and many multivitamins contain 5,000 I.U. The U.S. Institute of Medicine recommends that people get 2,300 to 3,000 I.U. of vitamin A each day and sets the safe upper limit around 10,000 I.U.

"I believe this upper level should be lowered," Michaëlsson says. When he and his colleagues gave the men dietary questionnaires, they learned that men ingesting as little as 5,000 I.U. of vitamin A per day were more prone to fractures than were men getting less.

Manufacturers should lower the amount of vitamin A in multivitamin tablets and fortified foods, such as cereals, says Michaëlsson.

The new study began in the early 1970s when researchers stored blood samples from 2,047 men about 50 years old. Since then, 266 of the men have had at least one bone fracture.

After dividing the men into five equal groups according to their blood vitamin A concentrations, the researchers found that men in the top group were nearly twice as likely as those in the middle group to have broken a bone. The correlation was particularly strong with fractures of the hip.

"I think it's pretty conclusive now that there's a bad effect of [vitamin A] supplementation," says Margo A. Denke, an endocrinologist at the University of Texas Southwestern Medical Center in Dallas. Elderly people may be at special risk because they're slow to clear the vitamin from their bodies. Studies of animals have established that excess vitamin A stimulates the formation of cells that dissolve bone.

However, since some vitamin A is necessary to maintain good eyesight and general health, Denke and Michaëlsson agree that fully fortified foods and supplements should remain available in countries where poor nutrition puts people at risk of a vitamin A deficiency. —N. SEPPA

Fiber Helper

Minuscule controllers may open data floodgates

Speeding up the Internet and other long-distance data networks is an expensive proposition. To reach planned transmission rates of 40 billion bits per second (Gb/s)—up from today's maximum rate of 10 Gb/s—telecommunications companies would have to install a new generation of optical cables that retain the quality of fast signals better than existing cables do.

Now, researchers have developed a liquid-crystal gadget that sits on the end of a hair-thin optical fiber of the type currently installed underground and corrects the worst signal damage that such a fiber inflicts, says John A. Rogers of Bell Labs' Lucent Technologies in Murray Hill, N.J.

"We're really doing things right on the head of a pin," says Rogers, who is moving to the University of Illinois at Urbana-Champaign.

Rogers and his colleagues focused on correcting a problem that results from light's polarization, which is the orientation of its electromagnetic fields. In optical fibers, light pulses may widen because of differences in the speeds at which signals of different polarizations move. As multiple pulses smear, the information they represent becomes indecipherable.

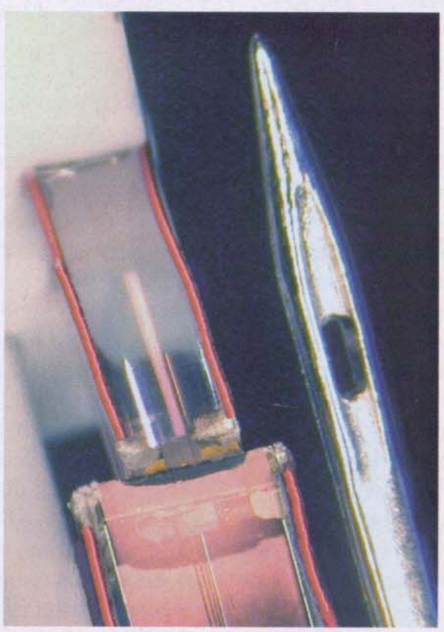
The new device links two optical fibers aligned end-to-end. It consists of gold electrodes that sandwich a thin film of liquid crystal.

A voltage applied to the device's electrodes produces an electric field of a chosen orientation that modifies polarization—for instance, by rotating it, says Ronald Pindak of Brookhaven National Laboratory in Upton, N.Y. Thanks to that modification, a standard device further along the optical channel can recompress the pulses.

Rogers, Pindak, and their colleagues at Lucent and the University of Minnesota in Minneapolis describe their invention in the Dec. 30, 2002 *Applied Physics Letters*. At a meeting in March, the team will present test results indicating that the gadget makes 40 Gb/s transmission speeds possible.

Other polarization controllers using solid crystals of lithium niobate work well, but they're bulky and cost tens of thousands of dollars apiece, Rogers says. The new technology ultimately may cost much less, he adds.

Impressed by the new controller, David M. Walba of the University of Colorado in Boulder predicts that such "liquid crystal devices . . . could form the basis of the next generation of telecom-switching components." —P. WEISS



B. ACHARYA/LUCENT

CHEAP FIX Smaller than a needle (right), a liquid-crystal and gold device tucked between these glass blocks tunes up signals passing through the optical fibers encased in the blocks.

Unnatural Biochemistry

Bacteria make and use an alien amino acid

Almost all organisms assemble proteins from the same 20 natural building blocks, known as amino acids. But now, in a feat of genetic engineering, researchers have for the first time constructed an organism that synthesizes and incorporates a 21st amino acid into its proteins.

The modified version of the common bacterium *Escherichia coli* could be valuable to scientists investigating why life operates with 20 amino acids, rather than, say, 19 or 21, remarks Ryan Mehl, a member of the team that created the bacterium at the Scripps Research Institute in La Jolla, Calif.

The work could also lead to biotech organisms that manufacture new materials from nonstandard amino acids. Instead of chemical plants, "we could have bacteria generating our polymers," says Mehl, who last September moved from Scripps to Franklin & Marshall College in Lancaster, Pa. He and his coworkers describe their organism in the Jan. 29 *Journal of the American Chemical Society*.

Hung-wen (Ben) Liu of the University of Texas at Austin rates the work as "beautiful." The research solves a technically challenging problem and potentially has many practical uses, he adds.

Researchers previously had coerced bacteria to take up extra amino acids from laboratory dishes and use them to make proteins (*SN: 6/3/00, p. 360*). But until now, no one had altered a bacterium so that it could synthesize a 21st amino acid and then incorporate it into proteins along with the standard amino acids.

The Scripps team, led by Peter Schultz, gave *E. coli* genetic instructions for making a nonstandard amino acid—one produced by another bacterium as part of a defensive chemical but not naturally integrated into proteins. All the modified *E. coli* requires to construct the new amino acid is salt, water, and a carbon source, such as glucose.

The scientists also genetically modified the organism's biochemical machinery so it would integrate the alien amino acid into proteins. To avoid inflicting any harm on the bacterium, the researchers made it use the extra amino acid in the construction of the oxygen-carrying protein called myoglobin—a protein not naturally found in *E. coli*.