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Published May 10, 2022. Editor's Headline: Life in the Dark

Yellowstone National Park holds soaring peaks, cascading waterfalls, steaming geysers, bubbling mudflats—and it holds the minuscule inhabitants that color the waters of Yellowstone's hot pools. Though recognizable only under a microscope, the tiny critters embellish diversity in astounding ways. They exist in huge colonies, every one adapted for a different temperature zone within the pool. Grand Prismatic Spring's eye-catching colors, from vivid orange to deep azure, denote the existence of multiple types of thermophilic (heat-loving) archae that thrive in temperatures of 147 to 188 degrees Fahrenheit. These organisms have small, simple cells that lack nuclei.

A microorganism of a different sort makes a living in the superhot vents far below the surface of the park. The scientific name of the bacterium, Thermus aquaticus, has been shortened to Taq. Until Taq was discovered, humans believed life could not exist without sunlight.

Life on earth is fueled by enormous amounts of energy, intercepted from the sun through the chemical reaction involving one main molecule, chlorophyll. Its reaction with water and carbon dioxide produces sugar, the main fuel that powers life, through a process called photosynthesis. All living creatures, scientists postulated until recently, partake of the sun's energy, either by generating photosynthesis or by eating the photosynthesizers.

In the late 1970s, the scalding hot pools of Yellowstone and the volcanic vents on mid-ocean ridges proved otherwise. There, scientists discovered Taq and its thermophile companions, all of them drawing their energy from the superheated waters. Thus began the study of a form of bacterial life that had eluded us before.

Taken as a group, bacteria are the master chemists of our planet. Even the chemistry of human cells is largely borrowed from bacterial guest workers, writes Richard Dawkins in *The Ancestor's Tale*, yet even these feats are only a fraction of what bacteria are capable of achieving. Not only that, there are many more of them (in terms of biomass) than there are of multi-celled beings from trees to humans. The great majority of life's diversity is microbial, and a substantial majority thereof is bacterial.

If plants and animals are treated as a pair of kingdoms, by the same standards there are dozens of microbial "kingdoms," each and every one so unique, they are entitled to the same status as animals and plants, writes Dawkins; animals, plants, and fungi constitute a mere three branches on the tree of life. What distinguishes these three from those of microorganisms is that each is made of many cells; all the others are almost entirely microbial. Yet at the biochemical level, these others are astoundingly diverse. Many of the microbial dozens of kingdoms are as different from each other as the three known "kingdoms" of human classification. Dawkins provides a diagram of three main superkingdoms or "domains" of which animals and plants—humans register in the animal kingdom—are part of Eukarya. Another domain comprises Eubacteria and yet another, Archaea.

Comparing genomes is one way of looking at diversity. Another is looking at the range of "ways of life," the trades, so to speak, that different life forms have carved out for themselves. Planet Earth's diversity is breathtaking.

From the biochemical point of view, koalas, moles, lions, and buffalos all derive their energy by breaking down complex molecules put together by sun-energy captured by plants. Koalas and buffalos eat the plants directly; lions and moles get their solar energy at one remove, by eating animals that ate the plants. Without the massive inflow of energy from the sun, life would—so the textbooks used to say—grind to a halt. That's before we knew about thermophilic microorganisms that live in the superheated vents.

Today's animals and humans use oxygen that was (and is) produced by plants and algae, but oxygen atoms were present in earth's early atmosphere, not as oxygen gas but tied up in compounds like carbon dioxide and water. Carbon today is mostly locked up in living bodies (trees, plants, animals, humans) or in certain rocks (chalk, limestone, coal) and petroleum, all consisting of the remains of once-living bodies.

Billions of years ago those carbon atoms would have existed in the atmosphere as compound gases such as carbon dioxide or methane. If humans burned all the fossil fuel in the world by tomorrow, much of the oxygen in the atmosphere would be replaced by carbon dioxide, restoring the planet to its ancient status quo. The only reason we have oxygen to breathe is that most of the carbon is tied up underground.

Love of high temperatures is far from rare among bacteria and archeans; in fact, it's quite common. Our familiar cool forms of life only very gradually evolved from it. When we dig down into the rocks, we dig backwards in time, rediscovering something of life's scalding beginnings. Today's scientists believe that life on Primitive Earth originated, not in the sea as was customarily thought, but deep underground, in the cracks of superheated rocks via hyperthermophilic bacteria.

"We shall be here after you are gone," are the words Dawkins puts into Taq's hypothetical mouth. Long after humans will have ceased to exist, Ancestor Taq and related bacteria and archeans will continue to watch over life. Even if our planet were hit by a nuclear holocaust, perish the thought, life will continue at microscopic levels. It's an arresting idea.