A Skeptics Guide to...

Life In the Universe

(by Peter Barrett , Canberra Skeptics)

It's one of the great questions: is there life elsewhere in the universe, apart from the Earth?

Skeptics would say, "Almost certainly, but at the moment we don't know how likely it might be."

Life thrives on Earth, particularly in the tropical and temperate latitudes. Life exists even in the harsh desert and polar regions. But most importantly, life has been found to exist in places previously thought inhospitable, such as inside rocks in the dry valleys of Antarctica or around geothermal vents, where the water is boiling hot.

The fact that life can survive in such unlikely places dramatically increases the range of potential habitats for life elsewhere. So are there places where life could exist elsewhere in our own Solar System?

The four main candidates in the 20th century have been the planets Venus and Mars and the moons Europa and Titan.

Venus is often called Earth's twin. The planet is about the same size and density as the Earth, and although it's closer to the Sun than the Earth is, this isn't a major problem. The major problem is the atmosphere, which is much hotter, denser and more corrosive than the Earth's. Even organisms which on Earth live in the deep ocean around geothermal vents would be unable to survive. Life as we understand it might have existed on Venus in its earliest days (more than 3 billion years ago) before the current atmosphere developed, but it would've died out long ago, and the evidence would probably have been destroyed long ago.

Mars has long held a fascination with us, with astronomers early in the 20th century believing they'd found evidence of canals. Unfortunately, Russian and American spacecraft showed Mars is a dry cold planet, with an atmosphere at the surface about 1% as thick as the Earth's, and no canals. Martian air is too thin to support liquid water, and it has been that way for, again, about 3 billion years. The result once again is that while there might've been life on Mars billions of years ago, conditions are now probably too harsh to support it. But scientists are still unsure, and as a result there is ongoing interest in exploring Mars.

Europa is a moon of Jupiter, the largest planet in the Solar System. Europa is a rocky moon covered by several tens of kilometres of water ice. There is a strong belief among planetary scientists that the effects of Jupiter's gravity heats Europa enough that the lowest parts of the ice are permanently liquid. Therefore, there may be a massive ocean under the ice. And if one thing is considered vital for life, it's water. This doesn't mean there *is* life on Europa, merely that it probably has one of the preconditions for life. Until a couple of years ago, there were plans to send a probe to Europa to melt through the ice and explore whatever ocean there might be underneath. But this is a massively complex engineering task, and there's no guarantee of success. In any case, there is currently no funding to develop the mission.

Titan is a moon of Saturn, the ringed planet. Titan is the only moon with a definite atmosphere. This atmosphere contains a similar mix of chemicals to the Earth in its earliest history, when life first emerged. The main difference is that Titan is a lot colder than the Earth was at that time. There is a theory that Titan may become more friendly to life, like the Earth is now, when the Sun heats up in a couple of billion years. NASA's Cassini spacecraft is currently examining Titan, along with

Saturn and its other moons, and the Huygens spacecraft landed on Titan in 2005, radioing back useful information about this enigmatic moon.

But what about elsewhere in the universe?

As far as we know, organisms can't live in a vacuum, nor in anything as hot as a star, so the best places to look for life are planets. The problem was that until the mid 1990s, we didn't even know whether other stars had planets. But now we know they do. If a star has a planet orbiting it, the star will have a slight wobble, caused by the planet's gravitational pull on the star. In 1995, this technique allowed astronomers to claim that they'd discovered a planet orbiting another star, although the planet was far larger than Jupiter, and it orbited its sun every four days. As of June 2006, nearly 200 planets had been discovered by this and other means. Unfortunately, these techniques aren't refined enough to be able to detect planets the size of the Earth, because of their relatively small size. However, at the very least, it suggests that large, gaseous planets are common. Perhaps we can assume that our Solar System is typical rather than unusual.

Nevertheless, remember that even if there's life Out There, that doesn't mean it's intelligent life, or even complex life. Life has existed on Earth for about 4 billion years. For 3 billion of those years, life was little more than single cell organisms. Complex life didn't appear until about 600 million years ago, and intelligent life didn't appear until about 100,000 years ago. In other words, intelligent life has only existed for a tiny fraction of the time that life in general has existed on Earth. It's therefore reasonable to assume that if we do find life on the planets orbiting other stars, we'll most likely find something equivalent to the most simple life forms on Earth.

Another point is that the Earth is unusual in a lot of ways. It's possible that if any one of these following factors didn't exist, complex life may not have arisen here.

- The Earth has an atmosphere at a temperature and pressure which allows liquid water to exist on the surface.
- The Earth's axis is tilted about 23 degrees from perpendicular to the plane of the Earth's orbit, which gives us seasons.
- The Moon provides light and tidal effects which affect the feeding and breeding cycles of many organisms.
- Plate tectonics (which move the Earth's continents around at the rate of a couple of centimetres a year) affects many aspects of the Earth, including changing ocean depth, altering weather, and putting ecologies of different continents in contact with each other, and all these factors affect evolution.

Finally, remember that even if there's intelligent life Out There, it's unlikely to be at a technology level equivalent to ours, simply because of the speed at which technology develops. Today's technology would be incomprehensible to people from just 500 years ago. Just imagine what technology a mere 500 years hence would look like to us.

This in turn has led to what's known as the Fermi Paradox: if there's alien life out there, why hasn't it visited us? After all, even if it will never be possible to travel at a speed greater than light, it still wouldn't take more than a few million years to travel throughout our galaxy. This suggests that either interstellar travel is impractical (in which case we might never be able to travel to the stars) or that we're alone as intelligent life, at least in this part of the universe.

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