

Astrobiology News June 2023: WOWs, I-WOWs, and the Ongoing Search for Extraterrestrial Life

Many clergy reading this column may be aware that the word “water” appears more frequently than “faith”, “hope”, “prayer” or “worship” in the Bible. Indeed, by some accounts, water is mentioned 722 times from Genesis to Revelation.¹ Whatever the exact number, it is clear that water connects critically to our lives, health, and spiritual or religious practices. Water’s unique chemical and physical properties make it essential to life on Earth, and they motivate NASA’s emphasis on “following the water” in the search for extraterrestrial life.

In last month’s column, I mentioned the science-fiction movie *Star Trek IV: The Voyage Home*,² where an Advanced Extraterrestrial Civilization (ETC) was attempting to resume communications with whales on Earth. Coincidentally, Alan Stern, noted planetary scientist and principal investigator of the New Horizons mission to explore Pluto and the Kuiper Belt,³ recently presented a very thought-provoking, albeit speculative, seminar to the Planetary Science Institute on the possibility of intelligent life – perhaps even civilizations – inhabiting worlds with subsurface oceans.

Stern distinguishes between three types of Water Ocean Worlds⁴ (WOWs): solid bodies with External-Water Ocean Worlds (E-WOWs), icy satellites and small planets with Internal-Water Ocean Worlds (I-WOWs), and giant planets with high-pressure interior oceans (possibly Uranus and Neptune). While Earth is presently the only known E-WOW, several satellites of the giant planets in our Solar System (e.g. Europa, Enceladus, Titan, Triton), as well as Pluto, fall into the I-WOW category. I-WOWs are also thought to be likely in exo-planetary systems.

Stern notes that studies conducted by the Cassini orbiter of plumes erupting from the surface of Enceladus “check all the boxes” of Astrobiology’s requirements for life. Evidence gathered from multiple instruments provide evidence for the presence of liquid water, “biogenic elements” (carbon, hydrogen, oxygen, nitrogen, sulfur, phosphorus), salts, heavy organic molecules, energy sources at the water-rock boundary, and suggests a suitably stable environment for life. Recently, NASA’s JWST mapped a water vapor plume more than 6,000 miles long erupting from Enceladus.⁵ The study’s co-author Stefanie Milam of NASA Goddard noted that JWST provides a unique way to directly measure how water evolves and changes over time across the immense plume and goes on to say, “Because of Webb’s wavelength coverage and sensitivity, and what we’ve learned from previous missions, we have an entire new window of opportunity in front of us.”

¹ <https://sites.duke.edu/theconnection/2014/06/05/remembering-gods-gift-of-water/> and private communication with Fr. Ed Foley, Catholic Theological Union.

² <https://www.imdb.com/title/tt0092007/>

³ <https://solarsystem.nasa.gov/people/36/alan-stern/>

⁴ <https://www.nasa.gov/specials/ocean-worlds/>

⁵ <https://www.nasa.gov/feature/goddard/2023/webb-maps-surprisingly-large-plume-jetting-from-saturn-s-moon-enceladus>

Now to the more speculative parts of Alan Stern's presentation! Stern notes that, in many ways, the conditions for life in subsurface oceans on I-WOWs may be less restrictive than for surface life on E-WOWs,⁶ suggesting that life may be more common for these types of worlds. He goes on to note that *if* an intelligent civilization evolved on such a world, our current searches, which are focused on detecting biosignatures of surface life or electromagnetic signals produced by civilizations like our own, would not identify them. Because they would be isolated by thick shells of ice and/or rock, they would be naturally insulated from communicating with other worlds. Furthermore, it seems unlikely that such civilizations would even learn that other worlds exist.

Granted, that last paragraph currently counts as speculation, not science. However, at the beginning of my professional career, exoplanets were speculation, and now the confirmed number of exoplanets is currently well over 5,000,⁷ showing a diversity that rivals worlds imagined in science fiction. The discovery of life in subsurface oceans on worlds in our Solar System would certainly suggest that some form of life evolved on similar worlds in other planetary systems. Employing a quote expressed in different ways by various famous people, including J.B.S. Haldane, Sir Arthur Eddington, and Werner Heisenberg, "The Universe is not only stranger than we imagine, it is stranger than we can imagine."

Until next month,

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⁶ I don't have time or space to detail them here, but life in I-WOWs may be immune to issues like distance from stars, peculiar orbits, and things like stellar flares or giant impacts that threaten surface life.

⁷ <https://exoplanetarchive.ipac.caltech.edu/>