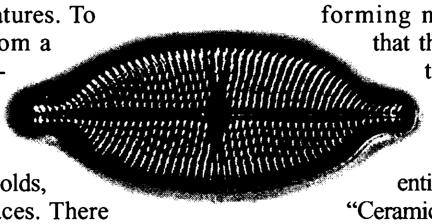
that takes hours to happen without silaffins. A scanning electron microscope showed that the precipitate had formed networks of minuscule silica spheres.

Kröger and his colleagues went on to analyze the proteins and show how their structures and chemical features could help catalyze the reaction of silicon-containing molecules into solid silica particles. The researchers "have done a great job of characterizing their proteins," says Galen Stucky of the University of California, Santa Barbara, who last year found what may be compounds with similar functions in silica-making sponges.

Besides helping to explain how diatoms transform dissolved silicon-containing molecules into sturdy solid particles, the finding is also a tantalizing clue for materials scientists who envy biology's ability to build sophisticated materials at ambient pressures and temperatures. To make any ceramic, from a dinner plate to a toughened drill bit, engineers and artisans now have to mix powders, press them into molds, and fire them in furnaces. There are no furnaces in sight when a developing child infiltrates itself with bone or a diatom drapes itself in silica lace, and materials scientists would like to know how they do it.



The Regensburg group suspected that diatoms make proteins that orchestrate the initial phase of biosilica formation—the growth of tiny silica spheres. For one thing, other researchers had already found organic molecules closely linked to diatom cell walls. After extracting the organic material from their diatom samples, the Regensburg researchers isolated three proteins that could instigate silica precipitation in a test tube—a pair of small, closely related silaffins (1A and 1B) and another larger one, silaffin 2. To begin unraveling how the proteins work, the group determined the amino acid sequence of silaffin-1B and ferreted out a gene from the DNA of the diatom *Cylindrotheca fusiformis*, which turned out to encode silaffin-1A as well. Kröger says the team also is now working to characterize silaffin 2.

The structures of these proteins harbor clues to the diatoms' silica engineering. The glasslike veil of a newborn diatom takes shape in a "silica deposition vesicle," where conditions are acidic. Both silaffins have an unusual amino acid motif, consisting of bonded pairs of lysines with a string of amine groups grafted on after the protein chain is formed. The researchers say that under acidic conditions, this motif should stimulate silicic acid molecules to form silicon-oxygen bonds, linking them together into silica particles. That might help explain how diatoms form solid silica from ingredients dissolved in their watery environs, but it doesn't explain how the algae coax the silica to form intricate patterns. Kröger conjectures that other features of the proteins could be at work.

Silaffin-1A and -1B both consist mainly of two chemically distinct components, one bearing multiple positive charges and another multiple hydroxy groups. To Kröger, the proteins resemble synthetic block copolymers—polymers in which two distinct segments, each repeated many times, alternate along the molecule. When some copolymers solidify, like segments cluster together, segregating into two separate phases that pattern the material with regions of contrasting chemical properties—somewhat the way drops of oil poured onto a saucer of vinegar form segregated droplets. Kröger wonders whether silaffins might be doing something similar within a diatom's silica deposition vesicle, forming molecular frameworks that then guide the growth of the silica.

However diatoms create their silica patterns, it's a trick materials scientists would like to emulate. "Ceramics are one of those unfulfilled materials we could use lots more of, if only we could get [them] easily," says materials researcher Paul Calvert of the University of Arizona, Tucson. Adopting biology's kinder, gentler methods could help engineers combine ceramics with other materials that can't take furnace temperatures. Quips Calvert: "You could make something with chocolate feet and a silicon carbide head." Unlikely material combinations, he says, could push forward such projects as "flexible electronics," in which silicon-based electronics are patterned onto polymer sheets. Diatom-like methods for making intricately shaped ceramics might also yield photonic materials, whose internal arrangements of solid and space could select and confine specific wavelengths of light for communication or computing.

The more scientists learn about diatoms' glassy laceworks, the more beautiful they seem.

–IVAN AMATO

Ivan Amato is the author of *Stuff*.

OCEANOGRAPHY

Has a Great River in The Sea Slowed Down?

For many millions of years, two "rivers" of seawater have been flushing the deep sea clean while shuttling chemicals and heat so as to reshape climate. Now, a new analysis of oceanographic data suggests that one of the two rivers has slowed dramatically within the past century, with implications for climate and the humans who are changing it.

ScienceScope

The Long View It's way too soon for scientists to take it to the bank, but the National Science Foundation (NSF) has begun discussing new initiatives in mathematics and the social sciences.

NSF is still awaiting White House reaction to its 2001 budget request, which won't be finalized until January. But NSF director Rita Colwell says she is already thinking about highlighting mathematics in her 2002 request and the social and behavioral sciences in 2003. "Mathematics is the foundation for all the sciences," she told a 1 November symposium at the American Association for the Advancement of Science (which publishes *Science*). And scientists "need the social and behavioral sciences to interpret the huge databases" being compiled in many fields.

The fledgling initiatives are a response to a White House request for a 5-year plan from each agency. But the Clinton Administration will be history after next November's election, meaning that Colwell, whose 6-year term runs through 2004, must sell her ideas to the next set of political bosses.

Double or Nothing? Science groups are taking another crack at getting a cherished funding bill through the House. But few expect the bill—which would enable, but not require, the federal government to double nonbiomedical R&D spending to $68 billion by 2010—to survive a clash with Rep. James Sensenbrenner (R–WI), chair of the House Science Committee.

In a repeat of last year's unsuccessful campaign, Representative Heather Wilson (D–NM) and nine cosponsors last week introduced the doubling bill (H.R. 3161), which mirrors a companion the Senate passed earlier this year (*Science*, 28 May, p. 1452). But Sensenbrenner, whose committee must approve the measure, has derided earlier versions of the bill, calling it a "feel-good" effort that will produce little actual cash for research. Still, Sensenbrenner aides say the lawmaker hasn't yet made up his mind about the current version, which probably won't get hearings until next year.

In the meantime, doubling backers—who have made the measure a centerpiece for a high-profile campaign—are expecting the worst. But some believe the dogged effort could eventually pay off in a future Congress. Jokes one lobbyist: "We'd like a win, but a valiant defeat might be just as glorious."

ty of Amsterdam and Marc Girard at the Pasteur Institute in Paris, will begin with phase I trials to compare the ability of several different vaccine preparations to elicit immune responses against HIV. The European team will test how well two different types of genetically engineered vaccinia viruses—one called MVA and the other NYVAC—serve as noninfectious vectors to present four key HIV proteins to the immune system. In each case, this "prime" will be followed by a "boost" vaccine preparation consisting of HIV's envelope protein, the main component of its outer coat.

In addition, the trials will mix and match proteins from two major clades, or subtypes, of HIV: clade B, which predominates in North America and Europe, and clade C, which now accounts for about 40% of new HIV infections in the world and is particularly rampant in China and India. The mix-and-match strategy should eventually allow researchers to determine whether a vaccine against clade B would also be effective against clade C and vice versa, once they are tested in full-fledged efficacy trials. "EuroVac is quite innovative," says team member Giuseppe Pantaleo, an immunologist at the Vaudois Hospital Center in Lausanne, Switzerland. "For the first time we will be comparing MVA and NYVAC with four major viral proteins, and it's the first time we will be trying to get cross-clade immune responses."

But it is EuroVac's plans to test a clade C vaccine that have provoked the sparring over turf. The clade C HIV on which the vaccine is based was provided by Hans Wolf, a virologist at the University of Regensburg in Germany, who obtained the viral strain from colleagues in China. In the meantime, Ho, who has his own contacts in China, has prepared a clade C vaccine using a somewhat different strategy, which uses both an MVA vaccine and a "naked DNA" preparation that delivers HIV genes directly to the body. Ho has been quietly talking with Chinese health authorities about testing his vaccine in China and has also been discussing funding with the New York–based International AIDS Vaccine Initiative (IAVI)—a private organization funded by numerous major foundations as well as the World Bank and the British government.

Wolf and Ho learned of each other's efforts only fairly recently. Wolf argues that the efforts are duplicative and criticizes IAVI for funding what he sees as a competitive study. "I would have nothing against it if someone like David joined in our trial," Wolf told *Science*. "But now IAVI is running around the world and putting money into a competing thing; this is irresponsible." Ho counters that "it is not unusual that multiple groups pursue the same objective" and adds that the differences between the two vaccine strategies might argue for comparing their effectiveness in parallel clinical trials. An opportunity to resolve this conflict may be at hand, however: Later this month, a Beijing meeting co-sponsored by IAVI will bring together representatives of the Chinese ministry of health, NIH, and IAVI, as well as one or two members of the EuroVac team.

Team Europe. Virologists Jaap Goudsmit (top) and Marc Girard are co-chairing the EU's first concerted AIDS vaccine effort.

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Viral immunologist Wayne Koff, IAVI's vice president for research and development, says that the clade C vaccines developed by EuroVac and Ho are only two of a number of possible preparations that could go into preliminary clinical trials in China, where more than 400,000 people are estimated to be infected with HIV. IAVI's basic strategy—to accelerate development of the most effective vaccine candidates—could well mean that it would end up funding a "head-to-head" comparison of the two vaccines. But whether either vaccine will ultimately end up a finalist, he adds, it "is too early to say."

–MICHAEL BALTER

ScienceScope

Leonid Fever Meteor watchers are planning an all-nighter for 17 November, when Earth will plow through the debris left behind by Comet Tempel-Tuttle. The comet zipped through the solar system last year, and astronomers expect rare Leonid meteor storms this year and next. While last year's crop of Leonids provided some spectacular fireballs, they fell short of a first-class storm. This time, experts say the fireworks should have more pop.

That prospect has researchers dispersing to far-flung locales to observe the storm. For instance, Peter Brown, an astronomer at the University of Western Ontario, is leading an expedition to the Canary Islands funded primarily by the U.S. Air Force, which hopes to glean insights into how to better protect its satellites. Other prime sites include Europe and West Africa, says Donald Yeomans, an astronomer at the Jet Propulsion Laboratory in Pasadena, California, who predicts peak meteor watching will occur at 01:48 Universal Time on 18 November.

Nobel Switch French research minister Claude Allègre is lucky that France has so many talented physicists. When Nobel laureate Claude Cohen-Tannoudji resigned on 13 October from the nation's National Science Council, it took Allègre just 2 weeks to find another Nobel-winning replacement. Last week, the minister named physicist Georges Charpak of the CERN accelerator center near Geneva to fill the empty slot.

But Allègre may need to do more than pull Nobelists out of a hat to end grumbling on the 27-member council, which prime minister Lionel Jospin created in 1998 to advise the government on research priorities. Allègre "confused [meetings of] the National Science Council with a press conference," Cohen-Tannoudji groused to the French daily *Le Figaro* after quitting. "He came to expound on decisions that he had already made."

Allègre can expect a somewhat more sympathetic ear from Charpak. Last month, Charpak was one of six Nobelists who signed a letter supporting the minister's overall research strategy.

Correction Last week's ScienceScope item "Upwardly Mobile" overstated the U.S. gross domestic product. It is $8.8 trillion.

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