turned on and off over a period of 15 years. Furthermore, Zelen, Lagakos, and coauthor B. J. Wessen wrote that they tested the data for evidence of "recall bias" and found none. Responding to doubts about the effects of Woburn's chemicals at low exposures, they said that because there are no data on this point, it would be foolish to assume the chemicals do not cause cancer.

Had the Woburn trial continued, phase two would have examined the question of cancer causation. Grace intended to argue that there is no evidence that exposure to TCE causes leukemia in humans. However, studies of TCE conducted for the National Cancer Institute and the National Toxicology Program have produced cancer of the liver, kidney, and other organs in laboratory rats and mice, leading the Environmental Protection Agency to label it a "probable carcinogen."

Industry officials counter by citing a review of the literature published in 1985 by Renate Kimbrough of CDC. She found fault with both of these TCE studies. The carcinogen that affects rodents appears to be a metabolite of TCE, Kimbrough said in a telephone interview, and it may be present only when the chemical is ingested at high doses. In her view, it is unclear whether or not the carcinogen is produced at low exposures, and she thinks it may not be produced at all in humans. She added: "As far as I know, there is no evidence in the literature of TCE's effect on the immune system."

Roisman said the attorneys for the Woburn families intended to brush aside the animal data with a new strategy, the same one used against Velsicol in Tennessee. "We approached it like a bus accident," he says. "When your client is hit by a bus, you don't go out and do an epidemiological study to see how many people hit by buses end up with broken legs. . . . You don't go out and check to see what happened in studies of animals hit by buses. You take your client to the doctor and say, 'Tell me what's wrong with this person.' " The doctor's answer provides the medical evidence of injury that justifies the suit, he says. "There's no argument about causation."

One of the leading medical witnesses for the Woburn families would have been David Ozonoff, director of the environmental health division at Boston University's School of Public Health. He coordinated a $60,000 study that compared immune system patterns in the blood of 22 clients with patterns from 47 other people in Boston.

The study found a significant difference in the client population, Ozonoff said. An index used to measure disease-fighting potential, the ratio of T4 to T8 cells, showed that the client population had an odd distribution of values, including an unusually high ratio of T4 to T8 cells for a few people. The tests also discovered antithyroid antibodies in some clients. Functional tests, in which a viral agent is introduced to serum to stimulate an immune response, indicated no difference between the client and the control groups. "What this means, I really don't know," says Ozonoff, except that he is convinced that the clients exhibited an abnormal pattern. The attorneys planned to use this as evidence of permanent injury to their clients' immune systems.

Levin planned to testify for the Woburn families, making just this point. He would have linked leukemia to immune system injury and to TCE in the water. Levin made a similar presentation in Tennessee, where the levels of pollution were higher and the chemicals (carbon tetrachloride, chloroform, chlorobenzene, and eight others) were more clearly dangerous. In this case the judge relied on Levin's testimony to conclude that the company's conduct had caused chemicals to "invade each particular plaintiff's body." Because the chemicals "were of such a nature as to cause the reported symptoms and cellular damage and adverse biological change (however slight), the court considers that this ingestion, inhalation, or contact caused emotional stress in each plaintiff." Specifically, the plaintiffs feared that they would get liver and kidney cancer, and "fear of developing a disease in the future, such as cancer, is an established item of damages."

Levin and Ozonoff may give testimony similar to that planned for Woburn in other lawsuits pending in the West. One mammoth case in Tucson, Arizona, involves 300 people who demand compensation from Hughes Aircraft. They say that TCE leaking from one of its plants has contaminated the city water, causing tumors, heart disease, liver problems, leukemias, birth defects, and nervous disorders.

In the Woburn trial, Grace intended to counter this thrust with testimony from Robert Waldman, dean of the University of Nebraska medical school, and Fred Rosen, an immunologist at the Harvard Medical School and physician at the Boston Childrens Hospital, and others. Rosen said in a telephone interview that Levin's interpretation of immune data is "ridiculous." His deposition in the Woburn case conveyed the same message, but in more circumspect terms.

Ridiculous or not, the theory is taken seriously by chemical companies and their attorneys. For example, the Monsanto Company has set up a lab in St. Louis to screen its agricultural chemicals for immune system effects. Already, one plaintiff's attorney in Missouri sent a tremor through the court when he used the phrase "chemical AIDS" in describing his clients' injury. The *Toxics Law Reporter* observed recently that "the use of evidence of human immune system effects to prove claims of latent injuries, including leukemia, from exposure to common industrial chemicals in ground water" could portend "an explosion" of such cases.

The Woburn suit is closed, but many feel that the issues it raised are far from settled. They will reappear in at least half a dozen other states where chemicals have been found in the ground water.

Meanwhile, Woburn residents may discover that their own problems are not over. A scientific advisory committee to the state department of public health concluded in June 1985—6 years after the tainted wells were shut—that the puzzle was far from solved. Of the water pollution theory, it said: "the panel weighed the evidence and found itself left with uncertainty." The "raised frequency of childhood leukemia in Woburn has not yet disappeared," the experts noted, and they suggested it would be prudent to investigate an equally plausible theory that the outbreak was caused by a virus. ■ ELIOT MARSHALL

Briefing:

Science Agencies Fare Well in Budget Battles

Congressional inaction on the 1987 federal budget has again left many researchers on the edge of their chairs awaiting news of last-minute decisions by the legislative body. At *Science*'s press time, Congress was still trying to reach agreement on a massive $570-billion spending bill for fiscal year 1987, which began 1 October.

While the funding picture remains uncertain for many basic research and applied science programs, the budgets for the National Institutes of Health (NIH) and the National Science Foundation (NSF) appear set. House and Senate negotiators are expected to accept appropriation conference reports on these agencies. A funding plan for the National Aeronautics and Space Administration (NASA) also appears firm.

NIH's budget is slated to be $6.18 billion, almost $1.2 billion more than the Administration originally proposed. NIH officials say somewhat more than 6200 research grants are likely to be funded—a rise from the 6100 supported in 1986, but about the same number as in 1985.

NASA's budget is expected to increase by

$600 million to $8 billion. Funding also is provided for a new space orbiter. The Department of Defense (DOD) is likely to shoulder the $2.96-billion cost. NASA officials, however, worry about having to pay for $265 million in costs for maintaining shuttle-related facilities and personnel. Potentially, programs like the Space Station, Advanced Communications Technology Satellite, the Trans Atmospheric Vehicle (space plane), and smaller science programs could be stalled or cut back.

The National Science Foundation's budget stands at $1622.9 million, less than the $1685.7 million proposed by the Administration. Of the total, $1406.2 million is earmarked for research, an 8% increase over 1986. ■ MARK CRAWFORD

Education Secretary Uses Harvard Podium To Take Host to Task

A speech by Secretary of Education William J. Bennett to Harvard College undergraduates on 10 October kindled sharp controversy even before it was delivered. Bennett used the Harvard rostrum to subject Harvard and other universities to wide-ranging criticism on educational, political, and moral grounds.

Harvard president Derek Bok reacted to a look at an advanced copy of Bennett's text by issuing a tart statement in which he charged Bennett with engaging in "polemics." In an academic equivalent of equal time, Bok also followed Bennett on the Friday program, making a brief rejoinder to the Education Secretary.

Bennett's speech was part of a weeklong program of undergraduate activities planned to celebrate Harvard College's 350th anniversary. Bennett was invited by dean of undergraduates Archie Epps.

Bennett, who earned a Ph.D. in political philosophy from the University of Texas and a law degree from Harvard, has been a combative Secretary of Education, particularly in conducting a highly public campaign for his own agenda of education reform. In his Harvard speech, a major theme was that students "deserve a university's real and sustained attention to their intellectual and moral wellbeing," and American universities, including Harvard, by and large were not fulfilling that obligation. Most colleges and universities fail to provide a good general education, he said. "Under the justification of deferring to individual choices, much is left to chance." He made clear that Harvard's core curriculum fell short of meeting his standards.

Turning to moral issues, Bennett faulted universities for self-righteousness, charging that universities are quick to "proclaim their duty to address all sorts of things that are wrong in the world," but tend to shrug off problems closer to home such as that of drugs on campus.

Bennett hit hard at what he sees as university laxity in fostering essential traditions of the free exchange of ideas on campus, citing growing signs of intolerance, particularly against "right-leaning speakers." And he scored a pervasive liberal bias in academe, observing that "Most of the people in the humanities and social science departments in the universities stand to the left of center."

Bennett expressed impatience with the universities' obsession with money, noting that higher education "refuses to acknowledge the obvious fact that, in general, it is rich." Higher education lobbyists in Washington he described as "very good at getting their funds from a Congress seemingly enraptured by the pieties, pontifications, and poor mouthings of American higher education."

William J. Bennett: *"Pieties, pontifications, and poor mouthing" from higher education.*

In his original riposte Bok said:

"Secretary Bennett's speech raises important questions about the role of universities and the education they offer. Instead of pursuing these questions in an informed and sober manner, however, he has followed his penchant for delivering highly publicized polemics against educational practices which he has not studied in detail and policies with which he happens to disagree. In doing so, he sheds more heat than light and squanders an opportunity to make a lasting contribution to educational reform." ■

JOHN WALSH

Hanford Plant Closed Over Safety Violation

Concern for public safety prompted the Department of Energy to close the plutonium production center at Hanford, Washington, on 8 October. The PUREX and the plutonium finishing plants, which manufacture bomb material for the military, may be out of commission for as long as a month while they undergo a management review.

DOE ordered the plants to shut down after workers violated rules that are meant to prevent fission accidents, including, in the worst scenario, a nuclear explosion.

As DOE spokesman Thomas Bauman explained, the decision to close the plants is meant to be a reprimand to the contractor, Rockwell International, for its inattention to quality control. "I don't want to say that these things have been happening all the time," Bauman said, "but we have had several incidents like this."

The latest violation occurred as Rockwell employees were about to move plutonium nitrate from one process area to another through pipes. Safety standards require that every plumbing connection along the route be "blanked off" by a metal block. This insures that if valves are opened accidentally, the material will not flow to the wrong tank. This precaution is necessary because liquids with a high concentration of plutonium must be stored in special tanks that prevent the buildup of a critical mass of fissioning material.

On 29 September, Rockwell workers came close to sending the plutonium along the pipe before inserting the metal blocks. How close they came has not been revealed. In any case, DOE says, it is unlikely that a criticality accident would have occurred because five closed valves blocked the path to the area where a critical mass might have accumulated.

Earlier this year, according to an aide to Washington Governor Booth Gardner (D), the plant managers made a less alarming but more embarrassing mistake. Just before the governor went on a tour of the Hanford facility, workers removed signs warning of radioactive contamination from a spill. Later, the governor learned that the bus on which he rode passed through a contaminated zone and picked up a small amount of radioactivity.

More recently, the *Seattle Times* published an investigative series describing management problems at Hanford as revealed in confidential reports by Rockwell's lead auditor at the site, Casey Ruud. He found problems in plant design, quality control,