UMBI NEWS

life. science. works.

Contact: Gene Levinson
(443) 250-9654
levinson@umbi.umd.edu

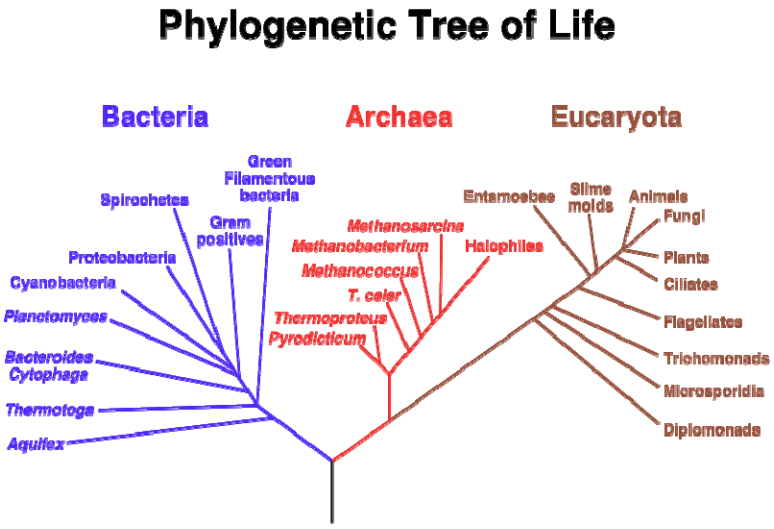
Most Radiation-Resistant Microbe: From a Third Kingdom of Life

September 25, 2007

Baltimore Maryland. For Immediate Release.

Anyone who thinks that all the major discoveries in science have already been made may want to have a closer look. In most cases, new findings depend on special conditions that reveal unusual or unexpected phenomena. And in the microbial world, we have hardly even begun to examine the extreme capabilities of the many millions of novel—and largely unstudied--microscopic life forms that surround us.

Investigators at Idaho State University and at UMBI, the biotechnology institution of the University System of Maryland, have now isolated the most radiation-resistant organisms known to science. The latest contenders are members of a remarkable kingdom of microorganisms known as Archaea. Archaea, first discovered only 30 years ago, like bacteria, have no cell nucleus, but they represent a kingdom that is closer, on the tree of life, to plants and animals than bacteria.

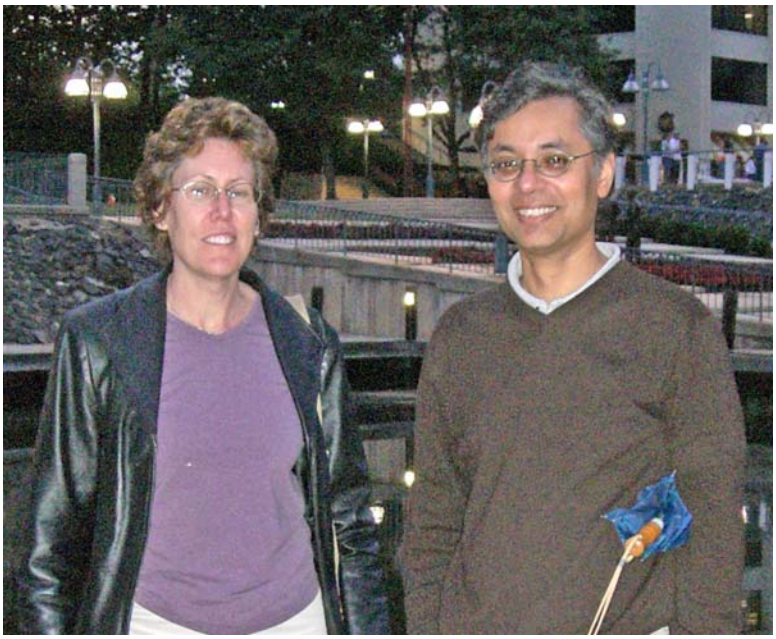


Using advanced techniques for isolating radiation-resistant mutants, Dr. Linda C. DeVeaux, Dr. Shiladitya DasSarma, and colleagues have isolated mutants that are more radiation-resistant than any other known life form discovered to date.

The radiation-resistant microbes depend on at least two different pathways for their radiation-resistance.

One such pathway is shared by bacteria, while the other is found in higher organisms such as multicellular animals. The latter pathway was activated in the radiation resistant mutants. The findings will appear in the October issue of the scientific journal *Radiation Research*. Other scientists contributing to the paper include Jochen A. Müller, Jonathon Smith, Jill Petrisko and Douglas P. Wells.

Many of these Archaeans thrive in extreme environments that would be quickly lethal to other life forms—such as volcanic boiling hot springs, caustic chemicals such as acids, hydrogen sulfide, or acids or alkaline conditions so extreme that they would burn through human skin. For this reason, the microbes are known as extremophiles, or “lovers of extremes”.



Dr. Linda C. DeVeaux and Dr. Shiladitya DasSarma

The rad-resistant microbes are mutants derived from *Halobacterium* species NRC-1. *Halobacterium* are found in bodies of water that are extremely salty, and in pools that are subjected to repeated drying cycles. In these extreme environments, ultraviolet radiation from the Sun combined with salty and desiccating conditions are very hard on DNA, the genetic material. Most cell types would suffer far too much damage to the DNA under such conditions to survive.

But life will find a way, and natural selection has favored the *Halobacterium* NRC-1, which has evolved some remarkable methods

for DNA repair. The mutants exceed the impressive radiation resistance of the natural species.

In general, extremophiles have offered unprecedented opportunities for developing new products in biotechnology. For example, studies of *Thermus aquaticus*, which thrives in boiling hot springs, have opened up a large market for enzymes that are now routinely used to amplify DNA sequences in forensics and biomedical research; this technique, known as PCR, has revolutionized biology, medicine, and forensics.

Before the isolation of the NRC-1 mutants, the contender for the most radiation-resistant organism has been *Deinococcus radiodurans*, a bacterial cell that was discovered in the 1950s as the sole survivor of canned meats that had been subjected to sterilization by lethal doses of radiation. The current champions were selected as survivors of multiple doses greater than 18,000 gray units (Gy) of radiation, considerably higher than the dose that kills half of the previous champion, *D. radiodurans*. For comparison, a dose of only 10 Gy is lethal to humans, and 60 Gy will kill an entire culture of *E. coli,* a common bacterium. One gray is equivalent to the amount of radiation in about 5,000 chest X-rays. Both *Deinococcus* and *Halobacterium* thus survive doses hundreds or thousands of times higher than those lethal to other life forms. The selected mutants of NRC-1 are even more resistant than *Deinococcus*.

As is often the case in biotechnology, the new discoveries suggest possible applications that could prove beneficial to humans, or that may have environmental applications. For example, it may be possible in the future to confer radiation-resistance, or DNA repair in general, by transferring the genes to other organisms, such as plants.

With research centers in Baltimore, Rockville, and College Park, the University of Maryland Biotechnology Institute is the newest of 13 institutions forming the University System of Maryland. UMBI has more than 60 ladder-ranked faculty and a 2007 budget of $59 million. Celebrating the institution's 20th year of service to Maryland and the world, UMBI is led by microbiologist and former biotechnology executive Dr. Jennie C. Hunter-Cevera. For more information visit http://www.umbi.org.

From its main campus in Pocatello, Idaho, Idaho State University serves as a doctoral-level statewide center of research, learning and the arts for 14,000 students. They come from across the region and around the world to study in the University's seven colleges, which

offer more than 280 certificates and degree programs. From nuclear engineers to health-care professionals, leaders in a wide range of disciplines have relied on Idaho State University as their springboard to success in the global economy. Visit ISU today at www.isu.edu. DeVeaux can be contacted at (208) 282-5661 or deveaux@physics.isu.edu.

###