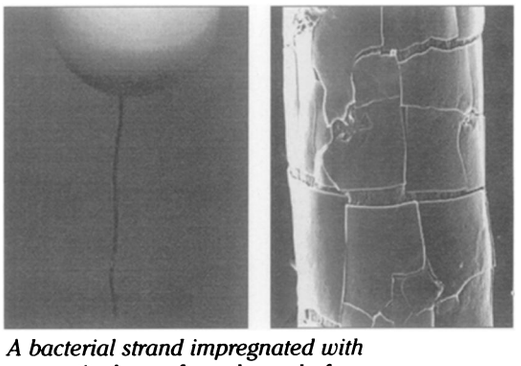
Ceramics cling to long bacterial strings

Many scientists have been looking to nature for ideas on how to make useful materials, an approach known as biomimetics. They are not only patterning materials after natural ones but also using organic matter to guide the assembly of inorganic structures—the same strategy that mollusks use to make their shells, for example.

Stephen Mann and his colleagues at the University of Bath in England have now recruited mutant bacteria to help them make ceramic fibers. By dipping long threads of the bacteria into suspensions of inorganic particles that are a few nanometers in size, the researchers have produced fibers of magnetite, cadmium sulfide, and titanium dioxide. The structure of the resulting fibers—inorganic matter on an organic scaffold—varies depending on how the materials interact with the bacteria.

Using bacteria as templates "has great potential," says Richard M. Laine of the University of Michigan in Ann Arbor. "If you can tailor the bacterial microstructure, then you can use biology to direct where the ceramics go. I think that it's a potentially hot area."

The Bath researchers used a mutant strain of *Bacillus subtilis* provided by Neil H. Mendelson of the University of Arizona in Tucson (SN: 2/12/94, p. 106). Unlike normal *B. subtilis*, the mutant cells don't separate completely into two cells when they divide. Instead, they remain connected, growing and elongating into a twisty chain.



S.A. Davis *et al.*/Chem. Mater.

A bacterial strand impregnated with magnetite hangs from the end of a magnet (left). A coat of titanium dioxide (right) cracked into plates when it dried on the surface of a bacterial thread.

The chains get easily entangled, Mendelson says, so dragging them out of their growth solution "pulls up thousands of bacterial filaments, which coalesce and dry into a single, hairlike structure up to a meter in length." These strands serve as the templates in the Bath group's study, which appears in the Sept. 21 CHEMISTRY OF MATERIALS.

Each of the three materials the researchers tested interacts differently with the bacteria, depending on whether it carries a positive or negative charge. Negatively charged particles of magnetite, an iron oxide, penetrate the thread, densely packing the spaces between the bacteria. The resulting structure can be suspended from a magnet but has no strength without the bacteria to hold it together. It crumbles if the researchers burn off the organic matter.

Neutral grains of the semiconductor cadmium sulfide don't penetrate the thread as well as magnetite, tending to collect mainly on the outside of the strand. Positively charged particles of titanium dioxide, a white pigment, don't penetrate the thread at all and form a surface coating a few micrometers thick.

Last year, Mann and his group used bacterial templates to make porous silica fibers. The current study takes the technique beyond silica, making it a more general approach, Mendelson says. "The whole idea is that you can use bacterial threads in clever ways to interface with inorganic chemistry."

Bacterial templates allow scientists to design materials with features in the micrometer- and centimeter-size range—larger than is possible with templates made from proteins or other molecules. These nonbacterial templates can generate structures similar to those that Mann's bacteria produced, Laine says, but he admires Mann's technique as "a unique use of biological materials." —*C. Wu*

Calcium gives black teens heart benefits

African Americans face more than twice the risk that whites do of developing high blood pressure, a major risk factor for atherosclerosis. This hypertension, which also tends to develop earlier in blacks, underlies a stroke rate that is 80 percent higher than that of the general U.S. population and a 50 percent higher mortality rate from heart disease. A new study indicates that among healthy black teenagers, consuming adequate calcium can help hold blood pressure down.

"When you have a problem as prevalent as hypertension [in blacks] and find an agent that can reduce that problem early in life, it may end up having enormous public health consequences," observes study leader James H. Dwyer, an epidemiologist at the University of Southern California School of Medicine, Los Angeles.

In the early 1980s, several studies found increased hypertension in persons with diets low in dairy products. Although such foods are rich sources of calcium, they also contain many other minerals that might be protective, complicating the interpretation of the results. In the new study, Dwyer's team isolated calcium's potential role in young blacks by giving supplements of the mineral to 65 girls and 51 boys.

For 8 weeks, on school days a high school nurse administered to each participant either a 1.5-gram calcium supplement or a look-alike tablet containing no nutrients. Most agreed to switch to the opposite type of tablet for a second, 8-week period. Twenty switched yet again, back to the first tablet, for a third phase of the study. Every 2 weeks, the researchers took the blood pressure of those who were still participating in the trial.

On average, diastolic pressure fell by 2 millimeters of mercury (mmHg) during periods when the teens received the extra calcium. The diastolic pressure is the vascular system's low point, occurring when the heart's chambers are filling with blood. The greatest drop—almost 5 mmHg—occurred among teens reporting diets low in calcium, Dwyer's team says in the September AMERICAN JOURNAL OF CLINICAL NUTRITION.

Systolic pressure, the system's maximum, occurs as the heart contracts and pumps blood. Calcium pills had no effect on this pressure—except perhaps in the teens whose diets were low in calcium.

Though blood pressure was within the healthy range in all of the students, Dwyer notes that without the calcium supplement "they tended to be in the top half of the normal distribution." The 5-mmHg drop in diastolic pressure seen in the low-calcium group, therefore, "would be sufficient to bring a large proportion of them below the average," he says. In fact, he notes, this diastolic-pressure drop is roughly equivalent to what has been observed in some adults who follow a low-fat, heart-healthy diet or who take blood-pressure medicine.

The finding that calcium supplements confer the greatest blood-pressure benefit on those with the lowest dietary calcium intake is consistent with what's been seen in adults, observes Janice Lea of the Emory University School of Medicine in Atlanta. Moreover, she notes, because heart disease can begin in youth, the new findings reinforce that "it's important to target young people and educate them about appropriate diets."

Though this new study hints that many black children might benefit from calcium supplementation, "we'd need a lot more studies to know for sure," maintains Elijah Saunders of the University of Maryland School of Medicine at Baltimore. Indeed, he says, compared to many other hypertension risk factors, such as excessive sensitivity to dietary salt (SN: 5/3/86, p. 280), stress, eating too little potassium, or obesity, "I don't think that calcium is a major player."

However, he adds, "this new study is interesting," and its findings deserve further investigation. —*J. Raloff*