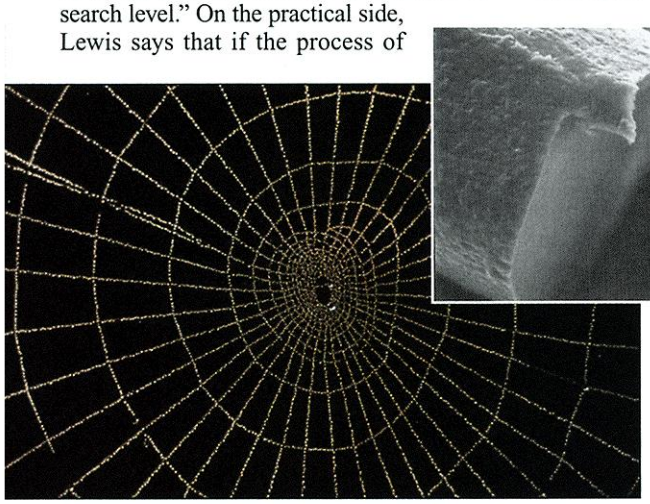
strong, lightweight fibers.

The new progress "is highly encouraging," says Randy Lewis, a molecular biologist and spider silk expert at the University of Wyoming in Laramie. "It opens up a lot of things on a practical level and on a research level." On the practical side, Lewis says that if the process of harvesting silk from cell cultures is perfected, it will lead to ultrastrong, flexible fibers for everything from artificial tendons and ligaments to lightweight body armor and high-strength composites. And on the research side, teams can now explore how changes in the silk genes and proteins affect the strength and flexibility of the fibers.



Nice threads. After years of attempts, researchers have coaxed mammalian cells into producing spider silk.

This promise is injecting new hope into a field in which progress has been "agonizingly slow," says team member Steve Arcidiacono, a fiber-spinning expert with the U.S. Army Soldier Biological Chemical Command (SBCCOM) in Natick, Massachusetts. SBCCOM and other teams have worked for more than 10 years to splice spider silk genes into other organisms in hopes of recovering enough silk to produce bolts of high-strength material. And although they've inserted the genes into bacteria, yeast, and plants, the result has always been disappointing: insoluble silk proteins that clump together inside the cells. Even when the proteins have been extracted and purified, researchers have managed to turn them only into worthless, brittle fibers at best.

The Nexia researchers thought they might get better results by transferring silk genes into certain mammalian cells that more closely mimic those used by the spider itself. In spiders, specialized epithelial cells produce and secrete a pair of proteins in a water-based solution in a spider's silk gland. As these proteins are pushed out of the gland, they self-assemble into fibers, although the details of this process remain unclear.

The Nexia team, led by molecular biologists Anthoula Lazaris and Costas Karatzas, spliced the silk genes into two different cell lines: bovine mammary cells, epithelial cells that excel at secreting proteins outside the cell; and hamster kidney cells, which are adept at producing large volumes of recombinant proteins. Both cell lines worked, each secreting soluble silk proteins outside the cells, where they could easily be collected.

The Nexia researchers then teamed up with Arcidiacono's group to spin the proteins into fibers. For this first study they spun fibers from just one of the proteins, dubbed MaSpI. The army researchers first concentrated the MaSpI proteins in water, then extruded them through a tiny hole at the end of a syringe and into another solution containing methanol, a change of environment that prompted the proteins to assemble into continuous fibers. And impressive fibers they were: threads that are lighter yet tougher than Kevlar and nearly as elastic as nylon.

That's still not quite as good as native dragline silk, which has even more flex. That difference may be because the fibers are made from only one of the two proteins spiders use to spin their fibers. Karatzas says his team will soon try to spin fibers from both proteins to see if this improves the fibers' properties.

Making bigger proteins may also help. Native silk proteins are heavyweights, each weighing some 150 kilodaltons, whereas those produced by the recombinant method are about 60 kilodaltons. Karatzas says his team has already produced heavier proteins by splicing three copies of the gene next to one another. The Nexia researchers plan to test these to see whether they make better fibers as well.

If either scheme works, it may help propel recombinant spider silk into early applications that require little material, such as biocompatible artificial tendons and ligaments, thin, biodegradable sutures for eye surgery and other delicate operations, and high-strength fishing line. Down the road, Nexia plans to transfer the genes to the mammary cells in goats, in hopes that the proteins can be harvested from the milk. That, in turn, could produce silk proteins in plentiful quantities for applications such as high-strength composites and soft, flexible bulletproof clothing for soldiers and police—all without the chore of figuring out how to raise spiders on a farm.

–ROBERT F. SERVICE

CREDITS: (LEFT TO RIGHT) RALPH CLEVENGER/CORBIS; A. LAZARIS *ET AL.*

ScienceScope

Closer to the Edge The viability of the Coulston Foundation in Alamogordo, New Mexico, once the nation's largest chimpanzee research and housing facility, is in question after a local bank filed suit to recover $1.2 million in defaulted loans. The U.S. Food and Drug Administration (FDA) has also said it will reject six product-testing studies carried out at the troubled facility since 1999. Coulston and FDA declined to comment. But animal activists who have followed the foundation's sinking fortunes say they would like the U.S. Department of Agriculture to take custody of the 250 to 260 chimps believed to still live there. Last summer the National Institutes of Health relocated 285 Coulston chimpanzees to Charles River Laboratories, ended Coulston's funding, and let lapse the foundation's permit to experiment on federally owned animals (*Science*, 24 August 2001, p. 1415).

Super Agency The British government plans to overhaul its health bureaucracy to focus on emerging diseases and the heightened bioterror threat. Over the next year, four agencies will be combined into a new National Infection Control and Health Protection Agency, according to a report last week from the U.K. Department of Health. It targets many areas for improvement—from registering research projects that involve dangerous pathogens to beefing up disease surveillance. "When we get outbreaks of disease, we often don't know what's caused them," says the U.K.'s chief medical officer, Liam Donaldson. The health department intends to pool the $50 million a year in research funds and devise a new strategy for spending the money.

Mine Disaster? Executives and politicians involved in an effort to convert a South Dakota gold mine into the world's deepest underground laboratory say the plan could collapse unless Congress alters a new law that would transfer part of the site to government ownership. Homestake Mine officials last week said the law, crafted last month by Senator Tom Daschle (D–SD) and Representative John Thune (R–SD), doesn't do enough to reduce the company's liability for potential pollution and safety problems associated with the proposed $300 million lab. Thune is organizing a meeting later this month to discuss solutions and ways to prevent the company from permanently flooding the mine in March. Earlier this month, ScienceScope (4 January, p. 27) failed to note that the new law requires the National Science Foundation, which is reviewing the proposal, to approve the project before the land transfer can take place.

This month Andrews and others will begin to wrestle with a slew of organizational issues, including whether to establish the fund as a new entity led by a seasoned executive (like In-Q-Tel) or to ask an existing outfit to manage the $25 million pot. Officials appear to favor the In-Q-Tel model but not its estimated 15% administrative costs. "I'm looking to hold down the overhead," Andrews says.

Whatever model is chosen, some analysts question whether the Army's venture into high-tech investing can pay off. Last year, for instance, an Army Science Board panel concluded that existing research funding mechanisms could meet the Army's needs. It also warned that creating a venture fund could embroil the Army in "tumultuous" debates over how to spend any potential income. But it questioned whether products made for the military will also be attractive to other consumers; the Army now earns less than $500,000 a year in royalties from products it helped develop, the panel noted.

Such concerns, however, don't worry the fund's backers. Although Dahlberg says he doesn't expect the fund "to change the world, it will help get [the Army] closer to the creative smaller organizations." House appropriators, he adds, are ready to boost its annual budget, to up to $50 million, if things go well over the next few years. Success could also mean spreading the concept to the other armed services. –DAVID MALAKOFF

ASTRONOMY

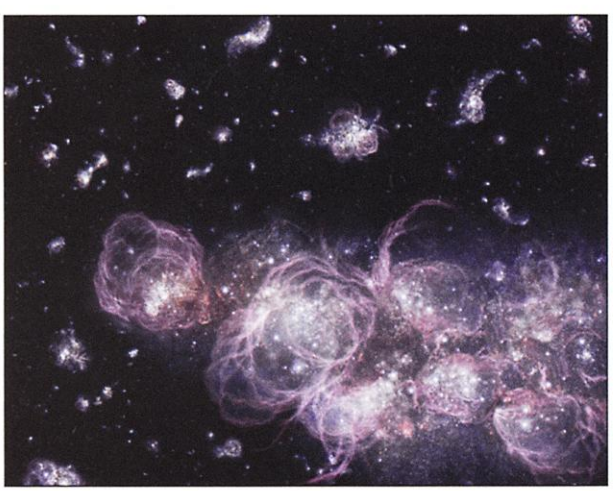
Star-Spangled Universe Dawned in Early Light

Hollywood directors would have filmed it differently, but Mother Nature started her performance with the grand finale. A few hundred million years after the big bang, long before anyone was around to appreciate the spectacle, the universe blazed with the most violent burst of star formation it has ever experienced. Since then, the rate of star formation has decreased, and the current activity is just a fizzle compared with the natal fireworks.

That new screenplay contradicts earlier scripts, which suggested that star formation gradually increased until a "baby boom" took place some 4 billion years after the big bang before dropping off again. "All analyses so far have missed a substantial part of the starlight in the very early universe," says Ken Lanzetta of the State University of New York, Stony Brook, who presented his results at a press meeting at NASA headquarters on 8 January 2002. A paper describing the new theory will soon be published in *The Astrophysical Journal*.

To learn about the early universe, astronomers examine very distant galaxies, whose light took billions of years to reach Earth. Three tiny patches of sky, known as the Hubble Deep Fields, have been studied in exquisite detail, both by the Hubble Space Telescope and by other instruments in space and on the ground. But according to Lanzetta, "even the deepest images made by Hubble are not sensitive enough to detect most of the light in the very distant universe." As a result, astronomers can glimpse only a small fraction of the amount of star formation in distant galaxies. "At these large distances, our telescopes see only the brightest parts of the galaxies," Lanzetta says. "The faint and intermediate-bright parts are below the observational threshold. But it's the intermediate-bright parts of galaxies where most of the starlight is being produced."

To calculate how much of that light had dropped below the range of visibility, Lanzetta and his collaborators analyzed all available observations of the Hubble Deep Fields. For some 5000 faint galaxies, they first determined their distances by studying their colors. More-distant galaxies appear redder because their light has been stretched more by the expansion of the universe. Then the astronomers calculated how much energy was produced in each pixel of the images. By comparing these results with data from nearby galaxies, the team was able to estimate how much starlight earlier analyses of the Hubble Deep Fields had missed—like a listener reconstructing the repertoire of a distant marching band by comparing recorded music with the booming of the bass drum. Lanzetta's technique "is really very



Brilliant debut. An artist's conception shows the spectacle of star formation that illuminated the early cosmos.

CREDITS: (TOP TO BOTTOM) DON FIGER/STSCI/NASA; ADOLF SCHALLER FOR STSCI

ScienceScope

FAME Flames NASA last week abruptly canceled a mission to obtain precise measurements of 50 million stars. The Full-sky Astrometric Mapping Explorer (FAME) was slated for a 2004 launch, but burgeoning costs prompted the space agency to abandon the project.

FAME's price tag had grown from $160 million to $220 million, primarily because of design and delivery problems with two dozen digital imaging cameras. And the final cost was likely to go higher, according to NASA officials and Kenneth Johnston, principal investigator and an astronomer at the U.S. Naval Observatory in Washington, D.C. "It's a great disappointment," says Johnston, who had hoped to convince the Department of Defense to cover the additional costs. The mission, selected in a tough 1999 competition, would have helped astronomers understand stellar evolution and the distance scale of the universe.

Accidental Death Tennessee authorities say that Harvard biochemist Don Wiley died in an accident. Wiley mysteriously disappeared on 15 November 2001 from a Memphis bridge over the Mississippi River; his body was found on 20 December 2001 some 480 kilometers downstream (*Science*, 4 January, p. 31). This week, Shelby County Medical Examiner O. C. Smith ruled out both foul play and suicide. Instead, Smith believes Wiley fell from the 35-meter-high bridge after leaving his rental car to check it for minor damage. Alcohol consumption, a seizure disorder, and a gust of wind caused by a passing truck all may have caused Wiley to lose his balance and fall over a thigh-high guardrail. He died from the impact on the water.

High Eye on the Sky Champagne flowed atop a remote mountaintop this week as astronomers dedicated the new 8.1-meter Gemini South telescope at Cerro Páchon in the Chilean Andes. The new $184 million telescope joins its identical twin, Gemini North, at Mauna Kea, Hawaii. Together, they give astronomers from the seven nations footing the bill—the United States, United Kingdom, Canada, Chile, Australia, Argentina, and Brazil—access to the entire sky.

Contributors: Katie Greene, Richard Stone, David Malakoff, Andrew Lawler, Constance Holden, Govert Schilling