RADIOACTIVITY'S ROLE:

North Korea. Iran. Dirty bombs. The specter of nuclear contamination seems larger every day. Not since the early 1960s -- when suburban families stocked their fallout shelters and schools had nuclear bomb drills -- has the world seemed so on edge.

This is especially true for anti-nuclear environmental activists, who are concerned about the long-term effects of radioactive fallout on the biosphere. I concur with them on many points because radioactive clouds can indeed cause horrific illness and uncontrolled mutations. But I wholeheartedly disagree that radioactivity is bad for life.

A fascinating link between life and radioactivity has just been discovered in a South African gold mine near Johannesburg. There, nearly two miles below the surface, are microbes living in cracks in rock. It's hot as the pavement in Phoenix in August. The pressure is high, the chemistry noxious. It's pitch black, meaning no photosynthesis. And there are no mineral springs of the type that give non-photosynthetic life a chance elsewhere.

We must ask the question, "On what energy source does this life depend?"

The answer is radioactivity.

Yes, you heard me correctly. From the rock comes the spontaneous disintegration of uranium, thorium, potassium and other unstable isotopes. The bursts of radiation from decay events can strip an atom of hydrogen from a molecule of water, creating free hydrogen. This is nature's perfect junk food: no fiber, no fuss, just pure, burnable energy. And feasting upon that junk food is a strain of bacteria related to the firmicutes, which dwell in boiling geothermal springs on the floor of the abyss.

It's no party in Johannesburg, however. Though the junk food is pure, there's not much of it around. The bacteria that dine upon it may have to wait thousands of years to reproduce. They live in the slow lane, in splendid isolation, far apart from what Darwin called the "tangled bank" of surface life.

NASA, which funded the study, loves the notion of radioactive bacteria because agency scientists are interested in the possibility of alien life. Our present answer to the question "Is there life on Mars?" for example, is "We're not sure, but if it does exist, it's probably below the permanent deep freeze of the planetary surface but above the heat of the interior."

Hence, from NASA's point of view, the best way to investigate the possibility of life on Mars is to look for places on Earth that resemble those of the Martian underground. The South African gold mine is their best bet, one that paid off, because it increases the probability that life exists on other planets or large moons. If life can exist in weird places and for weird reasons on planet Earth, then the same is true for weird places elsewhere in our solar system, or on weird ones beyond.

At this point, I'm feeling sorry for Spirit, the unmanned robotic geologist prowling around on the Martian surface. It's still going strong, more than a year after its planned obsolescence, not unlike the Energizer Bunny in a popular advertisement for alkaline batteries. But the romantic in me can't help but believe that his cold metal heart is a lonely hunter, looking in vain for life on the surface.

I hope that the discovery of an underground Earth ecosystem -- fueled by the same process (spontaneous fission) that makes our nuclear reactors go -- ends the exaggeration that nuclear power will ruin the biosphere. In fact, radioactivity has contributed much to biodiversity.
It's an important source for genetic mutations, upon which natural selection operates. It's also a fuel for Earth's underground heat engine. Without geothermal springs, life may not have gotten its start at all. Without volcanoes, Earth's carbon balance would be out of whack, its surface possibly frozen solid. Without plate tectonics, the diversity of life -- kangaroos in one place, giraffes in another -- would be much more limited.

Radioactivity in the wrong place is nasty. Radioactivity in the right place is essential.

A nuclear warhead is the wrong place. But I'm not so sure about the core of a nuclear reactor, where the advantage of a zero-carbon fuel might outweigh the risk of local contamination.