plants in the city formed a smog laden with sulfur dioxide and soot. On Friday, 5 December, schools closed and transportation was disrupted. On Saturday night, a performance of the opera *La Traviata* had to be abandoned after smog obscured the stage. It wasn't until Tuesday, 9 December, that winds finally swept away the fouled air.

By then, it was clear that a disaster was unfolding, as scores upon scores of people succumbed to respiratory or heart ailments. In 1953, the Ministry of Health concluded that the deaths of 3500 to 4000 people—nearly three times the normal toll during such a period—could be attributed to the smog. But officials decreed that any deaths after 20 December had to be from other causes. During the first 3 months of 1953, there were 8625 more deaths than expected. Officials put 5655 down to flu and listed 2970 as unexplained.

A few years ago, epidemiologist Devra Davis, a visiting professor at the London School of Hygiene and Tropical Medicine, which sponsored the conference, and Michelle Bell, then a graduate student at Johns Hopkins University in Baltimore, decided to test the idea that flu caused all the deaths. In 1953, influenza was not a disease that doctors were obliged to report to health authorities. But examining public health insurance claims, hospital admissions, and news accounts of the flu outbreak, Davis and Bell concluded that most of the excess deaths in early 1953 could not have been from flu. "Nothing we found said the flu outbreak was huge," says Bell. Often-listed causes of death such as pneumonia and bronchitis, they claimed, had to be from the Big Smoke or from persisting pollutants.

"It's a very interesting study to disentangle these deaths," says Ross Anderson of St. George's Hospital Medical School in London. Nevertheless, he suspects that influenza deaths were two to 10 times greater than reported, and that there might have been "the possibility of interaction" between pollution and flu. Frederick Lipfert, an environmental consultant in Northport, New York, presented his own analysis suggesting that flu was a bigger killer than Davis and Bell acknowledge. Another study put an upper limit on flu deaths. Epidemiologist Klea Katsouyanni of the University of Athens Medical School reported that data from recent flu outbreaks, analyzed by a pan-European pollution project, suggested at most 2650 flu victims in early 1953—although the real, unknowable tally, she says, was probably far lower.

Lingering on. Devra Davis says London's Big Smoke killed people for months afterward.

The debate is more than academic. Although London smogs are now more legend than reality, air pollution continues to smother big cities. In a new analysis presented at the meeting, the World Health Organization estimates that bad air kills about 600,000 people worldwide each year. "Some lessons of the Big Smoke still haven't been learned," Davis says. **–RICHARD STONE**

CREDITS: (TOP TO BOTTOM) BETTMANN/CORBIS; BASIC BOOKS

HIGH-ENERGY PHYSICS

Particle Trap Confirms Antimatter Shuffle

The neutrino has just become a little less mysterious. The first results from a Japanese experiment that measures antineutrinos streaming away from nuclear reactors show that antineutrinos behave just like their counterparts, neutrinos. The study, announced last week, also dispels uncertainties about earlier experiments that used neutrinos from the sun.

"It's a profound result," says John Bahcall, a physicist at the Institute for Advanced Study in Princeton, New Jersey. "It dots the i's and crosses the t's for the interpretation of what happens with solar neutrinos. It's an incredible achievement."

The experiment, based at a zinc mine in Kamioka, Japan, and dubbed KamLAND, is one of several underground experiments studying some of nature's hardest-to-capture particles. But whereas most of the other efforts detect neutrinos coming from the sun and from the atmosphere, KamLAND looks for antineutrinos created by 17 nuclear reactors that dot the Japanese landscape.

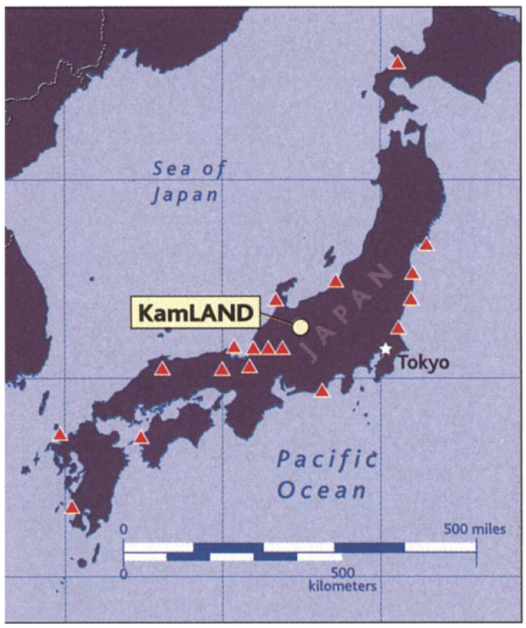
Like neutrinos, antineutrinos come in three varieties—electron, muon, and tau—named after other particles with which they are associated. The antineutrinos are generated by the decay of radioactive elements within the reactor. The detector itself is a 1000-ton sphere full of mineral oil and an organic solvent known as pseudocumene. When an electron antineutrino strikes a hydrogen nucleus—a proton—in the liquid, both particles change identities. The proton becomes a neutron, and the antineutrino becomes an antielectron in a process known as inverse beta decay. The scientists detect the flashes caused by the newborn antielectron and neutron, which signals that an antineutrino has met its demise.

In 6 months of observations, a team led by Atsuto Suzuki of Tohoku University in Sendai, Japan, detected 54 electron antineutrinos—significantly fewer than the 87 or so that the team should have seen, given the output of the reactors and the sensitivity of the detector. The deficit implies that electron antineutrinos change into muon or tau antineutrinos after they leave the reactor, just as electron neutrinos from the sun change into muon or tau neutrinos before reaching Earth (*Science*, 26 April, p. 632). "When you do it with the antiparticle instead

of the particle, you get a consistent result," says John Learned, a KamLAND collaborator at the University of Hawaii, Manoa.

"This is what everyone expected, but nature could have fooled us," says Bahcall. If neutrinos and antineutrinos behaved differently, they would violate an important principle in particle physics known as CPT symmetry. Physicists have tested the principle in the sector of physics that has to do with the strong force (and quarks and gluons), but KamLAND's result is the first to verify it with any degree of accuracy in the realm of the weak force (and neutrinos).

Furthermore, because the antineutrinos are created in nuclear reactors rather than in the core of the sun, physicists needn't worry that incorrect assumptions about the sun's inner workings might mess up their calculations. "There was a possibility that [the sun's] magnetic fields were flipping the spins of the neutrinos," says Learned. "The caveats about solar neutrino measurements are all eliminated in one grand stroke."



Ground truth. The subterranean Kamioka Liquid Scintillator Antineutrino Detector spots particles from Japanese reactors (triangles).

SOURCE: INTERNATIONAL NUCLEAR SAFETY CENTER AT ANL (OCTOBER 2002)

With more data and a refined understanding of the detector's properties, KamLAND scientists should be able to pin down the difference in mass between two species of neutrinos, says Giorgio Gratta, a KamLAND team member at Stanford University. That's one of the key parameters that dictate their properties. But even the first results are narrowing the possible range of the mass difference, Gratta says: "I'm very happy."

The KamLAND team hopes eventually to spot neutrinos coming from deep inside Earth. They are the product of the decay of radioactive elements that keep the planet's center so hot. The number of neutrinos from these nuclear reactions will give geologists a direct measure of the amount of radioactive material buried in the heart of the planet.

–CHARLES SEIFE

GENETIC MODIFICATION

Europe Prepares for Arrival of GM Foods

BRUSSELS—The European Union (E.U.) appears set to lift its 4-year ban on foods made from genetically modified organisms (GMOs), following the drafting of a new directive on food labeling late last month. The European Parliament is expected to give its final approval of the new rules next March, and the European Commission last week put in place the mechanism to make the new system work: the European Network of GMO Laboratories (ENGL).

The new rules will require a GMO label on any food containing more than 0.9% GMO material, a threshold designed to allow for some accidental contamination. "These are among the tightest regulations [on GMOs] in the world," says Barry Mc Sweeney, director-general of the commission's Joint Research Centre (JRC). JRC's main laboratory in Ispra, Italy, will coordinate the ENGL network of more than 45 institutes in the 15 E.U. member states and 10 countries that are expected to join in 2004. These labs will randomly test foodstuffs to ensure that they are GMO-free if they claim to be, or that they contain only approved GMO materials. "We need harmonized procedures and methods to ensure that we get the same results" all over Europe, says Guy van den Eede, coordinator of ENGL.

In the future, any food or feed company that wishes to market a new GMO will have to submit reference material and a specific testing method to the Ispra ENGL lab. ENGL will validate the test and, if approved, it will be registered as an international standard. All the ENGL labs will then use the test in their countries.

The idea behind the new legislation is to allow consumers to choose GMO-free food if they wish, while allowing biotech companies to market their wares. Although most environmental organizations welcome the strict regulations, one proposal drew fierce opposition. For a 3-year period, the commission wants to allow foods containing 0.5% of "GMO material unauthorized in the E.U., but which has undergone a favorable risk assessment." Peter Riley of Friends of the Earth in the U.K. says unlicensed GMOs should be completely banned: "If the U.S. is growing crops that are not accepted worldwide, it is their problem."

But E.U. Research Commissioner Philippe Busquin says the network "provides

ScienceScope

GM Corn OK Ending years of controversy, the Philippines has become the first Asian nation to approve the sale of genetically modified (GM) corn seed. The government's agriculture department last week gave Monsanto permission to market a strain modified to resist corn borers, a common pest. Monsanto's corn is the first major GM food crop to gain approval in Asia.

Size Counts NASA Administrator Sean O'Keefe says the international space station's crew is likely to grow after 2006. The prediction, made last week at a Tokyo meeting, was a relief to many scientists, who say that little meaningful research can be done with the current crew of three. O'Keefe told project partners that the Bush Administration's 2004 budget proposal, due in February, would include "the appropriate financing" to allow station science to expand by 2007 —a goal embraced by Europe, Japan, Canada, and Russia.

New Stem Cell Law Australia's Parliament this week approved national stem cell legislation that will harmonize a jumble of state and territorial rules. Under the new law, which was the subject of extensive debate (*Science*, 6 September, p. 1627), researchers will be able to use existing human embryonic stem cell lines and create new lines from excess embryos created for in vitro fertilization prior to 5 April 2002. Biologist Martin Pera of Monash University says the rules will allow research "to go forward on a sound ethical basis."

NIH Litmus Test? Concerns that the Bush Administration is blackballing ideologically incompatible science advice (*Science*, 15 November, p. 1323) now extend to the National Institutes of Health's (NIH's) advisory councils. In a 21 November letter to Department of Health and Human Services Secretary Tommy Thompson, Representative Edward Markey (D–MA) and three other lawmakers ask why one nominee to a National Institute on Drug Abuse panel was questioned about his voting preferences and his views on needle exchange, abortion, and drug legalization. The nominee, psychologist William Miller of the University of New Mexico, Albuquerque, says he was apparently rejected last January after giving incorrect answers. In this case and others, the lawmakers want to know "why ... this information is relevant" to providing scientific advice.