

evolution," Massey writes. To help develop a wide consensus on the changes, the science board, meeting the same day that Massey distributed his memo, unanimously passed a resolution creating a commission of 15 people "whose wisdom, knowledge and abilities can promote an objective examination of NSF's role in contributing to major national objectives, such as research excellence, economic growth, international competitiveness, industrial productivity and quality of life." The board's chairman, James Duderstadt, president of the University of Michigan, has said that the commission members will be appointed as soon as possible and that the panel will hold three public meetings where scientists, educators, industrialists and others can offer their views on where NSF should head.

Though the board now backs Massey's concept for the agency, some of its members were not so enthusiastic about it when they saw an earlier version in June. According to the provisional minutes of the closed session of the June board meeting, Massey's plan provoked "a lengthy, spirited discussion concerning the role of basic research. Several members stated the importance of emphasizing NSF's primary mission to support basic research within the strategic vision." In some respects the board's discussion was a milder version of the acrimonious debate over the strategic plan that Bernadine Healy is advancing as director of the National Institutes of Health to chart the future course of her agency. Healy's plan has alarmed many medical researchers, who argue that it gives NIH too much discretion in defining priorities and places too much emphasis on the commercial exploitation of their work. Some scientists complain that Healy is attempting to initiate a national industrial policy. Healy and her sup-

porters use the same rationale that Bloch made at NSF: If scientists and the agency do not set clear priorities, Congress and others who do not know or understand the problems will do it for them (see *PHYSICS TODAY*, August 1990, page 57).

A troubling budget

It is ironic that NSF is seriously considering ways to widen its horizon at a time when its budget is unlikely to keep pace with inflation. The House version of NSF's appropriation bill for fiscal 1993 would hold spending for research at this year's level of \$1.88 billion. The Senate version, which has been approved by the appropriations committee and is awaiting action by the whole body, would actually cut that figure by \$20 million—some \$352 million below the Administration's request for 1993. Massey is resigned to a flat budget and admits to his staff that he expects cries of anguish from academic scientists when the agency is forced to reduce or eliminate grants.

Massey's immediate options are limited not only by budget pressures. The Senate appropriations committee has given him some prescriptive directives about running the agency. These often read like Massey's own memo. "While recognizing the role the foundation has played in establishing US leadership in basic research over the past 40 years, the committee believes that the new world order requires the foundation to take a more activist role in transferring the results of basic research from the academic community into the marketplace," the report declares. "This role should include: opening up applied research programs to greater participation by nonacademic personnel; making education programs better prepare future scientists and engineers for the needs of industry; and building day-to-day working relationships with other Federal agen-

cies whose missions require cutting-edge technology." The appropriations committee directs NSF to revise its strategic plan accordingly by addressing the new role and to provide Congress with a budget that would enable the agency to achieve such ends. The committee also wants NSF to establish a formal working relationship with the National Institute of Standards and Technology in such fields as manufacturing, materials and engineering research. The report also calls on the agency to establish new centers for manufacturing processes, environmental technologies and advanced materials.

The Senate report bears the imprint of Barbara Mikulski, a feisty Democrat from Maryland, who heads the subcommittee with jurisdiction over NSF, as well as NASA, the Office of Science and Technology Policy, the Veterans Administration and several other agencies. Massey claims he had no warning that the committee would want to micromanage the foundation, and he has requested a meeting with Senator Mikulski. Though reports by committees of Congress do not carry the binding force of bills that become the law of the land when signed by the President, they are forceful messages to Federal agencies.

In an appendix to Vannevar Bush's report, a committee headed by Isaiah Bowman, president of Johns Hopkins University, provided a vigorous defense of basic research: "... it is important to emphasize that there is a perverse law governing research. Under the pressure for immediate results, and unless deliberate policies are set up to guard against this, *applied research invariably drives out pure*. The moral is clear: It is pure research which derives and requires special protection and specially assured support."

—IRWIN GOODWIN

GOOD NEWS FOR THE SSC AS SENATE APPROVES FUNDS AND MAGNETS WORK

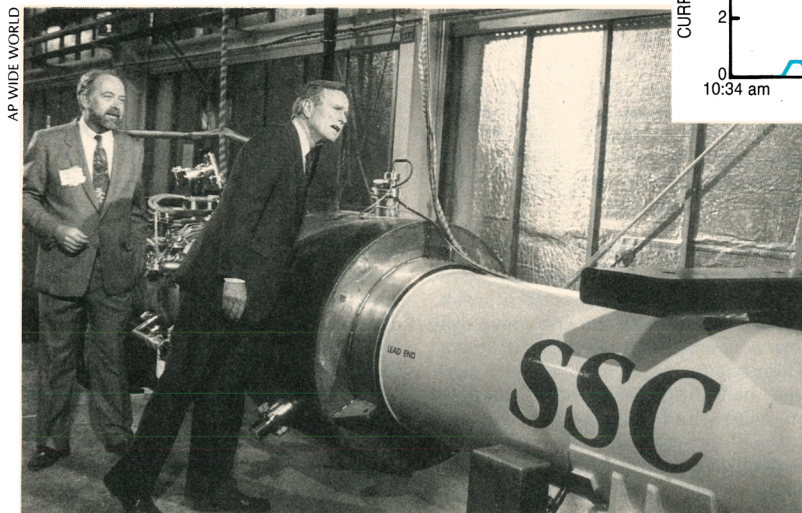
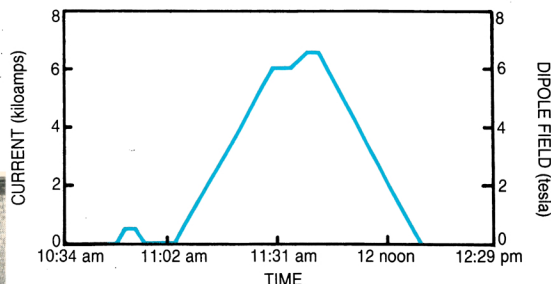
Fears that the House had dealt the Superconducting Super Collider a fatal blow last June were quelled on 3 August when the Senate decided to keep the project alive another year. After three and a half hours of debate on an amendment introduced by Dale Bumpers, a combative Arkansas Democrat, to eliminate all funds for the SSC from the 1993 Energy and Water Development Act, the Senate voted 62 to 32 against the motion. The margin was somewhat wider than the

62 to 37 tally on a similar effort by Bumpers to scuttle the project a year ago. The Senate vote knocked topsyturvy the 232 to 181 decision in the House on 17 June to bury the SSC before construction begins on an oval tunnel 54 miles in circumference around the gingerbread town of Waxahachie, Texas.

In passing the energy and water bill, the Senate agreed to provide \$550 million for the SSC. While that is \$100 million less than the Bush Ad-

ministration requested for fiscal 1993—which begins on 1 October—it ensures that the SSC proceeds. Even so, the question that now awaits an answer by a conference committee of House and Senate members is not whether the project will receive any money next year, but how much. Congressional staffers say that because the conference committee will be made up mostly of members of the appropriations subcommittees with jurisdiction over energy research in

Boosting the SSC, President Bush toured the magnet test building in Texas on 30 July, accompanied by the lab's director, Roy Schwitters. Two weeks later a string test of 5 dipole magnets plus a quadrupole proved a great success. The graph at right shows the current ramp up during the test to 6250 amps, producing the 6.6-T dipole field at which the SSC will run.



each chamber, the project is virtually certain to gain support. Senator J. Bennett Johnston, the Louisiana Democrat who heads the Senate Appropriations subcommittee for energy research programs and who is the floor manager of the SSC debate, argues that \$550 million is the "minimum figure necessary" in fiscal 1993 to keep the project on schedule for completion in 1999. Roy F. Schwitters, the director of the SSC Lab, figures that anything less will cause construction delays that may cost as much as \$1 million per day. In the meantime Schwitters faces more immediate expense problems: Contracts totalling \$640 million are being negotiated for work to be done in 1993.

House opposition to the Brodwingian \$8.25 billion accelerator was attributed to frustration over the increasing budget deficit and to retaliation against members of the Texas delegation who refused to support funding for riot-wracked Los Angeles. The action stunned high-energy physics communities everywhere. Protests were sent to House members even from CERN, which seeks to build the Large Hadron Collider in competition with the SSC.

Not all scientists, not even all physicists, favor the project. The critics argue that it will have limited technological benefits and that its high cost will reduce the funds available for other research programs in the Energy Department. The scientific

collision over the SSC was aired publicly in a televised match between Schwitters and Rustum Roy, a feisty materials scientist at Pennsylvania State University, on the MacNeil-Lehrer NewsHour over PBS on 30 July. During the broadcast Roy caricatured the SSC as little more than "one little curlicue on the end of a baroque piece of science." He claimed further that it is essentially a public works project funded by a Congress "befuddled by hyper language and a lot of exaggerations about benefits." Senator Johnston, another guest on the program, looked annoyed by Roy's remark, and Senator Bumpers, also on the show, pointed out in all fairness that one of the SSC's most ardent champions, Leon Lederman of Fermilab and the Illinois Institute of Technology, had laid the accusation to rest at a Senate hearing on 1 July. "Spin-offs would be a crazy reason for building the Super Collider," Bumpers quoted Lederman as saying. "We do not build it for spinoffs. We build it because we are curious."

A defining description

On the day of the MacNeil-Lehrer show, President Bush visited the Waxahachie site and delivered a most original, arresting and droll characterization of the project. "The Super Collider is... a big part of our investment in America's future," he told a crowd of laboratory scientists and staff. "And when you talk basic

research, this is the Louvre, the Pyramids, Niagara Falls all rolled into one. And where once we reached for the moon above to explore new frontiers of our universe, soon we'll begin to tunnel below to learn about the fundamental questions of science: how our universe began."

During the Senate debate in August, Johnston had cited letters and statements by physicists, including one signed by nearly 2100 scientists (see PHYSICS TODAY, August, page 59), as proof that "the American scientific community is a very strong and cohesive supporter" of the SSC. Even without economic benefits, said Johnston, the SSC is surely worth the price if only to tell us "what are the elementary forces... Why did we go to the Moon at much greater cost? Well, I guess to find out essentially whether it was made of green cheese. But almost nobody says it was not worth it."

Bumpers had argued that dropping the SSC from next year's DOE appropriation would help reduce the estimated \$400 billion budget deficit. In response, Lloyd Bentsen, an influential Texas Democrat who heads the Senate budget committee, calmly observed that the cost of the project would not make "a perceptible dent in deficit reduction," because it represents only 3.5% of Federal budget expenditures for general science. Johnston, who like Bentsen has been in the Senate for 20 years, noted that obtaining the knowledge and understanding of nature's forces "has to be worth 6/10ths of 1% of the R&D budget [or] 43/1000ths of this year's [total Federal] budget."

Still, a few senators preferred to defend the SSC on the basis of so-called spinoffs. For instance, David Boren, a Democrat of Oklahoma, asserted that the SSC "will revolutionize the computer industry [and] the medical community and transform our industrial and technological base. Economic opportunities never anticipated will arise, scientific advancements never predicted will proceed and educational worlds never explored will emerge. Even if the original scientific goals are not completely

met, the knowledge gained will completely change our lives."

"The truth is," Representative Newt Gingrich of Georgia, the Republican whip, had declared during a boisterous debate in the House last June, "I don't think there is a single person in this body who has the scientific background to know for sure whether this is the greatest investment ever or the worst investment." A similarly disarming remark came from Senator Phil Gramm, the Texas Republican who is among the SSC's strongest defenders. "I doubt if there is a member of the Senate who really understands to any degree what the SSC is about." Having said that, he trudged into more familiar territory. As a former economics professor at Texas A&M University, he claimed that between 20% and 30% of the US gross national product comes from high-energy physics. "Everything from the computer to television has come as a result of high-energy physics undertaken in this country," Gramm said.

On 14 August friends of the SSC gained confidence in the project when the long-awaited "string test" of a complete half cell of the main ring met the criteria set nearly three years before by the project's design group. The half cell, often called "the basic building block of the collider," consists of five full-length dipole beam-bending magnets and one quadrupole, each jacketed in a cryostat, along with associated components. The 15-meter

dipoles were built at Fermilab by engineers and technicians of General Dynamics. The quadrupole was built at the Lawrence Berkeley Lab and tested at 4.35 kelvin at Brookhaven.

While SSC officials had hoped to start the string test in June, it was delayed for more than a month to complete the test building and to run diagnostic procedures on the magnets. Schwitters had planned more than a year ago to complete the test by September, before the start of fiscal 1993, when the schedule calls for the magnets to begin to be manufactured in quantity.

A celebratory event

By early July, all was ready. The cooling to 4.35 kelvin took a week, during which time the cryogenic system was carefully checked for leaks. Then began weeks of low-power testing, including deliberately induced quenches and checks for thermal quench propagation through each magnet at currents of 2000 amps and above. The critical test took place on 14 August. Some 50 scientists and Energy Department officials jammed into the control trailer outside the test building to watch the event. As the current in the bending magnets ramped up, tensions increased apace in parallel in the trailer. Cheers went up when the current reached full power at 6520 amps, corresponding to the SSC's intended operating field intensity of 6.6 tesla, and was held at that level for a few minutes shortly

before noon CDT before it was lowered to zero. A bottle of California champagne was popped to celebrate the occasion.

"The results showed that the magnets and other subsystems can work together," said an enthusiastic Theodore Kozman, an associate director of the lab and head of the accelerator systems division there. Most important, there had been no quenches during the test.

Early next year the lab will conduct another string test—this time of a full cell, consisting of ten dipoles and two quads. When the machine is completed, each of the two main rings will have 43 cells in each sector; each ring is designed for ten sectors. The 8600 dipoles will be built by either General Dynamics in Hammond, Louisiana, or by Westinghouse Electric in Round Rock, Texas, the two firms that are competing for the magnet contract. Because the test magnets were among the early prototypes of the final design, each one cost slightly more than \$250 000. Once the magnets are industrially fabricated in quantity, the economy of scale should bring the sticker price down to about \$150 000 each. While Schwitters points to the magnet test as a sign to doubters that the machine will work as advertised, he also expects that Congress will continue to keep a careful watch on its progress and its costs.

—IRWIN GOODWIN
with additional reporting by
Bertram Schwarzschild

EXODUS OF FIVE OMB SCIENCE STAFFERS LEAVES GAPS IN KEY SCIENCE POLICIES

Five departures from the science research branches of the White House Office of Management and Budget have depleted the agency's ranks of technically trained staffers even as the fiscal 1993 budgets for the science agencies are critically debated in Congress. The absence of these people leaves gaping holes in the White House science policy apparatus when it comes to knowing the background and understanding the costs, risks and benefits of many programs supported by the budgets of NASA, the Department of Energy and the National Science Foundation. The flight of this flock has stimulated a flurry of rumors about their reasons for resigning. Speculations range from increased frustration with the dismal outlook for science funding to a serious rift with the agency's leaders over the way science budgets are parceled

out as well as to anxieties about the political discord among the White House, Congress and sections of the scientific community over such prize projects as Space Station Freedom and the Superconducting Super Collider. OMB's "gang of five" deny any internal conspiracy or impending crisis. Still, their departures are bound to have some serious ramifications for science agencies, for national labs and for academic scientists.

Joseph S. Hezir, deputy associate director for energy and science, was a 17-year veteran of the agency. He has joined the EOP Group in Washington as managing partner. EOP is a small consulting organization that advises clients on environmental, natural resources, energy and technology issues and on business opportunities created by government actions. The firm boasts of having four other former

OMB officials: two who left the agency before Hezir did and two who departed with Hezir. This group includes David Gibbons, who had spent 20 years there, the last few as deputy associate director for natural resources. At OMB Gibbons oversaw programs of several agencies with environmental missions, including the Environmental Protection Agency, the Department of Agriculture and the Department of the Interior. White House officials are dismayed about EOP because those associated with it appear to be cashing in on their inside knowledge and connections. Though Hezir insists that the letters in the firm's name have no real meaning, OMB staffers gossip that the initials stand for Executive Office Partners, a title suggesting a direct line to the White House.

With a bachelor's degree in chemi-