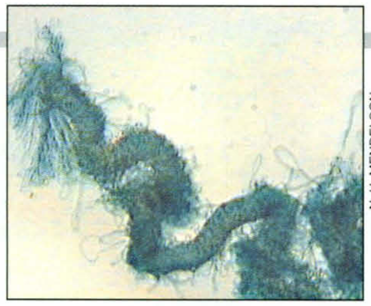
eled as elastic filaments, because ionized gases associated with them have mass and anchor the magnetic flux tubes in the interior. Because one end is weighted down, the filaments acquire tension, explains physicist Dana Longcope of Montana State University (MSU) in Bozeman.


N. H. MENDELSON

Biofiber. A bacterial "macrofiber" expresses a reporter gene (blue).

But theorists have had a hard time explaining how this tension causes flux tubes to twist above the surface of the sun and trigger flares, says Longcope. Then, MSU mathematician Isaac Klapper, who worked with Tabor, showed Longcope the new elasticity model for supercoiling bacteria. "I knew these were the equations that could describe magnetic flux tubes," says Longcope, and "it was a surprise that they came from bacteria." When applied to the sun, the model showed that the twisted magnetic flux tubes release their stored-up energy by writhing out of their plane, thus triggering solar flares. Longcope and Klapper describe this in a paper in press at the *Astrophysical Journal*. Modeling solar flux tubes is the first step in understanding them, and perhaps eventually predicting the flares, which emit energetic particles that can damage satellites, says Klapper.

Meanwhile, materials scientists have been pursuing another line of research on mutant *B. subtilis*. When cultured in crowded conditions, the separate strands become matted together into webs resembling spaghetti in a bowl. Mendelson invented a device to pull meter-long threads from webs; a thread contains up to 30,000 parallel bacterial filaments and "looks like nylon fishing line," says materials chemist Stephen Mann of the University of Bath in England.

Mendelson found that because the cell walls of *B. subtilis* consist of two negatively charged polymers that attract positively charged minerals, the threads bind mineral salts in solution, including those of iron, calcium, and copper. These encase and stiffen the threads, forming a crystalline fibrous framework—and opening a whole realm of potential new materials. Called bionites, these bacterial-mineral hybrids look like red, black, green, or silver fiberglass, depending on the mineral used. Weight for weight, bionites are stronger than steel, yet are also biodegradable.

In the most recent bionite work, Mann, Mendelson, and colleagues created siliceous bionites that may be useful for medical implants. Ordinary silica is a good candidate for implants because it is fairly inert and doesn't react with tissue. But an ideal material would be porous, so that natural tissue could attach to it, explains Stuart Williams, chair of biomedical engineering at the University of Arizona. Silica naturally contains only nanometer-sized pores, too small for cells to gain a foothold, he says.

Bionite researchers were able to improve on nature. Mann's team first made siliceous bionites, then burned out the bacterial fibers by heating them in an oven. The resulting white silica fibers contained ordered channels of two sizes: the tiny, natural pores, as well as larger channels 0.5 micrometer wide left by the fibers (*Nature*, 30 January). These large channels could provide a scaffolding for cell growth, as well as a route for antibiotics or growth factors added to the implant to leak slowly into surrounding tissue, says Williams, who calls this "a major improvement" in medical materials.

Even in microbiology, the mutant *B. subtilis* is finally getting its due. The microbe's antics are making their way into microbiology texts and for the first time in 20 years, Mendelson spoke by invitation at last year's annual meeting of the American Society for Microbiology. Accepting his ideas took time because of his "unique approach" and focus on mechanics, says microbiologist Gerald Shockman of Temple University in Philadelphia. But whether the research is called microbiology, mathematics, or materials science, it's clear that Mendelson's microbes have come into their own.

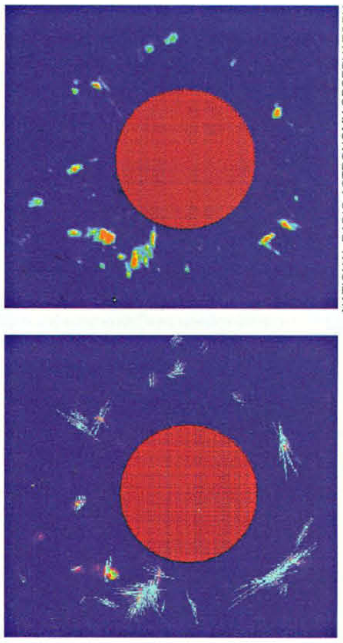
–Carol Potera

Carol Potera is a science writer in Great Falls, Montana.

ASTRONOMY

Mapping a Star's Magnetic Field

Astronomers have enlisted a continent-wide array of radio telescopes to map the magnetic field of a bloated red giant star. This first magnetic map of another star, to be published this week in *Astrophysical Journal Letters*, suggests that at least some stars have magnetic fields resembling those of Earth and the sun. And the details of the map—about 50 times smaller than the finest features visible to the Hubble Space Telescope—could help theorists model how red giant stars shed gas and dust into interstellar space.


NATIONAL RADIO ASTRONOMY OBSERVATORY

Fine detail. Regions of intensified radio emission around a red giant star *(top)* enabled astronomers to map parts of its magnetic field.

Astronomers can't observe magnetic fields directly, so Athol Kemball and Philip Diamond of the National Radio Astronomy Observatory in Socorro, New Mexico, relied on radio waves, which are polarized by magnetic fields. Normally, the radio waves from the star they observed—TX Camelopardalis (TX Cam), which lies about 1000 light-years away—would be too faint to see. But TX Cam is swathed in clouds of excited silicon monoxide molecules. These clouds act as an amplifying medium for radio waves, in much the same way that a laser amplifies light.

To pick up the signals and map their polarization, Kemball and Diamond turned to the Very Long Baseline Array (VLBA), a network of 10 identical radio telescopes that stretches across the United States. By combining signals from its far-flung dishes, the VLBA mimics a single antenna the size of the continent, picking up details that would elude smaller telescopes.

The VLBA's map of radio polarization across TX Cam is "strongly suggestive of order in the magnetic field," says Kemball, although he cautions that the map shows only two dimensions and doesn't pin down the field's north and south poles. But Kemball says the field's most likely structure is similar to Earth's field, with magnetic field lines looping around the planet parallel to lines of longitude. In several spots, however, the field lines are twisted and kinked, much as they are around flares on the sun. The magnetic kinks could affect the way gas and dust escape from the star, says Kemball.

He and Diamond hope to monitor TX Cam every 2 weeks, looking for changes in the field lines to see whether this giant star has a magnetic cycle. Meanwhile, astrophysicists are delighted by their first clear pictures of a star's field. The resolution, says Mark Reid of the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, "is truly astounding."

–Erik Stokstad