Mystery of Radiation-Resistant Bacterium Solved

Note from pastor Kevin: In the following article, we learn of how a bacteria protects itself from radiation. The self-protection built into these bacteria has taken very intelligent researchers decades to unravel and understand. It amazes me that these same researchers assume the bacteria evolved (by chance and time) into this protection capability. The reader would be better served to consider the Psalmist who acknowledges that it is God who made us (and made all things) by His infinite knowledge and power.

Ps 139:14 I will praise You, for I am fearfully and wonderfully made; marvelous are Your works, and that my soul knows very well.

Weizmann Institute organic chemists have solved an old scientific mystery of what makes a specific bacterium the most radiation-resistant living thing in the world. While some Russians had claimed it came from Mars, the Israelis found that its durability derives from the fact that the DNA in the red-colored Deinococcus radiodurans is packed tightly in a unique ring, which prevents pieces of DNA broken by radiation from floating off into the cell's liquids.

Writing in the January 10 issue of the journal "Science," Prof. Avi Minsky of the Rehovot institute's organic chemistry department said the microbe can withstand 1.5 million rads a thousand times more than any other life form on Earth and 3,000 times more than humans. An explanation has long been sought by the scientific community.

Its healthy "appetite" has made the bacterium a reliable worker at nuclear waste sites, where it eats up nuclear waste and transforms it into more disposable derivatives. The ability to withstand other extreme stresses, such as dehydration and low temperatures, makes the microbe one of the few life forms found on the North Pole. It is not surprising, then, that it has been the source of much curiosity worldwide, recently leading to a debate between scientists at the US National Aeronautics and Space Administration and in Russia, the latter saying that it originated on Mars, where radiation levels are higher.

Minsky, along with other scientists, believes that the bacterium's answer to acute stresses evolved on Earth as a response to the harsh environments from which it might have emerged. It is one of the few life forms found in extremely dry areas. The unique defense mechanism that evolved to help it combat dehydration proves useful in protecting it from radiation.

Since DNA is the first part of a cell to be damaged by radiation and the most lethal damage is the breakage of both DNA strands, scientists have focused on DNA repair mechanisms to find the answer to the microbe's resilience. Cells, including human cells, can mend only very few such breaks in their DNA. Microbes, for example, can repair only three to five. Yet D. radiodurans can fix more than 200. Thus scientists believed that the microbe must possess uniquely effective enzymes that repair DNA. However, a series of experiments showed that the microbe's repair enzymes were very similar to those existing in ordinary bacteria.

D. radiodurans was discovered decades ago in canned food that was sterilized using radiation. Red patches (which were bacterial colonies) were found in the cans, setting off questions as to how they could have survived. Though these questions have now been answered, the tide of speculation as to how and where these defense mechanisms evolved is likely to continue. Unlike other organisms, in which DNA fragments are lost due to radiation, this microbe does not lose genetic information because it keeps the severed DNA fragments tightly locked in the ring by the hundreds, if necessary. The fragments, held close, eventually come back together in the correct, original order, reconstructing the DNA strands.

"As exciting as these findings may be," said Minsky, "they are not expected to lead to the protection of humans from radiation. Our DNA is structured in a fundamentally different manner. The results may, however, lead to a better understanding of DNA protection in sperm cells, where a ring-like DNA structure has also been observed.

The Weizmann team, which used a variety of optical and electron microscopy methods, also found that the microbe undergoes two phases of DNA repair: During the first phase, the DNA fixes itself within the ring as described. It then performs an even more unusual stunt. The bacterium is composed of four compartments, each containing one copy of DNA. Minsky's group found two small passages between the compartments. After about an hour and a half of repair within the ring, the DNA unfolds and migrates to an adjacent compartment where it mingles with the copy of DNA residing there. Then the "regular" repair machinery, common in humans and bacteria alike, comes into play; repair enzymes compare the two copies of DNA, using each as a template to fix the other. Since the DNA has already been through one phase of repair in which many of the breaks are fixed, this phase can be completed relatively easily.

The team then wondered how the bacterium could live and function under normal conditions. DNA strands must unfurl to perform their job of protein production. How, they asked, can they do that if they can barely move? In their attempts to answer this question, they uncovered another of the microbe's survival strategies. Out of the four copies of DNA, there are always two or three tightly packed in a ring while the other copies are free to move about. Thus at any given moment there are copies of DNA that drive the production of proteins and others that are inactive but continuously protected.