The Scientist: NewsBlog:
Arsenic and old...photosynthesis?
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A previously unknown form of photosynthesis discovered in purple bacteria scooped from a Californian hot spring may be an ancient process that arose before the evolution of oxygenic photosynthesis, according to a paper published on Friday (August 15) in *Science.*

The bacteria use arsenic instead of water for photosynthesis.

"It's a fundamental, exciting observation," said Tim McDermott, a professor of microbial ecophysiology at Montana State University, who was not involved in the research.

The discovery "gives me a further appreciation of how talented, metabolically speaking, the microbial world really is," McDermott added. "Nothing surprises me anymore."

Arsenic is well-known for its toxicity; it was used so often as tool for homicide in the 1800s that it earned the nickname "king of poisons." A molecular analog of phosphate, arsenic disrupts production of ATP and impairs the function of proteins, among other mechanisms. Research has revealed that different oxidative states of the toxin function as an electron acceptor (arsenate) for anaerobic respiration in some bacteria, and an electron donor (arsenite) for CO_2 fixation in others.

Taking that research a step further, Ronald Oremland, a senior scientist with the U.S. Geological Survey, and colleagues isolated the bacteria from a hot spring on an island in Mono Lake, California, a closed basin lake high in salts and minerals. A sample taken from biofilms covering submerged rock surfaces in the hot spring exhibited arsenite oxidation in the light but not the dark, a sign of photosynthesis. From the sample, the researchers isolated a species of genus *Ectothiorhodospira,* anaerobic purple bacteria that typically use hydrogen sulfide as a reducing agent for photosynthesis. Grown in pure culture, the bacteria demonstrated the same arsenite-driven photosynthetic activity.

There are two evolutionary hypotheses for the wide diversity of microbes that respire arsenic, said Oremland. Since the process requites strong oxidants, it could have evolved recently in the presence of oxygen or nitrate, and diverged through rapid lateral gene transfer. Genomic analysis of the new discovery, however, provides molecular evidence for the alternate hypothesis, said Oremland: Arsenate respiration is an ancient process that evolved in the hot, anoxic environment of ancient Earth.

The next step, says Oremland, is to go back to the island and collect more samples to see if other types of bacteria have the same photosynthetic ability. But there was only one puddle with the biofilm, he said. "I hope it's still there."