be funds to meet our April payroll on the same basis as each of you was paid at the end of March." (Senior management had gone without pay in March and middle managers had received half pay; the rest of the employees received full pay.) But in mid-April, the company filed a report with the SEC stating that it was "unable to pay all of its suppliers and creditors on a current basis." And then on 30 April—"Black Friday," as some employees are calling it—Lilly and Kilgore informed the staff in a memo that there was not enough cash on hand to pay them. Kilgore left the building before the memo was distributed and installed a dead-bolt lock on the door to the offices.

The final straw occurred when the Internal Revenue Service demanded payment of $60,000 by 1 May, a claim that the memo said was an "unforeseen negative thing" that "jeopardized our cash."

The memo gave employees the option either of staying away from work in May, "in which case the company will consider your job having expired," or of reporting to work in the hopes that sufficient cash would become available to pay salaries. If not, the employees would be paid in stock, the memo said. Most of the scientists decided to take the first option and look for other jobs.

Several of the company's directors have also recently bailed out. The first to go was Marc H. Bozeman, a Los Angeles attorney and former director of compliance for the FDA's Bureau of Biologics. Bozeman, who is still handling Southern Biotech's legal matters with the FDA, resigned as director on 1 April, citing the company's inability to obtain satisfactory coverage for insuring officers and directors against liability as a reason for his departure. He was followed later in April by E. C. Watkins, one of the company's founders, and Robert Brackett, vice president for regulatory affairs, who had joined last September. McCormick was still a director in mid-May, and he told *Science* that he knew virtually nothing of the company's financial affairs.

Southern Biotech is thus faced with mounting bills, it has a promissory note to Key Energy Enterprises for nearly $1 million due in August, most of its scientific staff has left, and it still has no market for its stockpile of interferon.

Its extraordinarily swift rise and fall says a lot about the financial climate surrounding biotechnology in the past few years. Its impending collapse is likely to make the climate more hostile, however. Other companies now seeking capital will not find their task made any easier by Southern Biotech's performance. Potential investors in biotechnology should now be looking for something more than overblown promises when they decide where to put their money.

—COLIN NORMAN and ELIOT MARSHALL

Laser Wars on Capitol Hill

The House has invoked the laws of physics in a budget battle with the Senate over the best way to build space lasers

A strange and otherworldly force has intruded upon mundane politics in the nation's capital.

The laws of physics have been invoked in a battle between the House and the Senate over how the United States should build space lasers. A triumph of scientific reasoning could touch off an abrupt about-face in the U.S. laser program, which to date has consumed more than $2 billion in pursuit of long wavelength lasers that look increasingly useless. A more attractive candidate is the short wavelength laser. Alternatively, a continuation of the current program could result in the development of lasers that emphasize bravado and political muscle rather than technical excellence and the ability to slice through metal in real conflicts.

So far, the defense contractors behind the status quo seem in a position to prevail.

The House touched off the battle when it said the Administration's $156 million program in fiscal 1983 for the development of space lasers could result in a technical fiasco. From an evaluation of elemental physics, the House Armed Services Committee said the long wavelength chemical lasers currently under development by the U.S. military will be extremely difficult to convert into useful weapons and will pose hardly any threat to the Soviet military or other enemies in space. "It is the committee's judgment that emphasis is being focused on the wrong laser technology," said an April report on the Defense Authorization Act. The current effort should be scrapped, according to the committee, and in its place studies should be initiated on short wavelength lasers, which are more lethal.

On the other hand, the Senate says such a move would delay the launch of a U.S. space laser until late in the next decade. The current long-wave lasers are perfectly adequate, says the Senate, and, unless the current program moves forward vigorously, the United States will lose the race for the domination of space to the Soviets.

The war of words is currently in a deadlock. The Senate recently passed its defense authorization bill and backed the status quo. The House will not vote on its bill until sometime in mid-June. Differences in the bills will be ironed out in conference.

The Pentagon's current effort, pioneered by the Defense Advanced Research Projects Agency (DARPA), centers on chemical lasers. These produce coherent rays in the infrared portion of the electromagnetic spectrum (at about 2.7 microns). They work something like rocket engines, using hydrogen and fluorine as fuel. DARPA programs include one named Alpha, which is aimed at producing a hydrogen-fluoride laser capable of radiating 5 megawatts; Lode, which is to produce a 4-meter mirror for aiming laser beams; and a program called Talon Gold, which is to demonstrate the tracking of targets in space.

The nub of the House's argument is founded on physics. The shorter wavelength lasers it favors, operating at or near the visible part of the spectrum, could achieve the military goals of the program much more efficiently than long wavelength chemical lasers, which are fairly easy to defeat by having a target covered with special coatings or polished so it reflects much of the laser beam. The first consideration in favor of shorter wavelengths is that the optics in general are easier to make. With wavelengths 6 times shorter than the ones currently

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envisioned, the diameter of the aiming mirror could be 6 times smaller. (Optical tolerances, however, have to be more precise.) Also, a shorter wavelength means the power of the laser is focused into a smaller space, increasing its lethality. With a wavelength 6 times shorter, the diameter of a beam hitting a target will be 6 times smaller, the area 36 times smaller, and thus the overall flux per unit of target area 36 times greater. The alternative, generating 36 times more radiation from the laser device itself, is a prodigious undertaking that taxes the imagination. In addition, shorter wavelengths put more energy into targets. For a missile body struck by a long wavelength laser, about 99 percent of the energy is reflected. With shorter wavelengths, the figure is about 90 percent.

The push for short wavelength lasers is not confined to the House. Last year, the Defense Science Board recommended that the Pentagon switch its emphasis to shorter wavelengths. The director of DARPA, Robert Cooper, after conducting a review of all the agency's laser programs, told the House Armed Services Committee in March that shorter wavelengths are more efficient. Air Force Deputy Chief of Staff for Research Kelly Burke also agreed that program emphasis should be on shorter wavelengths.

In its April report, the House Armed Services Committee took the bold step of calling for a cut of $121 million from the Administration's fiscal 1983 budget request for space lasers, including the termination of two of the three principal long wavelength laser demonstration programs, Alpha and Lode. In place of these projects, the committee called for a $50-million program to explore short wavelength lasers.

In particular, the House committee encouraged the exploration of the free-electron laser (FEL), which is based on technology similar to that of particle accelerators.

Critics of the move have one main objection. The short wavelength idea has not been seriously explored amid the rush to exploit lasers, and the technology is in a rudimentary state. Senator Malcolm Wallop (R–Wyo.), an advocate of space lasers, asked from the Senate floor, should we wait "to build the infrared lasers we know how to build, and instead put our money on the short wavelength lasers we do not yet know how to build? We have heard this sort of thing before. . . . Because we have listened, we have slipped behind in quantity and quality of strategic weapons. . . . We are faced with two sharply contrasting sets of claims in this field. The bureaucracy's claims which are reflected in the [House] Armed Services Committee's report, and my claims, backed by the only source of facts in the field: the aerospace industry."

After Wallop's pitch, the Senate passed an amendment to the defense authorization bill calling for a demonstration space laser, preferably within the decade.

Despite the Senate's disdain for the short wavelength option, work on the idea has forged ahead under conditions of less than lavish funding. A working FEL has been built at Stanford University in California, and state-of-the-art data are being collected at the Los Alamos National Laboratory in New Mexico. A good test-bed for a large FEL, according to short wavelength advocates, would be the huge Advanced Technology Accelerator now under construction at Lawrence Livermore National Laboratory in California.

The battle over how to build a proper laser for fighting a war in space offers an interesting window into the process of government. A new idea and an impressive consensus on how to go about the job have emerged, yet the great momentum behind existing laser projects, on which defense contractors have already spent millions, threatens to thwart a more rational approach. The result could well be laser battle stations that cost billions and look impressive but offer little by way of a credible threat.

—WILLIAM J. BROAD

Reagan Proposes to Restructure Soviet Forces

Ironically, both sides might be more vulnerable under Reagan's arms control plan

President Reagan achieved political success with his recent proposal to negotiate reductions in U.S. and Soviet nuclear weapons, even if his formula for reductions fell flat. A week after Reagan's announcement, Soviet President Leonid Brezhnev indirectly rejected the formula by faulting it as prejudicial to the security of the Soviet Union and a cover for a continued U.S. military buildup. A group of congressmen and arms control experts within the United States claimed that it might endanger the security of both countries, and worsen international tensions. But the President received high praise nonetheless, simply for agreeing at long last to talk with the Soviets about nuclear weapons and to listen to any Soviet counterproposals.

Although a date has not yet been set, negotiations are now expected to begin in late summer at the Soviet mission and the Botanic Building in Geneva, the historic location of previous negotiations and the ongoing U.S.–Soviet talks about weapons in Europe. These talks have bogged down in large part because of U.S. insistence on its opening proposal, but this tactic will not be used during the discussions about strategic nuclear weapons. Administration officials admit that Reagan's formula is merely an opening gambit, and that it will inevitably be amended as negotiations proceed.

In hearings before the Senate Foreign Relations Committee, Secretary of State Alexander Haig acknowledged that the proposal imposes the heaviest burden on the Soviet Union, because it focuses on the weapons that form the bulk of the Soviet arsenal: land-based missiles. The proposal asks that the Soviets eliminate—over a period of years—the majority of its land-based missiles, destroying in the process about 3000 warheads. In compensation, the Soviets could increase the number of warheads on submarines by about one-third. The United States, in contrast, could increase the total number of warheads atop land-based missiles by 500, although it would have to cut the number of warheads aboard submarines in half.

The overall purpose of these cuts, Reagan says, is to reduce the total number of nuclear weapons in the world, as well as to restructure the Soviet's arse-

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