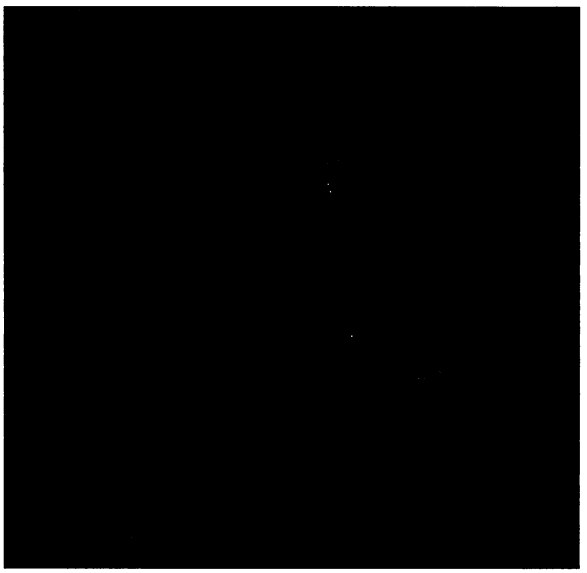

Hat trick. DOE sequencers score with rough drafts of chromosomes 5 (red), 16 (green), and 19 (yellow).

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three times each, contain 300 million bases and an estimated 12,000 genes, Richardson reported at the R&D Colloquium, a meeting in Washington, D.C., sponsored by the American Association for the Advancement of Science (*Science*'s publisher). "I'm very proud," Richardson said, noting that some of the genes are involved in diabetes, cancer, and other important diseases. "We're close to completing three chapters on the book of human life."

Those "chapters" are still in draft form, however, containing up to one mistake in every 100 bases and only about 90% of the gene-containing DNA in each chromosome. In contrast, chromosome 22 is 99.99% accurate (*Science*, 24 September 1999, p. 2038). Next in line for completion is chromosome 21, which the public consortium expects to have in final form in a few weeks. Meanwhile, JGI labs at Stanford University and the Los Alamos National Laboratory in New Mexico plan to produce a fully finished version of chromosome 19 by the end of 2000; they hope to complete chromosomes 5 and 16 a year later, says JGI sequencing chief Trevor Hawkins, in Walnut Creek, California. In addition, Hawkins says, JGI is working on stretches of DNA from the mouse that are equivalent to the three human chromosomes, to speed discoveries about the functions of the genes.

JGI's news represents a milestone for DOE management, which had invested in new technology and a slightly different approach to sequencing the genome. Unlike other labs, which use a bacterial phage called M-13 in the final step of sequencing, DOE chose to use bits of DNA called plasmids, which provide order and orientation even of draft sequence. Moreover, JGI decided not to rely on the popular Applied Biosystems capillary sequencing machines but to buy 84 machines made by a competitor, Amersham Pharmacia Biotech. Working out the kinks took a lot of dedication: One night, lab manager Susan Lucas was discovered in the lab in her pajamas. But the effort paid off, Hawkins notes: "We've had a 10-fold increase in throughput and efficiency in the last 8 months."

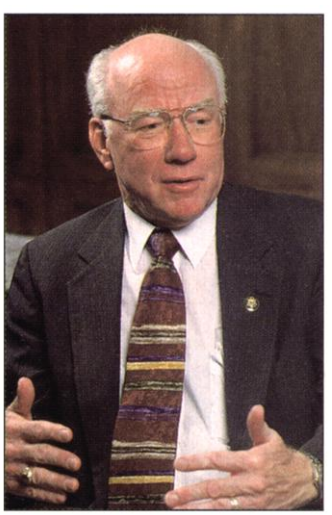
His colleagues are impressed: "Their performance has been remarkable," says Richard Gibbs, who heads the sequencing effort at Baylor College of Medicine in Houston. Leroy Hood, president of the Institute for Systems Biology in Seattle, goes further, saying that JGI's process improvements suggest that its performance has been "even better" than the labs funded by the National Institutes of Health. **–ELIZABETH PENNISI**

SCIENCE EDUCATION

Ehlers Offers Remedies For Ailing U.S. System

Joined by a fellow Republican and a Democrat, and with backing from scientific, professional, and educational societies, Representative Vern Ehlers (R–MI) last week unveiled three bills to improve science and math education in the nation's elementary and secondary schools.

The long-awaited proposals would create several programs at the National Science Foundation (NSF) and provide tax breaks and incentives for teachers to join and remain in the profession. The legislation tackles problems that Ehlers identified in his 1998 report on the state of U.S. science (*Science*, 31 July 1998, p. 635). But unlike that policy report, which was requested by the House leadership and sank without a trace, Ehlers says he will fight to get his education bills enacted.



Talk therapy. Representative Ehlers hopes his bills will stimulate interest in education reform.

Ehlers knows that he faces an uphill battle to win the support—or even the attention—of a majority of his colleagues in both houses of Congress, currently wrangling over a host of bills that would revise federal education policies. So he has assembled an impressive roster of supporters, including the American Chemical Society, the National Science Teachers Association, and Nobelist Leon Lederman, to lobby for his measures. "The formula for safe passage through the rapid technological change in our society is science education," says Lederman, the former director of the Fermi National Accelerator Laboratory. "We already know how to improve things, but we need leadership and a central strategy. I applaud Mr. Ehlers for taking the initiative."

The centerpiece of the reforms is the National Science Education Act (H.R. 4271). It directs NSF to create a variety of programs, including grants for schools to hire master teachers in math, science, and technology education, professional development in new technologies, and scholarships for teachers to carry out collaborative research. It would also set up an advisory panel to spread the word about exemplary curricula, an exercise that has already gotten the Department of Education into hot water with many conservative groups (*Science*, 11 February, p. 956). Companion bills would give a 10-year, $1000-a-year tuition tax credit to science and math teachers and beef up in-service and summer training institutes.

Ehlers pointedly refuses to put a price tag on his proposals, saying only that they would cost a tiny fraction of the current $20 billion federal investment. At a press conference last week, fellow House Science committee member Representative Sherwood Boehlert (R–NY) took a dig at his more fiscally conservative colleagues by urging them "to resist the temptation to cut taxes too much and instead put adequate resources into areas of need, including science education." Representative Eddie Johnson (D–TX) noted that a better trained workforce would cut down on the cost of remedial programs and reduce the need to hire foreign scientists and engineers.

NSF officials praise Ehlers's interest but express concern over whether they would receive additional funds to pay for the added responsibilities. The bills will be referred to the science, education, and tax committees. Even if passed, however, they would need the support of a separate set of spending panels before any of Ehlers's ideas could be implemented. **–JEFFREY MERVIS**