manganese deposits as stromatolite components until they examined several samples using scanning electron microscopy. That analysis revealed an unusual abundance of fossil microbes, while thin sections under a petrographic microscope exposed dendritic structures, very similar to those in found in fresh-water carbonate stromatolites. “We returned to the cave to have a closer look at the black layer, realizing its stromatolite nature and its huge extension,” he says. “We were shocked to observe at least three levels of stromatolites, which extend for more than 2 km in the main gallery of the cave.”

Without light to drive photosynthesis, how are these underground stromatolites formed? Electron microprobe analyses and other data support the idea that chemolithotrophic, manganese-oxidizing microbes, growing in a low-gradient water-table stream, are the likely culprits that began this process at least 1 million years ago, according to Rossi and his collaborators. Uranium-series dating of mineral formations lying above the stromatolites is consistent with this minimum age.

“The idea that microbial communities could have thrived in caves during the Precambrian to protect themselves from [ultraviolet irradiation] is exciting but hard to check,” Rossi says. “There are no caves of Precambrian age that we know of. Because of the limitations of normal dating methods, there are very few caves with proved ages older than 1 million years.” (The Precambrian period ended about 590 million years ago.) He and his collaborators are attempting to improve the age dating of the stromatolites and want to determine their growth rates. “We are also mapping the distribution of the different stromatolite levels in this vast cave system, and trying to locate sites in which manganese-iron stromatolites could be growing,” he says.

“The amazing preservation of the bacteria shown in the cave stromatolites is simply not seen in subaerial rock varnishes,” says geographer Ron Dorn of Arizona State University in Tempe, a leading expert on manganese oxide coatings on desert rocks. He considers the findings reported by Rossi and his collaborators “outstanding.”

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**Tossing Molecular Wrenches into Viral and Toxin Nanomachines**

If antimicrobial molecules could be crafted like metaphors, poetic microbiologists would be strolling golden pathways. Never mind: those microbiologists who now tinker with “nanomachines,” including molecular components of the botulinum and anthrax toxins and from viruses such as Ebola, seem pleased with this new way of framing efforts to develop remedies and preventive agents, as evidenced by several who spoke during the plenary session, “Jamming Nanomachines,” part of the 9th ASM Biodefense and Emerging Diseases Research Meeting, held in Washington, D.C., last February.

The botulinum toxin is a “modular nanomachine,” says Mauricio Montal of the University of California, San Diego, noting that the toxin forms after the full protein is clipped to form one light and one heavy chain that are held together by a disulfide bond. This disulfide-linked pair of polypeptides consists of three “modules,” none of which is toxic by itself, he says. The assemblage is “remarkable when the modules work together, forming the most toxic protein we know.”

In terms of its deadly effects on humans or other vulnerable species, botulinum toxin interferes with nerve-cell transmissions at synaptic junctions by blocking release of acetylcholine mol-
Spiked with Receptor Proteins, Synthetic Cells Efficiently Entrap Viruses

Synthetic protocells, consisting of a lipid membrane embedded with the viral receptor protein Ephrin-B2 and wrapped around a nanoporous silica core, efficiently bind and absorb henipaviruses, according to David LaVan of the National Institute of Standards and Technology (NIST) in Gaithersburg, Md., and his collaborators there and at Weill Cornell Medical College in New York, N.Y. Some henipaviruses, which include the Nipah and Hendra viruses as well as those responsible for parainfluenza, respiratory syncytial virus, mumps, and measles, depend on binding to that protein to enter cells. In this case, the protocells prove highly efficient at taking up avirulent analogues of such viruses—“essentially clearing a test solution” and thus diverting those viruses from living cells, according to LaVan. Details appear in the March 1, 2011 PLoS ONE, http://dx.plos.org/10.1371/journal.pone.0016874.

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