genera *Haloterrigena*, *Natronomonas*, and *Halorubrum* as well as a single-celled alga known as *Dunaliella*.

The microorganisms grown from the buried halites brought back from Death Valley differ from others found trapped in fluid inclusions in modern halite, Lowenstein points out. “The ancient prokaryotes are coccoid-shaped and ‘miniaturized,’ with cell diameters of less than 1 μm, much smaller than the straight or curved rods and coccoid-shaped prokaryotes (typically about 1 μm in diameter) of their surface counterparts,” he says, noting that the recovered microbes resemble modern “starvation-survival” forms of microorganisms.

One major question is how cells that are “trapped alive” can maintain themselves for thousands of years. Perhaps the miniaturized cells used carbon and nutrients from the debris of other organisms within the inclusions or from *Dunaliella* by-products, Lowenstein and his collaborators speculate. In modern hypersaline systems, for example, *Dunaliella* cells produce glycerol.

“This [research by the SUNY group] is a major advance,” says Vreeland of WCU. “The presence of algal cells inside the inclusions . . . provides at least some energy source for repair of damage over time [and] at least some mechanistic hypothesis for those who want to believe that an organism can survive but can’t get past the idea that they have to metabolize.” However, he adds, “In such closed systems any metabolism would produce wastes that would ultimately kill the trapped organisms.”

Lowenstein agrees that metabolically active microbes in such inclusions need some means to dispose of waste products. “We do not see gas bubbles in fluid inclusions, which suggests CO₂ and other gaseous compounds are not abundant,” he says. “We know the fluid inclusions are anoxic, so the aerobic halophilic archaea that we cultured from fluid inclusions must be able to switch to anaerobic behavior, but how?”

“There are many ways in which salt can help make a habitable environment in a dry place,” says Christopher McKay, an astrobiologist from the NASA/Ames Research Center in Moffett Field, California, who also studies halite deposits. “The salt layer often acts like a lid holding in water while allowing sunlight to penetrate. Salt also lowers the vapor pressure and hence the evaporation rate. . . . We see examples where the absorption of atmospheric moisture by salt provides a source of liquid water.”

Some Strains of Foodborne Listeria Target the Heart

Some strains of the foodborne pathogen *Listeria monocytogenes*, known for causing gastroenteritis, also can infect the heart, sometimes fatally. Moreover, heart-targeting strains apparently favor muscle tissue instead of valves, setting them apart from other bacterial pathogens that target this organ, according to Nancy Freitag at the Chicago College of Medicine, part of the University of Illinois in Chicago, her colleague Francis Alonzo, and their collaborators, Linda Bobo at Washington University School of Medicine in St. Louis, Mo., and Daniel Skiest of Baystate Medical Center-Tufts University School of Medicine in Springfield, Mass. Slight changes in proteins that enable this pathogen to bind and enter host cells might help to explain this unusual targeting of the heart instead of other tissues and organs, the researchers say.

In addition to causing gastroenteri-
Gut Microbiome Possible Role in Heart Disease, Three Distinct Human “Enterotypes”

Shifting the composition of the gut microbiome, including use of antibiotics to suppress metabolic activity of the microbial flora, might help to prevent or treat atherosclerotic heart disease, according to Stanley Hazen of the Cleveland Clinic Foundation in Cleveland, Ohio, and his collaborators. Thus, although dietary choline can accelerate atherosclerosis in mice, antibiotic treatments block that effect, apparently by suppressing microflora in the host gastrointestinal tract and preventing trimethylamine N-oxide (TMAO) from forming in the liver and moving into circulating blood. Details appear in the 7 April 2011 *Nature* (472:57–63). Separately, although the human gut contains many species of microbes, and they vary greatly between individuals, those microorganisms can be classified into three main “enterotypes,” according to Peer Bork of the European Molecular Biology Laboratory in Heidelberg, Germany, and his collaborators. Although complex, the enterotype classifications may help explain why individuals respond differently to various drugs and diets, and also might help in diagnosing disorders such as colorectal cancer and diabetes.

Details appear online 20 April 2011 *Nature* (DOI: 10.1038/nature09944).

Kathryn Boor of Cornell University in Ithaca, N.Y. If specific traits associated with the most deadly strains were better understood, strategies might be developed to combat them, keep them from the food supply, or screen particularly vulnerable people during outbreaks that those strains cause.

Moreover, clinicians need to think more broadly about microorganisms that may be involved in endocarditis, Boor says. Other bacterial pathogens that can damage the heart, including *Streptococcus* or *Staphylococcus* strains, typically grow on and damage heart valves. By contrast, *L. monocytogenes* strain 07PF0776 apparently prefers heart muscle. “Examining strains from unusual cases can lead to breakthroughs about the fundamental physiology of microbes,” she says.

*L. monocytogenes* is responsible for about 1,500 cases of listeriosis yearly in the United States, yet its death rate of 20% is among the highest for foodborne illnesses, according to officials from the Centers for Disease Control and Prevention in Atlanta, Ga. Listeriosis is on the rise in Europe, and that increase appears to stem from increased consumption of refrigerated foods, reflecting this microorganism’s preference for growing at cool temperatures. Although a common contaminant of deli meats and soft cheeses, recent U.S. outbreaks were linked to contaminated potato salad, packaged salad greens, and refrigerated waffles.

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Metagenomic Analysis Suggests Fourth Domain within Tree of Life

Analysis of metagenomic data suggests a fourth domain of life, according to Jonathan Eisen of the University of California Davis (UCD). Based on biological samples collected from 2003 to 2007 during the Global

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