

quarks. It's the collisions between quarks that produce new particles, and those collisions take place at a range of energies, depending on the way the quarks happen to be rolling around inside the protons. By contrast, the NLC would smash together electrons and positrons, which appear to be indivisible units of matter and would therefore collide at about the same energy each time. The result, says Caltech's Barish, is that "the NLC is a fantastically good place to do quantitative work after initial discoveries isolate something. It's a terrible place to go [beforehand] because you don't know where to look." To live up to its potential, say physicists, the NLC would have to take its cues from the LHC.

In any case, many of the SSC's backers

think their project's demise has hurt the prospects for such international collaborations by scaring off potential foreign partners. "We don't have any international credibility," says SLAC's Stanley Wojcicki. After what has just happened with the SSC, he asks, "How can [an international partner] justify getting involved with us?"

Indeed, many physicists say the loss of the SSC, devastating in its own right, marks a still greater watershed in U.S. high-energy physics: the end of a golden age of federal support. Beyond all the particular factors that may have contributed to the project's defeat (see box on page 645), Wojcicki sees an overriding shift: "a very radical change in a partnership between the federal govern-

ment and the particle physics community that has gone on since World War II and the Manhattan Project."

The several hundred physicists who had settled in Waxahachie are keenly feeling the end of that partnership. The \$640 million in termination money will cover 90 days of severance pay and help with relocation, among other things. But after that, many staffers at the SSC laboratory face bleak prospects. Says Kirk, who still has his job at Argonne, "I hope they will realize in Congress that they have disrupted our lives in ways that can't be repaired by a few weeks of severance pay." The same bitter lesson, he says, applies to the field as a whole: "I don't see any future."

—Faye Flam

RESEARCH MANAGEMENT

New Rules Squeeze EPA Scientists

Microbiologist David Lewis of the Environmental Protection Agency's (EPA) research laboratory in Athens, Georgia, has won seven performance awards for the quality of his research on microbial ecology. Nowadays, however, Lewis feels it's a major achievement if he's able to do any research at all.

What's changed? EPA scientists like Lewis are spending less time on their own research and more on monitoring researchers who work for EPA under contract. The reason: Last year, EPA adopted new requirements—which include filling out more paperwork and seeking multiple approvals for research projects—to make sure contractors aren't ripping off the government. After a year trying to work with the new rules, EPA researchers are complaining the rules not only have crippled EPA's ability to conduct research, but also fly in the face of Vice President Al Gore's campaign to reinvent government by removing bureaucratic barriers to increased efficiency. The changes "run 180 degrees counter to Gore's plan," says Bob Swank, research director of the Athens lab. "Productivity, morale, and esprit de corps have never been so low," adds Swank, who has worked at EPA since its inception in 1970.

The paper avalanche was triggered by an internal investigation alleging serious problems in EPA's \$1.2 billion a year program that funds outside research and consulting. Investigators cited such abuses as a Superfund cleanup company that spent contract money on alcoholic beverages and tickets to sporting events, as well as the practice of allowing contract researchers to operate "sensitive" EPA management databases as though they were government employees (*Science*, 7 August 1992, p. 740). In response, EPA now requires agency scientists to record every interaction with contractors and to follow every regulation scrupulously. Although the new procedures may stop some of the

most egregious practices, the cost to EPA's science has been enormous.

The bottom line, according to Swank and others, is that EPA is "doing less science for more money." For example, the length of time between when an EPA scientist proposes an idea for a contract research project and when it's funded has grown from 16 to 26 months. That delay, he says, forces scientists "to be clairvoyant about what they'll need 2 years from now."

Although it's hard to quantify the damping effect on science, EPA researchers have a personal measure of what the changes have meant—a sharp increase in the time spent managing contracts. That includes writing elaborate work assignments that require approval from several EPA and contract officials, and performing such tasks as ordering lab materials, something contractors are no longer allowed to do. Lewis estimates he now spends 90% of his time on contract management, compared with 10% before the reforms went into effect.

Lewis' may be an extreme case, but other EPA researchers say the time spent on contract work has at least tripled, from about 10% to 30% or more. "I have had to postpone setting up experiments to get contract work done," complains James O' Callaghan, a neurotoxicologist at EPA's health effects research lab in Research Triangle Park. "It's a total mess," adds Linda Birnbaum, a toxicologist and top official at the health effects lab.

The added red tape has forced Lewis to forswear daily interactions with two contract scientists who work in his lab because such interaction could be seen as a form of "personal services" provided by contractors, an administrative no-no. The result, Lewis claims, is a scientific "nightmare." "It is evident...the quality of research and level of

productivity of my project has suffered rather severely," Lewis wrote recently to the director of the Athens lab, Rosemarie Russo.

Top EPA officials say the agency is sympathetic to the complaints from scientists but is powerless to change the situation. Gary Foley, EPA's acting research chief, says EPA would prefer to do more research in-house, but a shrinking staff—1800 compared with 2250 in 1971—makes that impossible. At the same time, he says, the EPA research office's spending on contract research has grown by one-third since 1980.

EPA would like to reverse this trend by converting contract scientists into EPA employees, thus reducing the number of contracts EPA scientists must oversee. Although that would run counter to President Clinton's promise to reduce the federal work force, EPA officials have asked the White House Office of Management and Budget to make an exception for the agency. "If we can't fix the problem," says Foley, "the only alternative is to do less research." That's a concession few at EPA want to make.

—Richard Stone



Seeing red. EPA scientist David Lewis is fuming over additional red tape.