“…biology is at the point where it must choose between two paths: either continue on its current track, in which case it will become mired in the present, in application, or break free of reductionist hegemony, reintegrate itself, and press forward once more as a fundamental science. The latter course means an emphasis on holistic, “nonlinear,” emergent biology—with understanding evolution and the nature of biological form as the primary, defining goals of a new biology.”

 - Carl Woese “A New Biology for a New Century” 2004 p.185

MICROBIOLOGY AND MOLECULAR BIOLOGY REVIEWS, June 2004, p. 173–186

Carl Woese (1928-2012) discovered Archaea. He determined that Archaea were representative microorganisms of a third domain of life. He invented the sequencing technique for the 16S ribosomal RNA gene to determine the differential phylogenetics of bacteria and archaea. Carl Woese did not receive a Nobel prize for this work. He deserved the prize. Professor Woese lamented the state of biological science as merely genetic engineering and the lack of emphasis on creativity and bold discovery.

Professor Woese would have enthusiastically approved of Tullis Onstatt’s work to establish a “New Biology for a New Century.” “Deep Life” documents the search for the limits of Biology using Carl Woese’s anaerobic 16S ribosomal RNA techniques.

I am eight years late for this party. “Deep Life” was published in 2017. My sincere apologies. Nonetheless, “Deep Life” is a masterpiece of New Biology. The late Professor Tullis Onstott’s work is not just another popular science book. The detail, structure, content and the vivid storytelling makes this a must read for anyone interested in “A New Biology.” "Deep Life" is Tullis Onstatt's record of discoveries, observations, conflicts, negotiations, fund-raising, collaborations, and everything needed to achieve his scientific goals. TO must have kept detailed notes of his experiences as a geologist-microbiologist searching for life in the depths of the earth.

 I missed this gem as did many others. \*

(\*I was made aware of Tullis Onstott and Deep Life from a recent reading of “Becoming Earth” by the science journalist Ferris Jabr, Random House 2024. Jabr briefly references TO and Deep Life.)

Throughout the last half of the twentieth century our attention has focused on the search for extraterrestrial biology. Astrobiology, the Space Shuttle, Hubble Telescope etc. absorbed all of our focus. Intrepid explorers, such as TO have been testing the limits of biology and the anaerobic Archaea and Eubacteria that have made this their subterranean home. These explorers’ efforts were no less daring than the astronauts orbiting the Earth. The scientific knowledge gained rivals that of Darwin, Wallace and other 19th century naturalists. “Deep Life” tells this story. This work is a classic and will endure. TO tells this amazing story that spans the years 1992 through 2009. This story bridges the end of the Cold War with the remnants of underground nuclear testing requiring major environmental cleanup and remediation, and from the Manhattan Project with its toxic chemical and radiological waste, to NASA plans to drill into Martian soils to search for extraterrestrial life. Most important to open the age of New Biology with the microbiological techniques required to discover and characterize extremophile Archaea and Bacteria living underground. “Deep Life” culminates with the discovery of multicellular roundworms living in the depths of South African gold mines. Tullis Onstatt was an important part of this history. He foresaw the future and the significance of his experiences and just how important these are to our nascent understanding of New Biology, our Earth and the search for extraterrestrial life.

His adventures had taken him to exotic and severe locations which include drilling subterranean Triassic lake beds, in Thornhill, Virginia, drilling cores at Cerro Negro near Seboyeta, New Mexico, Parachute, Colorado, sampling underground water at the East Driefontein Gold Mine, South Africa, descending to sample at the Homestake Gold Mine, Lead, South Dakota, drilling through permafrost in the Arctic to test a NASA project to test the feasibility of deep drilling on Mars at High Lake, Nunavut, Canada.

TO is a masterful storyteller. His epigraphs at the beginning of each chapter are short excerpts from Jules Verne’s “Journey to the Center of The Earth” (1864). Jules Verne’s reality is not even close to what we know now. Indeed, TO paints vivid Jules Verne-like images of the real subterranean. TO is not limited to the underground. He tells stories of the University scientific meetings, post-apartheid South African culture; a hair-raising, low altitude Arctic floatplane trip in near zero visibility; student involvement in microbiology and on and on.

Many interesting facts and stories are found in the Notes section. I think that the notes are interesting reading by themselves. He does not clutter his main story with the technical notes which are massive, detailed and yet understandable. The notes could be a standalone book. His notes add enjoyable and informative details. I have learned a great deal of facts from his notes. For example, I did not know that the Idaho National Labs was doing research on an atomic powered airplane. I remember reading about this concept in Popular Science magazine in the 1950’s, but I always thought that this was a concept and not a real engineering project. TO’s explanation of stable and radioactive isotope dating is extensively concise, clear and comprehensible. Also, I did not realize that Archaea are exclusively methanogens, while Bacteria produce Hydrogen and no Methane. He describes the metabolic pathway of Sulfate Reducing Bacteria. Of course we cannot leave off the Death-o-Meter. My only regret is that TO does not discuss my favorite microorganisms, Magnetotactic Bacteria. This is a tiny flaw.

“The best summary of “Deep Life” is excerpted from the final paragraph*.*

*“Today the exploration of subterranean life is not how big the subsurface biosphere is or how far it extends, although these are still significant questions in and of themselves. It is more about discovering the boundaries of our imagination. It is more about removing the blinders that hobble us and our perceptions of the deep biosphere and of life in general is a never-ending challenge. We must always be prepared to be surprised, because many wonders still await us down there in our hunt for deep life.”*

Professor Tullis C. Onstott has succeeded in writing an amazing scientific classic. To find out about the Death-o-meter go read “Deep Life.”it.

Jim Powers

13 February 2025