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LIQUID WATER ON MARS

Ken Tapping, 7th October, 2015

For years the landers and orbiters exploring Mars have showed us a planet's surface that has been and is still being moulded by water. There are channels and erosion gullies running down cliff faces and slopes. Many of those features are fresh; images of the same places taken a few years or less apart often show new channels. The reason for some reluctance in emphasizing the role of water in this until now is the hostile environment on the Red Planet's surface. The air pressure is so low that to survive there we would need almost a full space suit. In addition it gets very cold. On a summer's day the temperature may rise to a comfortable 20 Celsius. However, during a summer's night the temperature may fall to -70 Celsius. The dry surface cools rapidly and the thin atmosphere does little to trap the heat. Daytime temperatures can be high enough for ice to melt, but at such low pressures, that water would go straight from ice to vapour. However, despite this, those erosion channels keep appearing, hinting at water emerging from below the ground and flowing over the surface. Then it was discovered that Martian water is very salty.

Mars was once like our world, with rivers, lakes and possibly oceans. As rivers and streams flow over the land, they dissolve salts from the rock minerals. These get carried to the ocean or lakes where they accumulate, which is why our oceans are salty. In lakes where the water has no exit, the water evaporates, leaving the salts behind, and the remaining liquid (called brine) gets saltier and saltier. If Mars once had a lot of surface water, most of which has been lost to evaporation, what is left would be extremely salty. A saturated solution of salt in water (a solution holding the maximum amount of salt) freezes at about -21 Celsius. Although the surface of Mars goes through wild daily variations in temperature, just below the surface the temperature would be fairly steady, roughly equal to the average daily temperature. This means that at least some of the time liquid brine may be flowing just underground.

On a warm day it could emerge on the faces of cliffs and slopes, flowing downhill, cutting channels and then evaporating or disappearing back into the ground. The presence of liquid water below the surface of Mars raises the possibility of living things being there too. There are creatures here on Earth that live happily in extremely salty water, in some cases when that water is boiling hot. That may apply to Mars too.

The sort of life with which we are familiar is based on chemical reactions. Plants use solar energy to convert carbon dioxide and water into sugars and complex organic chemicals. Animals like us get those complex chemicals by eating plants or by eating animals that eat plants. We use those chemicals in two ways: we obtain energy by "burning" some of them with the oxygen we breathe, and we use some of that energy to turn the chemicals left over into the material we need to build and repair our bodies. There are other ways this can happen. In small cavities deep in the rock beneath our feet there are tiny creatures that obtain energy and sustenance from the chemical reactions between the rock in which they live and volcanic fluids seeping through it. Such examples suggest that living creatures may well be living in the brine below the Martian surface, going dormant when the water freezes and getting back to business when things warm up again. These creatures are probably very small, possibly too small to see without a microscope.

Of course we have no guarantee that life on Mars would follow the path it followed here on Earth, and in our searches for it we will have to take that into account. It may well be "Truly Alien".

Saturn lies low in the sunset glow. Venus rises about 3am, with Mars (much less bright), and Jupiter (nearly as bright) following close behind. By 5am all three planets should be visible. The Moon will be New on the 12th.

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