vited applicants to apply by fall for awards of up to $750,000 per year to test new methods, and DOE is also getting ready to take a big leap into sequencing.

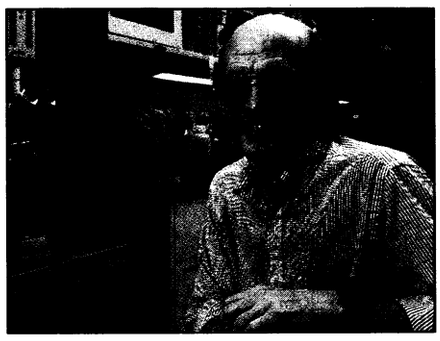
Indeed, that's why DOE called the meeting last month in Santa Fe. The agency wanted to bring together experts from DOE centers and other sites to talk about technical options for skimming through the genome and snatching useful data inexpensively ("low-pass" sequencing). Even though DOE funds may be cut, says David Smith, director of DOE's Health Effects and Life Science Research Division, the outfit that runs DOE's genome work, the agency is "going to be transferring a higher percentage of whatever resources we have" into sequencing. Smith says he hoped people at the Santa Fe meeting would arrive at a consensus about the relative value of low-pass versus more precise techniques, but they didn't. "There's a big range of opinions" about which methods are worth trying, Smith says, and he's mulling them over right now.

At one extreme, according to Santa Fe attendees, are proposals for very low-precision methods, such as that offered by Richard Gibbs of Baylor College of Medicine in Houston. Gibbs is in favor of skimming generich areas as long as it's merely a "down payment" that leads to complete data. "It's perfectly legitimate, I think, to survey a region, and if you don't like it, move on," he says, but "you must always justify your activity by showing you can go back and finish the job." Others, like Roe, would like to dissect the genome in detail because, he says, "it turns out that the difference between you and me" comes down to variations in single base pairs.

Moyzis, director of DOE's genome center at the Los Alamos National Laboratory, also advocates a low-pass approach. His scheme involves what he calls "sampling," in which patches of chromosomal DNA at regular intervals along the genome are sequenced with some redundancy, oriented, and linked with other patches, giving intermittently high precision over a large territory. This approach, he says, would "democratize" genetic studies by quickly giving researchers a complete picture of the genome with information on most genes and biologically "hot" zones. It will also feed directly into another ambitious DOE project at Lawrence Berkeley Laboratory (LBL), which is led by Palazzolo.

In the past, LBL has focused on sequencing the fruit fly genome and small stretches of human chromosome 5. Palazzolo says resources are now being redirected from chromosome 5 to 16, so that a team can start sequencing well-ordered clones delivered from Moyzis's group at Los Alamos. Unlike the Sulston-Waterston-Roe team, which plans to use random sampling and redundant sequencing, the Palazzolo-Moyzis team plans a "directed" strategy, with as little redundant sequencing as possible. Palazzolo thinks the costs for both methods are comparable, but claims that the DOE approach can easily be "tuned" to yield a precision of 99.95% or better.

Many alternatives were discussed at Cold Spring Harbor as well; no consensus emerged there, either. But there is a movement to compromise, even among sticklers for precision, such as Roe. While he prefers achieving a 99.99% level of precision, Roe concedes that would be "very expensive," and it's not clear "we can afford the Cadillac of genome sequencing." On the other hand, he regards anything less than 99% precision as "a dead end," because the data would be riddled with gaps. But Roe is willing to settle for 99.9%. Having secured that objective, he says he "shook hands" with Sulston and Waterston at Cold Spring Harbor and will join them in sequencing chromosome 22. "We're already doing it," says Roe, who says he has sequenced about 1 million bases.



TOM HEINE/WASHINGTON UNIV. SCHOOL OF MED.

Price chopper. Robert Waterson aims to sequence human DNA for 10 cents per base.

While the genome community may not agree on which method is best, they have reached consensus on one thing: It would be useful to get more data. "We're scientists," says Venter. Rather than engage in "religious" speculation, "I believe strongly in doing the experiment and letting the data tell you where to go." The data-gathering is now under way.

With so much at stake, scientists are elated and apprehensive about where these sequencing experiments will lead. Roe says, "We're on the verge of something very exciting" that will "set the tone of health care for the next century." But "our reputation hinges on this," and "we have to walk carefully and understand how to do it right."

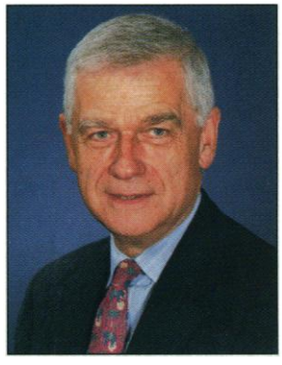
–Eliot Marshall

BUDGET RESOLUTION

Senate Restores NIH Funding Cut

Biomedical researchers won a significant victory last week as the Senate rescinded a proposed 10% cut in funding for the National Institutes of Health (NIH). Although this will be good news for some, not all researchers have reason to celebrate: NIH's good fortune may come at the expense of the rest of the domestic budget, including other science programs.

Senator Mark Hatfield (R–OR) led the effort to restore funding to NIH. His success was impressive: His amendment was the only significant change in the budget resolution accepted by the Senate, and it passed by a large margin (85 to 14). The vote returns $7 billion of the $7.9 billion that a draft resolution had removed from NIH's budget over the next 7 years, also adding back money for education, Medicare, Social Security, defense, and foreign aid (*Science*, 26 May, p. 1120). But most nondefense discretionary accounts would be "taxed" to pay for the adjustment, including general science and space (down $700 million over 7 years), energy (down $100 million), natural resources (down $700 million), agriculture (down $400 million), and transportation (down $1.3 billion).



Paper victory. Hatfield helps restore NIH funding—but it's only round 1.

On the Senate floor, Hatfield described this solution as "robbing Peter to pay Paul," adding that it was "the only way I could find to salvage and save NIH." He said his first choice, taxing defense and international programs to pay for health, appeared to have the support of only about 20 members, forcing him to adopt a formula that appealed to advocates of military funding.

The House and Senate must now reconcile differences in their budget resolutions, which are not binding on appropriators. With regard to NIH, the House budget plan calls for a 5% cut next year and a 6-year freeze; the Senate version now calls for a cut of roughly 1% a year.

The vote was applauded by a coalition that had mounted a fierce lobbying campaign on its behalf. "Sanity prevails. ... I couldn't be more pleased," said Sam Silverstein, president of the Federation of American Societies for Experimental Biology (FASEB). He sent FASEB members a memo lauding Hatfield and praising the membership for the "outpouring of faxes, phone calls, and other contacts."

NIH Director Harold Varmus, who called the original Senate plan "a prescription

for disaster," saw the amendment as "a very significant moment" for NIH and the Department of Health and Human Services. He was "impressed" by the strong show of support not just from longtime friends of NIH but also from senior Republicans such as Alphonse D'Amato (R–NY), Connie Mack (R–FL), and Arlen Specter (R–PA). Even so, Varmus warned researchers that "we still need to keep our guard up. The scientific community needs to be aware that we're quite early in the [budget] process. ... It's not going to be fat city for biomedical research."

As an example of how tough times have become, Varmus said that NIH may have to consider reducing the 3% to 4% annual increase that is standard on continuing NIH grants. "Our ability to fund new grants is going to be determined most dramatically not by the intramural program but by the extent to which we ... [adjust] payments to holders of multiyear grants," Varmus said.

Last week, in a lecture to the Massachusetts Medical Society, Varmus reinforced that message by urging biomedical scientists to recognize how much has changed in the last few years. "The research enterprise is making a painful transition from an era of growth to an era of steady-state activity," he said. Despite Hatfield's victory, Congress's drive to cut the budget suggests that even this sober assessment may be optimistic.

–Eliot Marshall

GEOSCIENCE

Republicans Take Ax to NOAA Research

A group of Republican lawmakers surprised the Clinton Administration last week with a proposal to dismember the National Oceanic and Atmospheric Administration (NOAA) as part of eliminating the Commerce Department. The plan was much more radical than NOAA officials were expecting, and they warned that it would disrupt weather forecasting and curtail research on topics ranging from volcano plumes to the ocean depths.

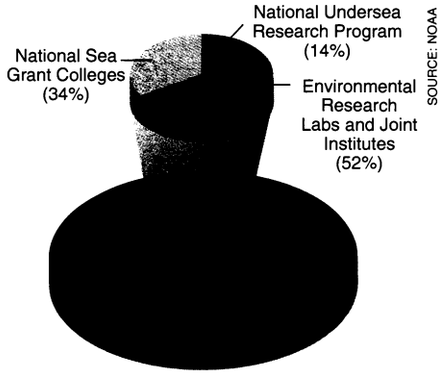
Advocates of the plan, led by freshman Representative Dick Chrysler (R–MI), believe that NOAA does applied research that should not be funded by the federal government. They want to halt NOAA's coastal and water pollution studies, dispose of the agency's fleet of research vessels, and terminate the office responsible for a range of oceanic and atmospheric research. The National Weather Service and NOAA's constellation of weather satellites would be transferred to the Interior Department; portions of that service would be turned over to the private sector. The plan would also sell off NOAA's 11 environmental research labs.

The radical reshuffling, incorporated into a bill slated to be introduced next week in the House, has won the endorsement of some influential Republicans. "The Commerce Department is history—put a fork in it," said Budget Committee Chair John Kasich (R–OH), who attended a press conference to unveil the plan. And Senate Majority Leader Bob Dole (R–KS) also added his blessing, calling Commerce "the basement of the federal bureaucracy."

NOAA officials were caught off guard by the details in the bill. They had thought the GOP plan would simply shift most of the functions of the agency—whose $2 billion budget represents 40% of the Commerce Department—to the Interior Department rather than dismantle them. "This jeopardizes our ability to perform our basic functions," Doug Hall, Commerce assistant secretary for oceans and atmosphere, told *Science*. "It would decimate atmospheric research in this country as well as our satellite network."

Scientists who benefit from NOAA largess agree. "This will hurt a lot of individuals and a lot of schools," says Christopher Harrison, a University of Miami geophysicist and general secretary of the American Geophysical Union. He also disputes Republican claims that NOAA's research duplicates efforts by other federal agencies.

Chrysler's bill is one of a series that fleshes out proposals to abolish particular agencies. Before it becomes law, however, it must pass the authorization and appropriations panels that set policy and distribute money. "Many of NOAA's functions are strongly supported by the chairman, and any move to dismantle these would likely face strong opposition," said Steve Hanson, a spokesperson for the House Resources Committee chaired by Representative Don Young (R–AK), which oversees ocean and fisheries policy.



How NOAA Spends Its Money

- Oceanic and Atmospheric Research
- National Marine Fisheries Service
- National Ocean Service
- National Environmental Satellite, Data and Information Service
- National Weather Service
- Other Accounts
- Program Support

Disappearing act. GOP proposal would wipe out NOAA's oceanic and atmospheric research.

Indeed, NOAA officials are banking on a rift between Republicans to save their turf. "About 70% of the fishing industry is in Alaska," says Hall. "And some of the most severe weather is there too." He counts the two Alaskan senators and Senator Mark Hatfield (R–OR), chair of the powerful Senate Appropriations Committee, among NOAA's allies. They are also anticipating support from those who know NOAA best. The Republican co-sponsors "by and large are not really familiar" with the research NOAA conducts, says Ned Ostenso, NOAA assistant administrator for oceanic and atmospheric research. A Republican staffer sympathetic to NOAA agrees. "We'll get our shot at this," he says. "Why get into a frenzy over this now?"

For Ostenso, however, this is more than an academic exercise: His office would be eliminated under the Republican plan. Its annual budget of $132 million operates 11 environmental research laboratories, funds eight joint institutes and 29 Sea Grant College Program institutions, and supports an undersea research program at five universities. Woods Hole Oceanographic Institution in Massachusetts, for example, gets $1 million a year for a Sea Grant program that carries out both fundamental research and community outreach. "It would be hard to find other funding sources, particularly for outreach," says Judy McDowell, project director.

NOAA officials are skeptical that the private sector would be interested in taking over the environmental labs. "I haven't had any calls from anyone today wanting to buy them," says Hall. The bill would also require the agency to:

- Halt the modernization of NOAA's fleet and dispose of all its assets;
- Transfer nautical and charting functions to the Defense Mapping Agency or privatize those functions; and
- Terminate specialized agricultural, marine radiofax, and forestry weather services, as well as the regional climate centers run by the National Weather Service.

Hall is particularly worried about the fate of the NOAA satellites that monitor the Earth continuously. Coincidentally, the latest geostationary weather spacecraft was successfully launched the same day the Republicans unveiled their plan. The cuts, Hall said, would force NOAA to abandon some of those expensive satellites to save money.

–Andrew Lawler