

## Is There Life Out There Assembly?

From childhood, I have always enjoyed science fiction, both in books and on film. A regular feature of the genre is the ‘first contact’ scenario, when humanity meets with alien life. Sometimes it goes well, as in many *Star Trek* episodes; sometimes badly, as in the film *Alien* and the ensuing franchise. Sometimes it is mysterious, like *2001 – a Space Odyssey*. Sometimes it is heartwarming, like *ET*. This question of alien life seems to obsess us. Do aliens exist? There is so much space out there that it seems impossible that life has not evolved elsewhere. As the great science fiction writer, Arthur C. Clarke put it: ‘Two possibilities exist: either we are alone in the universe or we are not. Both are equally terrifying.’

Our species is on the hunt for life beyond our planet and there are some pretty good places to look, even locally. The likeliest places for life to be found in the Solar System (other than upon Earth) are two moons: one of Jupiter, the other of Saturn.

I refer to Europa, a moon of Jupiter, and Enceladus, one of Saturn’s moons. Both have the potential to harbour life. Both moons are entirely covered by ocean: they are water worlds. Europa has more than twice the amount of water in Earth’s oceans; the ocean may be between 40 to 100 miles deep. The surface of both moons are covered by deep ice sheets, but both have the three ingredients necessary for life: liquid water, a source of energy and the right chemical elements, such as carbon, hydrogen, nitrogen and oxygen. In addition, Enceladus has hydrogen cyanide – a molecule that wouldn’t do you or me much good, but we think is a key to the origin of life.

One of the ways we can tell if there is life, either on Earth or on another world, is if we detect the right biosignature. That is, if we detect certain chemicals that are definitively associated with biological activity. Interestingly, both Enceladus and Europa have traces of those chemicals. Enceladus has a great deal more methane than it should and Europa has homemade carbon dioxide. These are strong signals that life could exist in the dark waters of the distant moons. So strong that NASA is redirecting the Juno spacecraft, orbiting Jupiter since 2016. Juno is now on course for Europa.

The European Space Agency is also targeting Europa, sending a mission to sample its water and try to detect alien life. That spacecraft is already on its way – it was launched on 14 April last year – but it’s a long way to Jupiter. It won’t arrive until July 2031.

Is there life? Maybe. The chemical signatures are there; the building blocks of life are freely available. Most of life on Earth is in the ocean. Not only plants, coral, fish, and mammals, but also extremophiles — organisms that survive in extreme environments. They live in freezing realms below arctic sea ice and in the boiling temperatures and crushing pressures around deep-sea hydrothermal vents. That sounds a lot like the conditions that would exist on these water moons.

So alien life could be found close to home, in our own solar system. We know that billions of years ago water existed on Venus and Mars, and the conditions for life were in place there too. Life can potentially hop between planets on meteorites and space debris, so if we find any fossil life on Venus or Mars, it may be that the three planets share some elements of similarity in the lifeforms. But if there is life underwater on Saturn and Jupiter’s moons, it has almost certainly evolved separately from life on Earth or Earth’s near neighbours. And if it were the case that life can emerge twice in one solar system, it suggests that life will

probably emerge very frequently in the universe. There are trillions of planets in just our own galaxy. When you look up at the night sky, there could be life looking back at you from many of the points of light above.

In science fiction, in order to make for an exciting story, we tend to meet aliens who are roughly like us and have understandable motivations. In reality, that is unlikely to be the case. Aliens, if they exist, will be radically different. Those forms of life would probably not be human-like, in the manner of Star Trek's Vulcans and Klingons. Our first thoughts go to finding intelligent life, but we would more probably encounter it in the form of bacteria or simpler lifeforms. If we were to meet another intelligence, they would be unutterably strange and unknowable. They would probably be so strange that communication is impossible. The philosopher Ludwig Wittgenstein said, 'If a lion could speak, we could not understand him.' He meant that communication is not based upon the shared words we use, but on a shared understanding of the world. Humans and lions are too different to share enough common ground to communicate. Imagine then, the problems with communicating with something completely other to ourselves. Or a hivemind. Or an intelligent ocean. Or a creature that lives for thousands of years and operates on a different time scale. Or a million other possibilities.

This question of alien life is not just prompted by thoughts about water moons in our own solar system. It is made into a live issue by the on-going work of the James Webb Space Telescope. This telescope is so sophisticated that it can determine the chemicals in the atmospheres of exoplanets – planets orbiting stars many lightyears from Earth. The biosignature that tells us that we are not alone – that alien life exists, in some form – the biosignature that we have sent spaceships to Europa to find, may be available to us from other solar systems first. In fact, I wonder if we don't already have it. The journalist Sean Thomas has made an interesting connection. Consider the recent words of three eminent people in the field of astrophysics.

On New Year's Eve, the musician Jools Holland invites guests to hear bands play on his TV show *Hootenanny*. One of the guests was Dame Maggie Aderin-Pocock, an astrophysicist and presenter of *The Sky at Night*. As he usually does, Jools asked her for predications for 2024 and received an interesting reply. She answered, 'I think we're going to discover alien life; it's definitely out there.'

Then let's be aware that a few days ago an Oxford astrophysicist, Dr Becky Smethurst, stated in one of her YouTube broadcasts, 'I think we are going to get a paper that has strong evidence for a biosignature on an exoplanet very, very soon. Let's just say it's on my bingo card for 2024'. Then, in the first week of January, the astronaut Tim Peake said in an interview 'Potentially, the James Webb telescope may have already found [alien life]... it's just that they don't want to release or confirm those results until they can be entirely sure, but we found a planet that seems to be giving off strong signals of biological life.'

To hear it once is interesting. Twice is more so. Three times is certainly thought-provoking. And we know the James Webb Telescope, as identified by Tim Peake, has the power to do it. Two of the three speakers referred to a paper or results. These papers take time to be peer-reviewed and double-checked. A few years ago, the presence of phosphene in the clouds of Venus provoked a false claim that we had found life there. Prior to that there was a suggestion that we had found bacteria on Mars, which came to nothing. So, this may all be a wild goose chase. Or it might be an actual wild alien chase.

I don't think it is a wild guess to suggest that there is a possibility that we will soon hear news of a scientific paper, revealing that the James Webb Space Telescope has done something incredible – proved that we are not alone in the universe. If there is life out there on an exoplanet, it is a long way away. And we wouldn't know if the life is bacteria, or something more technologically developed. Of course, we would immediately train all our resources on the planet to see if we can link the biosignature with something called a technosignature – emissions of radio waves or other signals of an advanced civilisation.

To know we are not alone would be incredible in itself – to find intelligence would be (potentially quite literally) Earth-shattering. Let's see what 2024 brings.