Are we alone after all?

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Who to believe?

Is it possible that intelligent life in outer space exists? Could it be that Earth has already been visited by aliens? Are there traces left for us to find? Is it up to us to make the first step? These thoughts have captivated mankind for centuries, and still inspire the quest to reach out, find out, and discover; despite the fact that scientists are fundamentally split on the question of whether or not life outside the Earth exists. Some believe that there are simply so many planets out there that it would be impossible for us not to find intelligent life someday. Others believe that due to the lack of evidence, we cannot accept this prospect until presented with proof. So which scientists should we agree with? Those for or those against?

Throughout history, our predecessors have shown remarkable resistance to accepting ground-breaking concepts, greeting new ideas with denial, sometimes even persecution, only to be proven wrong eventually. There are many examples of this happening: over 2,000 years ago, Aristarchus of Samos wrote about the Earth being just one of many objects moving around the Sun, even though the modern idea of planetary orbits did not exist. His work shows geometrical calculations based on observations, showing the Sun to be much bigger than the Earth and the Moon. Even though these calculations supported his ideas, they were not accepted as true until the 17th century. And so throughout the dark ages and beyond, people continued to believe that the Earth was the centre of the universe – to say otherwise was heresy. Indeed even Copernicus and Galileo, who we celebrate today as great visionaries and seekers of truth, were severely punished for challenging the Roman Catholic Church's view that the Earth was the center of the universe.[1]

So should we rule out the possibility of extraterrestrial life just because of insufficient evidence?

Interestingly, some scientists believe that it is our loneliness in the universe that causes us to imagine that extraterrestrial life is possible. The universe is vast and never-ending; there are billions of trillions of stars, planets, meteors, and comets. To think of this seemingly infinite space with no intelligent life other than our own is not a comforting thought to say the least. In fact, it is positively terrifying when one really thinks about it. It has been suggested that to calm these fears, we invent stories to fill up the void beyond our solar system, in order to imbue a lifeless universe with intelligent life and thus to make it seem a more habitable and friendly place to live.

On the other hand, scientists such as Carl Sagan and Stephen Hawking argue that it is exactly because the universe is so vast that it would be improbable for life not to exist somewhere other than Earth. Hundreds of planets are being discovered every year.

In six weeks alone, the National Aeronautics and Space Administration (NASA), found 700 possible planets and 5 new solar systems.[2] Scientists

believe that a small group of these may be capable of supporting life. Many such planets, nicknamed 'Goldilocks planets' (not too cold, not too warm – the conditions are 'just right' to support life) have been found already; including Gliese 581 c, Gliese 581 d and OGLE-2005-BLG-390Lb, all of which have Earth-like qualities.[3]

Recently, on September 29th, 2010, a new Goldilocks planet was discovered by scientists using one of the most powerful telescopes on Earth - the Keck telescope in Hawaii. Gliese 581 g lies 20 light-years away from Earth in its star's Goldilocks zone – an area where temperatures are favourable and planets may be capable of containing water, and therefore also life [Figure 1].

This planet might be the most similar Goldilocks planet to Earth yet discovered. "The fact that we were able to detect this planet so quickly and so nearby tells us that planets like this must be really common," commented Steven Vogt, an astronomer at the University of California Santa Cruz.[3]

The planet's average temperature is thought to be between −31°C and −12°C, and we know for a fact that there are many intelligent animals living in these types of conditions on Earth, such as polar bears, whales, and even humans (for instance the Inuit people). Dr. Vogt goes on to state that, "The number of systems with potentially habitable planets is probably in the order of 10% or 20%, and when you multiply that by the hundreds of billions of stars in the Milky Way, that's a large number. There could be tens of billions of these systems in our galaxy".[3] Tens of billions of planets is a huge number. Surely we cannot be so naïve to think that we are the only intelligent life in such a vast universe?

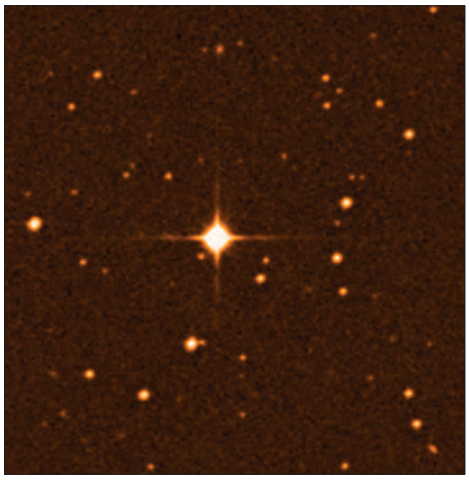

Figure 1: ESO. (unknown) "The star Gliese 581". ESO. http://www.eso.org/public/images/eso0722c/ on 29-12-10. Used with permission under the Creative Commons Attribution 3.0 Unported license. http://www.eso.org/public/outreach/copyright.html

This problem has been drawing attention since the conception of the Drake equation[1] in 1960. Yet, some scientists argue that if the chance of finding life were so huge, we should have found it by now. Frank Tipler, for example, has proved that, if using pessimistic numbers, the chances of finding a civilization in the galaxy is lower than one. Even Frank Drake (the inventor of the Drake equation) has stated that the Drake equation is just a way of "organizing our ignorance" on the subject.[4] On the other hand, Dr. Carl Sagan used optimistic numbers to conclude that there might be millions of civilizations in the Milky Way alone.[5]

Arsenic Based Life

One reason for which we have not yet found any traces of intelligent life might be because we have no idea what to look for. The key to actually finding intelligent life is to fully understand what the term means. But how do we define intelligent? Some think that any form of life that can survive should be classified as intelligent, whereas others state that even *Homo sapiens* cannot be placed in this category.[6] Search for Extraterrestrial Intelligence (SETI) believes that intelligent life must be able to transmit and receive signals,[7] whereas a more general definition is perhaps that intelligent life must be able to learn.

Furthermore, just because we Earthlings need certain elements and compounds to survive (for example oxygen and water) it does not necessarily mean that any other intelligent life form would as well. Recently, as a matter of fact, a microorganism has been found[2] which uses arsenic instead of phosphorus in its cell components. Phosphorus is essential to both DNA and RNA, which carry genetic information for life, and was until recently considered absolutely essential for all living cells. Arsenic on the other hand, despite

[1]The Drake equation is used to estimate the number of extra-terrestrial civilizations in the Milky Way galaxy with which communication might be possible.

[2]A microorganism called Strain GFAJ-1 was found on 2nd December, 2010, by NASA researchers in Mono Lake in California [Figure 2]. Strain GFAJ-1 belongs to the class Gammaproteobacteria. The researchers began by giving the microbe both phosphorus and arsenic and eventually removed the phosphorus. The microorganism continued to grow, living only on arsenic. The location was chosen because of its high alkalinity and levels of arsenic, which are partly a result of Mono Lake's 50-year isolation from a source of fresh water.

being chemically similar to phosphorus, is poisonous to most life on Earth.[8]

According to NASA, this finding will dramatically expand the search for intelligent life, as it affirms the possibility of life which does not need the same conditions as most other organisms in order to survive.

"The idea of alternative biochemistries for life is common in science fiction," said Carl Pilcher, director of the NASA Astrobiology Institute in California. "Until now, a life form using arsenic as a building block was only theoretical, but now we know such life exists in Mono Lake."[8]

This discovery also leads us to the revelation that we might not as easily recognize intelligent life forms in outer space – they could be completely different from our expectations. As Felisa Wolfe-Simone, a NASA Astrobiology Research Fellow in California and the research team's lead scientist, stated: "We know that some microbes can breathe arsenic, but what we've found is a microbe doing something new – building parts of itself out of arsenic. If something here on Earth can do something so unexpected, what else can life do that we haven't seen yet?"[8]

This shows us that so far, we might have been looking for the wrong thing. "The definition of life has just expanded," said Ed Weiler, NASA's associate administrator for the Science Mission Directorate at the agency's Headquarters in Washington. "As we pursue our efforts to seek signs of life in the Solar system, we have to think more broadly, more diversely and consider life as we do not know it."[8]

Public Reaction

This change of mindset presents a new question: If we were to discover intelligent life, what would the result be for us? A reaction similar to the War of the Worlds radio panic[3] in 1938 could be the outcome of such news. Awe is another option. Is terror or amazement the more likely response from our side?

There is also a lot of speculation as to what the intelligent life forms if found would do. Would they be friendly and wish to establish contact with us? Or is it more likely for them to be hostile and angry for having been discovered? It is impossible to tell at this point. However, to avoid a worldwide panic, agencies and organizations are trying to prepare us, the people of Earth, for the possibility of finding intelligent life.

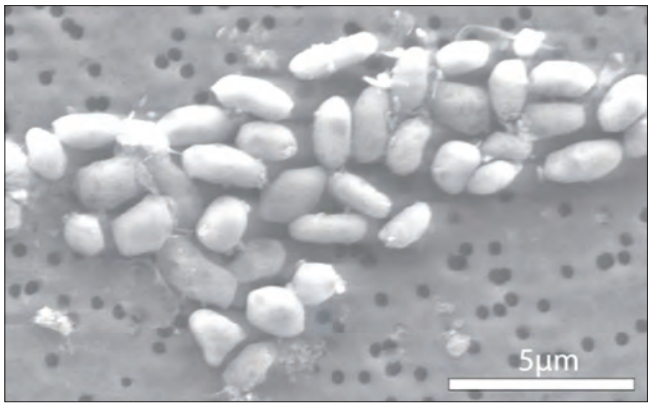

Figure 2: Blum, J. (unknown) "GFAJ-1 grown on arsenic". Available from: http://www.nasa.gov/topics/universe/features/astrobiology_toxic_chemical.html on 20-12-10

The Search

Reassured that public relations on the E.T. topic are well taken care of; scientists are free to pursue the quest to find extraterrestrial intelligent life. New projects are constantly cropping up to try and discover any trace of other-worldly intelligence. Organisations such as SETI, for example, are searching the skies for radio wave activity – if found such evidence would settle the matter and thus prove that intelligent life exists. An associated idea is that intelligent life might send laser signals into outer space.

This is one of the best ways to discover other possible intelligent life forms in the galaxy – by looking for evidence of technology developed by that life. Scientists conducting the High Resolution Microwave Survey in 1992 scanned the whole sky for strong microwave signals; their logic being that at some point intelligent beings on other worlds might eventually develop radio technology capable of sending these signals. In 1993, however, the United States Congress advised NASA to end the project.[9]

Nevertheless, in 1998, NASA astronomers began to search for pulses of laser light. They thought that possible intelligent creatures in outer space might have developed powerful lasers. They then may have transmitted short laser light pulses into the universe for observers, such as us, to detect.[10]

The only drawback with such space communication is that light signals must travel for thousands of light years in order to reach their destination, and it would take just as long for any reply or laser pulse to reach us. So, if we were to receive any kind of signal from outer space, it would be from the distant past, and there would be no guarantee that the life forms would be still alive.

Have we reached a setback in our quest to find intelligent life in outer space? Yes. Does this mean we are going to stop searching? Definitely not. As Mark Twain put it, 'There can't be rainbows without rain,' meaning that until you reach the end result, there are inevitably going to be obstacles along the way.

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About the Author

Ana Pavlova was born in 1997 and lives in Romania. Her favourite subjects are Science, French and History. In her free time she enjoys playing tennis, reading, learning new things and spending time with her family; she particularly enjoys a heated debate! She hopes to study law or politics at University; however, she is still unsure as to what career path she would like to follow.

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