mice exhibit accelerated aging, "you'd have to knock out p53 and get a longer life-span," Guarente says. But "we already know what happens then: You get cancer."

Researchers can't yet circumvent this problem, but Donehower has managed to collect some preliminary data. Mice that carry one normal and one inactive copy of *p53* suffer from a high incidence of cancer. But two of 217 such animals he studied did not happen to get tumors—and they "lived much longer than any of the wild-type mice," says Donehower. "It's only two mice," he cautions, but he would like to follow up this tantalizing observation to see if small amounts of p53 make for a longer life-span, provided the animal remains cancer-free.

Teasing apart p53's age-promoting and cancer-preventing capabilities might eventually lead to therapeutic interventions, suggests Ronald DePinho, a cancer geneticist at the Dana-Farber Cancer Institute in Boston. Perhaps such an approach would "help the organism age gracefully," he says, without compromising its ability to guard against cancer.

–EVELYN STRAUSS

CLIMATE CHANGE

Reducing Uncertainties Of Global Warming

About all that climate researchers can say with any confidence concerning global warming is that the world has warmed during the past century and much of that warming is probably due to humans pouring greenhouse gases into the atmosphere. How bad could things get as the world continues to warm? Scientists' bottom-up approach—trying to understand the role of every part in the dizzyingly complex climate machine—has left that question unanswered. But in this issue of *Science* (p. 113), a group of researchers take a top-down approach: They plugged different combinations of values for fundamental properties of the climate system—such as its sensitivity to the nudge that humans are giving it—into a computer model and looked to see how well the model's output matched long-term observations. The results are mixed.

Climate dynamicist Chris E. Forest of the Massachusetts Institute of Technology and his colleagues used this new combination of computer simulation and observations to calculate climate properties that had usually been estimated from climate models alone or from polling researchers for their opinions. Using an intermediate-complexity model simple enough to make hundreds of long runs, Forest and his colleagues simulated the climate of 1860 to 1995 under accumulating greenhouse gases. They compared their results to three observational records of temperature that gauge global warming: the changing temperatures of the surface, the upper atmosphere, and the deep ocean.

In the model, they included three adjustable "knobs": the sensitivity of climate to a given amount of added greenhouse gases, the rate at which the ocean can take up heat, and the ability of aerosols—microscopic particles found in pollutant hazes—to change solar heating of the atmosphere. Forest and his colleagues twiddled the knobs over a range of values, ran the model under a large number of setting combinations, and then compared the simulated climate trends with the three observed temperature records. If a three-setting combination produced a reasonable match for all three records, then each of the combination's settings became a possible value of the actual climate property.

By their own concession, Forest and colleagues had varied success pinning down key parameters of the climate system. The rate at which the ocean takes up heat—and counteracts greenhouse warming—couldn't be usefully constrained. "Our result suggests that more research is needed" on ocean heat uptake, they write.

Their lower limit (90% confidence level) on the all-important climate sensitivity—1.4 kelvin for a doubling of atmospheric carbon dioxide—matches the long-cited, subjective 1.5 K lower limit recently repeated by the Intergovernmental Panel on Climate

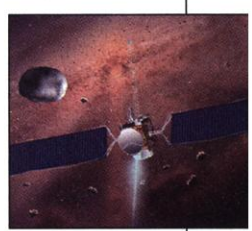
Prospect unclear. Climate uncertainties, such as the effect of this Himalayan pollutant haze, hinder projections of greenhouse warming.

CREDITS: (LEFT TO RIGHT) M. POSFAI *ET AL.*, *JOURNAL OF GEOPHYSICAL RESEARCH* **104**, 21685 (1999); DAWN, WILLIAM K. HARTMANN

ScienceScope

NASA Shakeup Newly confirmed space chief Sean O'Keefe is preparing to name ex-astronaut Charles Bolden, an African American, as his deputy. O'Keefe is filling that job for the first time in a decade as part of his effort to lift the agency from a budgetary morass.

Space scientists are anxious to see how the duo deals with NASA's research program. Earth-based astronomers recently headed off an attempt to chop $550,000 in annual support for the Arecibo radar in Puerto Rico, used to track near-Earth objects. NASA complained that the funding wasn't peer reviewed, but later restored $400,000 for 2002—with no promises for 2003. Planetary scientists, meanwhile, recently won approval for two new missions. Dawn (above) will rendezvous with the largest known asteroids, Vesta and Ceres, while a space telescope called Kepler will search for Earth-sized planets orbiting other stars. Both are slated for a 2006 launch, although budget troubles will delay Kepler for at least a year.



Gene Count Sequencers hope to at least double the number of documented microbial genomes, to more than 50. The number of genes in the human genome, meanwhile, will creep steadily upward from initial estimates of about 35,000. But that total will be dwarfed by the discovery of many more thousands of genes within genes—coding regions for a variety of proteins that begin or end in different places along the sequence of a single gene.

Science & Security Congress will finally pass legislation that increases security at labs working with potential bioweapons, leading some universities to decide that the costs outweigh the benefits of the research. Some scientists, meanwhile, are waiting to see how the Department of Heath and Human Services wields its new authority to classify some information—including lab locations and possibly research findings—as secret.

University researchers will finally get some relief from export regulations that have ensnarled projects—from satellites to supercomputers—involving advanced technology and foreign partners. The State Department is expected to publish new rules that protect academics who allow foreigners access to bona fide research projects.

Contributors: The *Science* News Staff

Change (IPCC) (*Science*, 26 January 2001, p. 566). At that level, "future changes in climate are of considerable concern," notes climatologist Tom Wigley of the National Center for Atmospheric Research in Boulder, Colorado. But Forest and colleagues came up with an upper limit even higher than the IPCC's: 7.7 K, compared with the IPCC's 4.5 K. The only way they could bring their scorching upper limit down was to use an expert opinion as the starting point for their statistical analysis of their modeling, an option that climate modeler Michael Schlesinger of the University of Illinois, Urbana-Champaign (UIUC), calls "extremely unsatisfactory." Schlesinger has conducted a similar analysis with Natalia Andronova of UIUC that yields an upper limit as high as 9.3 K, depending on the uncertain role of variations in the brightness of the sun.

Calculation of the likely range of the aerosol effect seemed most successful. Forest and his colleagues found that aerosols have most likely cooled the planet, but not as much as IPCC allowed. The net effect of aerosols could have been to reflect 0.30 to 0.95 watt per square meter of solar energy back into space, according to their result, compared with IPCC's admittedly uncertain range of zero net effect to more than 4 watts per square meter of net cooling. If correct, Forest's modest cooling would mean that most of early greenhouse warming is not being masked by aerosols. But aerosol modeler Joyce Penner of the University of Michigan, Ann Arbor, cautions that Forest probably shouldn't be lumping all types of aerosols together. She notes that some, such as those from field and forest burnings, do not concentrate in northern mid-latitudes, as Forest had to assume. "I wouldn't want to rewrite IPCC," adds climatologist Gabriele Hegerl of Duke University in Durham, North Carolina, but Forest's "range [for aerosols] is more likely than the very high ones of IPCC." To be more confident, researchers must further refine the top-down approach and, like it or not, gain more bottom-up understanding.

–RICHARD A. KERR

HARVARD DISAPPEARANCE

Missing Biologist Found Dead in River

The body of Harvard biochemist Don Wiley was found last month, 5 weeks after he disappeared while attending a professional meeting in Memphis, Tennessee. The corpse was discovered floating in a Mississippi River tributary in Louisiana, more then 300 miles south of the bridge where Wiley's abandoned car was discovered at 4 a.m. on 16 November. Dental records confirmed the identity of the Lasker Prize winner.

"It's a long ways, but the river has a mind of its own," said Lt. Joe Scott of the Memphis Police Department.

As *Science* went to press, Memphis police were awaiting results of an autopsy to determine the cause of Wiley's death. Colleagues have said that they doubt Wiley would have jumped off the bridge, but so far police have found no evidence of foul play (*Science*, 14 December 2001, p. 2265). A wallet containing identification was found with the body.

Harvard president Lawrence Summers issued a statement saying that the loss left a "tremendous void" in the campus community, which was shut down for winter vacation when the news arrived. Wiley's principle research sponsor, the Howard Hughes Medical Institute, has yet to set a timetable for determining the status of the lab, according to institute spokesperson Bob Potter (see Letters, p. 43). "It's just too early for that," says Potter. "Everybody has to come to terms with the fact that Don is not coming back."

–JOSH GEWOLB

NUCLEAR SCIENCE

U.S. Breeder Reactor Runs Out of Lives

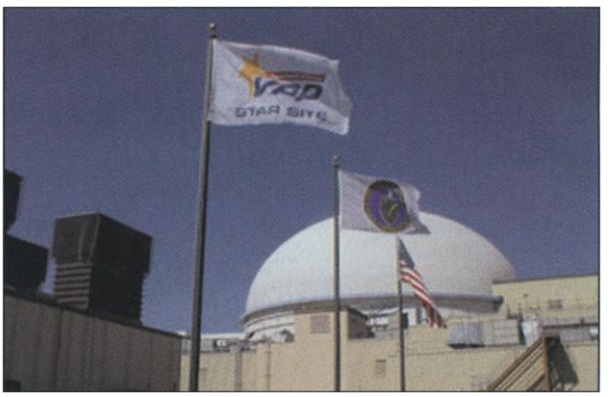
This time the decision looks final. The Bush Administration has abandoned its search for a new mission for the Fast Flux Text Facility (FFTF) in Hanford, Washington, and is planning to decommission the reactor.

The 19 December announcement marks the end of a decade-long saga for the Department of Energy's (DOE's) experimental breeder reactor. Concerns that its fuel might be a tempting target for nuclear terrorists, the high cost of restart, and the lack of a clear mission sealed its fate. But many FFTF opponents are already gearing up for the next fight, over getting the government to spend the $300 million needed to permanently shut down the facility. "The department's final determination is based on sound science, an extensive analysis of the costs and benefits of disposition options, and an in-depth consideration of the feasibility of commercial use options," said Energy Secretary Spencer Abraham in a written statement.

Proponents saw the reactor as an important source of radioisotopes used in cancer therapy and other treatments. But most biomedical researchers say that the isotopes are available from other sources and that restarting the reactor would drain scarce resources from other DOE research programs. "The data were compelling a long time ago that the cost of restarting FFTF relative to the need was not favorable," says Ken Khrone, a radiologist at the University of Washington, Seattle.

FFTF went online in 1980 but was shut down in 1992 because of high operating costs. DOE has since spent about $35 million a year to maintain the reactor in standby mode while exploring possible uses ranging from producing tritium for nuclear weapons to plutonium-powered batteries on deep space probes (*Science*, 4 April 1997, p. 28). Last January, the outgoing Clinton Administration ordered the facility permanently closed, but Abraham stayed the order in April, soon after taking office.

Abraham ultimately rejected two ideas, one from a consortium of companies that wanted to produce and sell medical isotopes, the other to use the facility to research advanced reactor designs. "Both were found to have major drawbacks and present potential DOE liabilities that collectively could exceed $2 billion," concluded DOE's review leader, Robert Card, in a 14 December memo to Abraham. Those costs were too much for a shrinking DOE budget, says Tom Carpenter, who heads the West Coast office of the Government Accountability Project, a public interest law firm that opposed a restart: "The proposal to restart FFTF may have gotten somewhere 10 years ago, but not in this budget climate."



Half-mast. DOE officials flagged uncertain large costs as the main reason for shutting down the reactor.

This same fiscal climate already has chilled other Hanford cleanup operations. Last spring, the Bush Administration requested $430 million less for cleanup activities at Hanford than required under a binding agreement with Washington state and the Environmental Protection Agency, although Congress later restored the funds. With even more money needed next year to begin shutting down the reactor, another round of budget battles seems like a good bet.

–ROBERT F. SERVICE

CREDIT: FFTF