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The importance of water

Ken Tapping, February 5, 2019

Titan, the largest moon of Saturn is, like Earth, a world with an atmosphere, rivers, lakes and seas. However lying almost 10 times the Earth's distance from the Sun, Titan gets only around 1% of the light and heat we get, and it is very cold, around -180 degrees Celsius. On Titan, water is a permanently frozen rock mineral; those oceans are made up of liquid hydrocarbons, mainly methane and ethane. However, with an atmosphere, rivers, lakes and oceans, could there be living creatures swimming around? There certainly are the ingredients for life as we know it, except one: liquid water. Water is actually quite unique, and for our kinds of living things, not just any liquid will do.

Do you remember those school chemistry experiments, where you dissolved substance A in water in one test tube, and dissolved substance B in water in another test tube? You then poured one solution into the other, and the mixture fizzed, changed colour, or formed a solid precipitate which went to the bottom, or some combination of these. If you took substances A and B and mixed them, perfectly dry, nothing would have happened, until you added some water.

Life as we know it is based on chemical reactions, and water makes most chemical reactions easy. More things dissolve in water than in almost any other liquid. When we dissolve substances like common salt (sodium chloride) in water, something interesting happens. Interaction with the water molecules causes the salt molecules to break into sodium and chloride ions. When you dissolved substance A in water, it broke into bits, and so did the molecules of substance B. These bits then moved around in the water, joining briefly up to form different combinations. If one of these combinations was a gas, it fizzed off and escaped. If one was a solid, it precipitated to the bottom, and some of these combinations might have been coloured. All this rearranging of the bits into new combinations was made possible by the unique qualities of water. One other useful property of water is it does not dissolve fatty, greasy stuff, so we can be made of cells that can contain water, where all the interesting chemical reactions of life can take place, without dissolving us. These useful properties are not possessed by liquid methane and ethane. If there is life on Titan, it will have to be distinctly different from us.

This is why we are most interested in searching for life on worlds where liquid water is a possibility, such as under the ice on Jupiter's moon Europa and on Saturn's moon Enceladus. This is also why we got so excited by the possible discovery of a liquid water lake under the ice on Mars.

If we think of living creatures as things that take in energy and material from their environment, discarding waste energy and material, growing and then replicating themselves in a manner that makes it possible for them to evolve to accommodate environmental changes, the possibilities are probably endless. We just need environments where all these processes are possible, and where conditions change slowly enough for the living things to adapt. However, we might not even recognize such life forms. Imagine creatures on a frigid object beyond Pluto, where solar energy is a mere trickle and environments change only over billions of years, with lives so long that they would never notice us or we them, or plasma creatures living in the atmosphere of a star, living very short lives. So in our search for life we are mainly looking at places with liquid water, where we have the best chance of detecting life that is enough like us for us to notice it.

Mars, fading as it recedes, lies in the southwest after dark. In the predawn sky, Jupiter shines brightly in the southeast, with Venus, even brighter, to its left, and further left and much fainter, almost lost in the dawn glow, lies Saturn. The Moon will reach First Quarter on the 12th.

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