

crepit nuclear weapons complex, would increase from \$5.5 billion to \$6.5 billion.

Emphasizing Clinton's—or perhaps Gore's—"green" views, the big winners at DOE would be solar and other renewable energy sources (up 27% to \$327 million) and biological and environmental research (up 17% to \$416 million). Losers include nuclear energy research, whose current \$345 million budget is to be lopped in half, as well as basic energy sciences, which would fall about 2% from its 1993 figure of \$814 million. In particle and

nuclear physics and in fusion research, the bottom lines show small gains in most instances, but even there the increases go for construction, leaving the core science programs with little more than cost-of-living gains of around 3%. The budget seeks \$20 million to start work on the Tokamak Physics Experiment at the Princeton Plasma Physics Laboratory, \$26 million to begin the Advanced Neutron Source at Oak Ridge National Laboratory and \$36 million to create an asymmetric "B-factory"—an accelerator producing B

mesons—which would go up at either SLAC or Cornell University. Fermilab, which wanted \$100 million to hasten the upgrade of its main injector, may have to settle for the \$25 million in DOE's budget, and the SSC under Clinton's plan would get not the \$860 million called for in the building program but \$640 million and a stretch-out of three years. Worse, the venerable Los Alamos Meson Physics Facility is to be scuppered, with just \$1.5 million allowed for closing it down.

—IRWIN GOODWIN

HAPPER LEAVES DOE UNDER OZONE CLOUD FOR VIOLATING POLITICAL CORRECTNESS

These are turbulent times in Washington for science. Consider the case of William Happer, who was dismissed from his post as director of energy research at the Department of Energy after opposing the prevailing views of Vice President Al Gore Jr and his environmental aides on the harmful effects of ozone depletion and greenhouse gases on the Earth's environment and on human health. Happer's dispute with Gore's people is the first instance of the Clinton Administration enforcing its version of "political correctness" on scientists in its midst. The sacking of Happer, a former Princeton University physics professor with impressive credentials, raises questions about whether the Administration will be able to recruit scientists for sensitive positions when science conflicts with politics.

As a holdover from the Bush Administration, Happer was not expected to stay on in the Clinton Administration. The White House could easily have dumped him in favor of its own choice for top scientist at DOE. Instead, after President Clinton's inauguration, Happer was asked to remain at his post until a successor could be appointed. Energy Secretary Hazel R. O'Leary, a former electric utility lawyer and energy regulator in the Ford and Carter Administrations, as well as John H. Gibbons, the President's science adviser, had received enthusiastic messages about Happer from scientist members of the Clinton transition team, from DOE lab directors and from lawmakers in Congress. They called for Happer to be kept on. O'Leary agreed to hold on to Happer, and so did Gibbons, but Gore and his teammates thought otherwise. As George Brown Jr, the California Democrat who heads the House Committee on Science, Space

and Technology, observed: "Happer marches to a different drummer than Al Gore. Will is a pure scientist. Al Gore is a politician."

Widely regarded as a leading authority on laser spectroscopy and optical pumping of spin-polarized nuclei, Happer was plucked from Princeton by the Bush White House in May 1991 to serve at DOE (PHYSICS TODAY, September 1991, page 65). He was confirmed easily by the Senate in August of that year. Even so, the job was not expected to be easy—and as it turned out, it wasn't. Sidney Drell, deputy director of SLAC, had it exactly right when he forecast that Happer was "stepping into a caldron" at DOE. One of Happer's first assignments was to get the nuclear and particle physics communities to agree on scientific priorities in the face of severe budget restraints. He was distressed to find he couldn't obtain consensus.

Opposing an apocalyptic vision

Signs of Happer's heterodoxy on prevailing environmentalist positions first appeared at a meeting of the Federal Coordinating Council on Science, Engineering and Technology more than a year ago, during the Bush Administration. On that occasion he opposed the apocalyptic vision of an environmentally ravaged Earth, the theme of Gore's best-selling book, *Earth in the Balance: Ecology and the Human Spirit* (Houghton Mifflin, 1992). At the meeting Robert T. Watson, then chief scientist for NASA's Mission to Planet Earth (which uses satellites to study global climate change), delivered a scary account of increases in greenhouse gas emissions that could cause global warming and of exposure to cancer-causing ultraviolet radiation resulting from atmospheric ozone depletion. When Wat-

son spoke of an "ozone hole over Kennebunkport," President Bush's summer retreat, Happer, visibly angry according to eye witnesses, interrupted the discourse, calling the concept rubbish, only using a more colorful epithet.

Happer argued that knowledge of the interactions controlling climate and understanding of abrupt atmospheric perturbations are incomplete and inexact. For starters, he urged FCCSET to endorse setting up a network of instruments to monitor the "discrepancy" between predicted levels of uv-B, normally blocked by stratospheric ozone, and the actual levels of uv-B measured at the Earth's surface. Happer explained that most of the ground measurements of uv-B are now made at airports, where chemical pollutants in the ambient air are apt to upset the readings.

The FCCSET incident quickly became a cause célèbre among Washington environmentalists. The staff of the Senate Subcommittee on Science, Technology and Space, which Gore headed at that time, characterized Happer's doubts about the extent of a greenhouse effect as "the Bush White House effect."

After Clinton's election, Happer continued to press for new and better placed instrumentation to measure uv-B. Among those who reviewed Happer's ideas on this subject was Watson, who is rumored to be in line for a top job at the White House Office of Science and Technology Policy. It also was looked at by Kathleen McGinty, who served as legislative assistant for energy and environmental issues for Gore in his last years in the Senate and is now director of the newly formed White House Office of Environmental Policy, created at Gore's insistence. The response, not

surprisingly under the circumstances, was that Happer's advice was no longer needed.

Happer, for his part, refused to be silenced. At a hearing on 26 April before the House Appropriations subcommittee on energy and water, Happer once more advocated additional instrumentation to measure uv-B. "What little data we have shows very little change [in the amounts of uv-B reaching the ground since the discovery of ozone holes] and, if anything, a slight decrease," he told the subcommittee. Later, in response to questions from panelists, Happer indicated he is at odds with the Vice President's views on global warming and declared that better scientific evidence of the phenomenon is needed before mitigating measures are taken. "As an individual I think there has been an exaggeration of the dangers of ozone depletion and climate change," he said, making a distinction between his opinions and official Administration policies.

Evaluating the uncertainties

Scientists continue to disagree on whether increased levels of CO₂ will be harmful or beneficial, Happer said at the hearing. He referred to climate models by Robert A. Berner, a Yale geophysicist, showing that even in the Mesozoic and early Paleozoic periods, when CO₂ levels were much greater than today's, the Earth was "a reasonable place to live." Arguing from Berner's work, Happer said the geochemical carbon cycle calculated over 570 million years supports the contention that wide variations of CO₂ in the ocean-atmosphere system have been associated with a succession of "greenhouses" and "icehouses" over extremely long time scales.

Happer also sided with those atmospheric scientists who are critical of NASA's planned Earth Observing System, an array of satellites on board orbiting space platforms that might cost as much as \$30 billion to build, launch and operate. EOS would monitor the critical climate variables in the Earth's atmosphere, on its land surface and in its oceans to enable world leaders to make informed decisions on global climate change. The trouble is EOS is still years off, and meanwhile, said Happer, targeted studies of atmospheric change could be made from aircraft, from ships and from the ground. In fact, Happer told the House panel, DOE is already engaged in a "major initiative" to improve the scientific understanding of climate change. His offhand remark was hardly a throwaway line. In effect, Happer

had announced a turf war among several agencies over the topic.

Such statements simply emphasized that Happer was on his way out and he was not leaving quietly. In an interview, he said, "It seems to be an act of treason to propose that there is a great deal of interesting and useful research that needs to be done on the origin, extent and effect of greenhouse gases." Before leaving DOE at the end of May, Happer discussed some of his views about his 22 months in government service. Relaxed in a leather armchair at a corner of his bare-walled office on the seventh floor of the Forrestal Building in Washing-



Happer: 'A hard act to follow.'

ton, Happer spoke with candor and some courage. Those who know Happer well say he possesses little guile and even less patience.

He said he would have preferred to remain on the job a while longer, in part to shepherd the Superconducting Super Collider through this year's budget process. He is "very worried," he stated, about the prospects for the SSC in Congress. Not only is the SSC good science, he asserted, but the machine needs to be completed because the US needs to "follow through on its commitments. We made a bargain with our own citizens in Texas, with taxpayers in the rest of the country and with the world's particle physicists. If the Federal government were to back out now, I would not be able to hold up my head. This feckless, on-again-off-again behavior of the government is something I neither like nor understand. . . . As an American, one who isn't a high-energy physicist, I'm confident we can build it ourselves, without foreign assistance, if we had the will. . . . If the SSC goes down this

year, it will pull down other physics facilities under construction or under consideration—the Relativistic Heavy Ion Collider [at Brookhaven], the Advanced Neutron Source [planned for Oak Ridge] and the B-factory. If the SSC falls, the rest will go, like so many dominoes."

Happer expressed concern about DOE's ability to "manage its mortgages" on all of its new and proposed physics facilities. He said construction of the \$2.7 billion ANS at Oak Ridge should have been delayed a year or two. He also questioned the inclusion in the fiscal 1994 budget request of an asymmetric B-factory, a colliding-beam accelerator that would produce B mesons. SLAC and Cornell University have spent two years competing to build it. A scientific committee selected jointly by DOE and the National Science Foundation, and operating under the chairmanship of Stanley Kowalski of MIT's Bates Laboratory, is meeting this month to evaluate the technical merits of each design; it expects to have its report finished by 15 July so that Congress will be able to decide whether to fund R&D for the facility in this budget cycle. The winner's prize is \$36 million, which is already requested in DOE's budget for 1994.

Vulnerability of basic research

While budgets for major facilities are precarious enough, Happer considers basic research even more "vulnerable." In light of recent expressions in Congress about shifting more R&D funding into so-called strategic research and into generic technologies and manufacturing processes, said Happer, he has become increasingly concerned about support for basic science. "I got into a lot of trouble when I called for academic birth control," Happer observed. "The number of people doubled in condensed matter during the decade of the 1980s and people in it wondered why they faced hardship getting their proposals funded. Research scientists were not being singled out for pain. We tend to think that PhDs are entitled to support by government. That argument is self-centered and self-defeating. Is it any wonder that many of those in Congress think of us as arrogant? We need to rid ourselves of hubris."

Happer then lit out against "people in Washington who think they know everything about technology policy" and argued that "all you have to do is hold off basic research while the money goes to applied research and to work that's closer to the market." He became angry, he said, at a recent

meeting of O'Leary's principal aides to discuss the "values" of DOE. They omitted listing science research and education. "I proposed adding 'science' to the list and, after a brief dialogue, the word was placed at the bottom and a question mark was drawn behind it," Happer noted. "Then I suggested 'education,' and a little later it was added and the word 'training' was written alongside education, again followed by a question mark. I hope this does not represent a new approach to the department's traditional priorities. I tried to convey that tradition by informing the people around the room that DOE and its predecessor agencies had contributed to the research of about 60 Nobel Prize winners."

Happer also was involved in the dispute that broke out in the Administration in April over efforts by Vice President Gore to persuade the President to fulfill the commitment to freezing US levels of CO₂ emissions at 1990 levels by the end of the decade—the year that had been proposed by the European Community for limiting CO₂. Gore argued that the commitment, promised by Clinton during the 1992 election campaign, would send an unmistakable message to the world that the new Administra-

tion is making a clean break with the Bush Administration's position of refusing to sign the international biodiversity treaty at Rio de Janeiro last summer. Gore's proposal met with resistance from several Cabinet members, principally Treasury Secretary Lloyd Bentsen and DOE's O'Leary. After discussions, O'Leary contended that the Administration had not studied how limiting CO₂ emissions would affect America's energy usage and its industrial economy. In the end, Gore prevailed and Clinton announced on 22 April, Earth Day, that the US would lower emissions of greenhouse gases to 1990 levels by the year 2000—though the details and the regulations or incentives were still to be worked out.

Gore's position, as explained by an aide, is that not joining with the 160 nations that endorsed the Rio agreement would give the impression that scientists still harbored doubts about the threats of global climate change. "Let's be clear that the decision is political, not scientific," said Happer.

Happer's friends admire his courage and say his experience is a cautionary tale for scientists in government. As SLAC's Drell sees it, "Will is going to be a hard act to follow."

—IRWIN GOODWIN

ASPIN SHOTS DOWN 'STAR WARS' FOR DOWN-TO-EARTH DEFENSES

If the Clinton Administration has its way, "Star Wars" will be remembered only as a series of movies. On 13 May, Defense Secretary Les Aspin declared "the end of the Star Wars era" and changed the name and direction of the Strategic Defense Initiative, the missile-defense program that President Reagan launched at the end of a televised talk to the nation in March 1983. In fact, Reagan's action had simply repackaged an existing Defense Department program that was running at about \$1 billion per year.

Over the next ten years the US managed to spend some \$32 billion on SDI. With that amount of money it was not surprising that scientists and engineers at the defense labs and at industrial firms came up with such far-out ideas as hypervelocity rockets, particle beams and nuclear-driven x-ray lasers that someday would wage a titanic battle somewhere between heaven and Earth.

Reagan's program didn't achieve his intended goal of "rendering nuclear weapons impotent and obsolete"

and, to be sure, hasn't succeeded in deploying a single weapons system. But it did go some way toward destroying the Soviet system. Alexander Bessmertnykh, the former Soviet foreign minister, said as much during a conference at Princeton last February. The masters of the Kremlin decided that SDI was "something very dangerous" to their military and economic authority, he asserted. Indeed, Bessmertnykh stated, the effort to develop an all-Soviet SDI, along with the Chernobyl reactor explosion in 1986, hastened the beginning of the USSR's end.

The idea of shooting down ICBMs with space-based lasers and projectiles launched from satellites or platforms met with profound skepticism among many in the scientific community in both countries. The American Physical Society's report on directed-energy weapons, issued in April 1987 by a 14-member committee headed by Nicolaas Bloembergen of Harvard and C. Kumar N. Patel, then with AT&T Bell Labs, found SDI technologies orders of magnitude short of

maturity (see *PHYSICS TODAY*, May 1987, page S1). In the Soviet Union, Evgenii Velikhov and Andrei Sakharov, among others, were publicly critical of the concept.

After reviewing the program during his first four months in the Pentagon, Aspin told reporters he had concluded that the US is still decades away from developing and deploying a space-based defense against missile attacks. The program will now revert to its pre-SDI name of Ballistic Missile Defense and seek to improve ground-based systems such as the Patriot missile, which was used in the Persian Gulf War to protect troops against short-range missiles like the Soviet-built Scud.

Whacking at the budget

Notwithstanding the change, the program's \$3.8 billion budget request for fiscal 1994 would remain unchanged, said Aspin at his news conference, but future budgets would be downsized to reflect the new course correction. Even so, Aspin has informed some members of Congress that he is willing to accept modest budget cuts sooner so long as R&D is allowed to continue. It is virtually certain that attempts will be made in Congress this summer to whack at least \$1 billion from the program in the quest to cut Pentagon costs and limit the deficit. Scaling back the program, under any name, is bound to cause pain in the defense industries, particularly those located in California, where the state's finance commission estimates that local firms have about one-third of SDI's contracts. Among those most likely to be hard hit are Rockwell International and TRW Space and Electronics Group, which together received contracts totaling \$1 billion last year to develop "Brilliant Eyes," a network of missile-tracking satellites devised by scientists at Lawrence Livermore.

Jobs may be the most potent reason for maintaining the program at any level. Jim Sasser, a Tennessee Democrat who heads the Senate budget committee, has argued for years against SDI's precipitous growth, which, until recent years, has been faster than that of anything else in the budget—"faster than Medicare, Medicaid and even interest on the Federal debt." If the redirection and reduction are seriously carried out, says John Steinbrunner, a defense analyst at the Brookings Institution, "it will help demystify the program. SDI was as much an ideological cause as it was an R&D enterprise to develop a weapons system."

—IRWIN GOODWIN ■