

Preparing for the Discovery of Extraterrestrial Life Through the Lens of Science Fiction

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November 13, 2020

For hundreds of years, we have wondered why we seem to be the only intelligent beings out there. For hundreds of years, we have been speculating about life and intelligence from beyond our small rocky island in the solar system. Unfortunately, everything we know about extraterrestrial life is just that- speculation. There are only a few instances of actual possible scientific evidence of extraterrestrial life or intelligence, like the Wow! Signal and Tabby's Star, and they have mostly been explained by abiotic phenomena - until now.

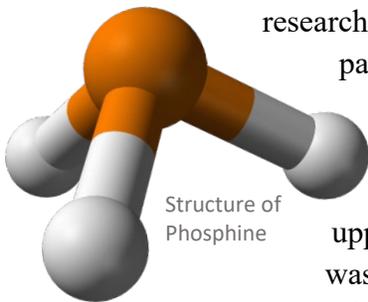
On September 14, 2020, a team led by researcher Jane Greaves published a paper in the journal *Nature Astronomy* announcing the discovery of the chemical phosphine (PH_3) in the upper atmosphere of Venus. It was discovered at a

concentration of 20 parts-per-billion, meaning that for every billion molecules in Venus's atmosphere, one can expect to find 20 molecules of phosphine. While this may seem like a tiny amount, it is millions of times greater than what can be produced abiotically. The researchers spent four years rigorously validating their discovery and ruling out tens of different possible abiotic sources of phosphine, finally concluding that more study was needed, and that life was a *possible* source. While this awaits independent validation, we can entertain

ourselves with some speculation. How could Venusian life work? What kinds of peculiar organisms may greet us when we visit?

Jay Werkheiser explores this in-depth from a scientific perspective in his "Alien Biochemistry." Werkheiser uses established chemistry to discuss a few of the many ways the biochemistry of alien life could be different from ours, from the possibility of non-carbon (silicon) based life, which he does not think is plausible, to the many different variations of Earthlike carbon-based life. One of the topics he explores is the possibility of carbon-based life using solvents other than water, focusing mainly on ammonia (NH_3) and ammonia-water mixtures. He briefly mentions more exotic solvents like hydrogen chloride (HCl) and hydrogen fluoride (HF), commonly found in their hydrochloric and hydrofluoric acid forms, but suggests that they are unlikely.

However, this is important to us- on Venus, the most abundant liquid solvent exists as concentrated sulfuric acid (H_2SO_4) droplets in its upper atmosphere. They make up the thick haze that shrouds its surface- as you can imagine, there is quite a lot of sulfuric acid in Venus's atmosphere. Sulfuric acid is extremely polar and an excellent solvent, meaning that many reactions can take place in a sulfuric acid solution. Unfortunately, like hydrochloric and hydrofluoric acid, sulfuric acid vigorously attacks almost all known organic substances. If anything lives on Venus, its chemistry will be radically different from us Terrans. For a good precedent to begin thinking outside the box

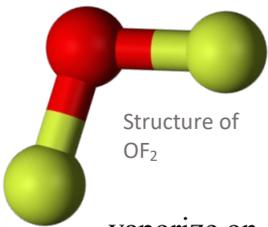


Structure of Phosphine

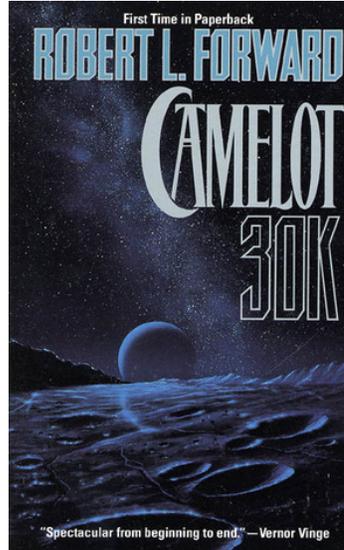
with, we can turn to science fiction- specifically a genre of science fiction called hard science fiction, in which authors focus on scientific accuracy.

One of the most notable hard science fiction authors, physicist Robert L. Forward, has written many novels, novellas, and book series on alien life. One of his most scientifically fascinating works is his novella *Camelot 30K*. The 30K in the title offers some insight into the weirdness of the setting: a tiny, frigid minor

planet in the outer solar system with a temperature of about 30 Kelvin. The plot revolves around a group of humans sent to the dwarf planet to interact with an intelligent species of aliens with blood made of oxygen difluoride (OF_2) and bodies made of materials that would vaporize on contact with human skin. The human explorers control robot ambassadors which enter and explore the aliens' population centers. Navigating the alien cities, which resemble the 1800s in technological and scientific advancement, the explorers piece together the story of their society and reproduction in a fascinating journey through exotic biology, chemistry, and nuclear physics.



Structure of OF_2



But a true scientific understanding of alien life doesn't just require strange ideas about exotic biochemistries- it also warrants an understanding of the idea that an alien mind is likely wildly different from our own. By our nature, we cannot understand what it "feels like" to be anything other than humans- we are self-centered beings, and our brains are what they are. However, we can study and understand the minds of other beings from an analytical perspective to prepare ourselves for when we meet intelligent extraterrestrials. In the article "The Sucker, the Sucker!" by Amia Srinivasan, a philosopher and professor at the University of Oxford, Srinivasan discusses the nature of consciousness within octopuses, the most intelligent invertebrates. The main difference between octopuses and vertebrates is the decentralization of their nervous system- their arms contain more neurons than their brains. Srinivasan examines the biological basis of cephalopod intelligence, concluding that their experience is so alien to us that we may have to redefine consciousness entirely. Despite the vast differences between humans and octopuses, however, they are still earthly creatures and follow all the same basic principles of earthly life. For even more exotic intelligence, we must again turn from fact to science fiction. Here, a work with a particular focus on the strangeness

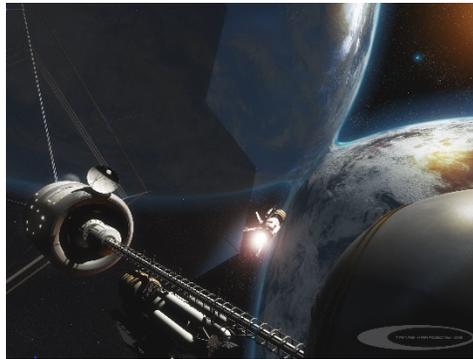


A scene from *Arrival*, a film based on Ted Chiang's *Story of Your Life*

of alien intelligence is Ted Chiang's novella *Story of Your Life*, which follows linguist Dr. Louise Banks as she works with the U.S Government to establish communication between humans and advanced alien visitors. As Dr. Banks learns the alien language, she realizes that the aliens' minds

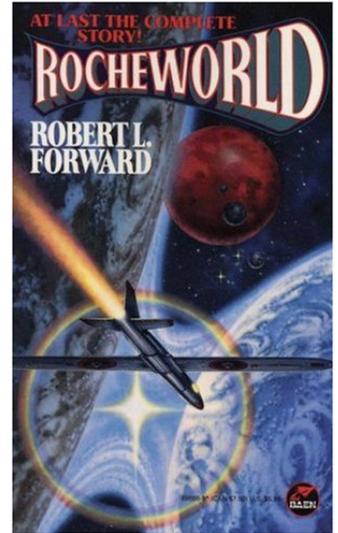
work radically differently from human ones. They view the universe nonlinearly with respect to time- to them, all things exist through all times simultaneously. While Dr. Banks cannot know for certain what it “feels like” to be one of these aliens, she can understand it by analyzing its behavior, language, and mathematics. Although science fiction is fictional, speculating about different forms of intelligence through reading and writing it can prepare us for a perhaps even stranger reality. However unlikely, if we discover intelligent life on Venus, we should not apply a self-centered view of consciousness. Instead, we should assume nothing and take a measured, scientific approach. A true understanding of an alien consciousness like Dr. Banks and the real-life researchers of cephalopod intelligence pursued will facilitate communication and prevent hostility.

However, just a conceptual understanding of the mind of an intelligent extraterrestrial is insufficient. How should we approach communicating and interacting with it? What kind of dynamic could there be between us and an intelligent species so close to us? We already know that, if there is life, it is likely far less advanced than us; else we would have heard radio broadcasts or seen its effects on the planet. And if history tells us anything, a first contact between more advanced human explorers and natives does not end well for the natives. However, we can strive not to repeat the mistakes explorers have made in the past by approaching first contact very carefully. We have already established that any alien consciousness is likely vastly different from our



A computer rendering of the double-planet Rocheworld featured in the *Rocheworld* series

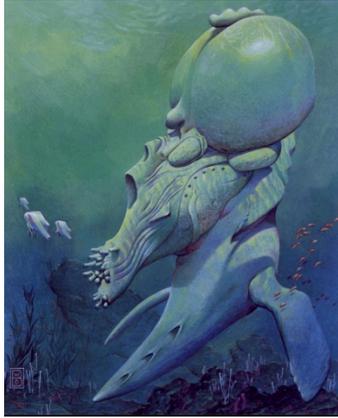
own. How can we reconcile our motives with theirs and ensure that something we may think is benevolent is not actually harmful? Again, this has no real precedent, so we can look to science fiction. Robert L. Forward’s *Return to Rocheworld*, the second novel in his *Rocheworld* series, portrays first contact from an external perspective. On the double-planet Rocheworld, there are two main climates in two different regions: a wet, rich ecosystem with an intelligent species called the Flouwen living comfortably at the top of the food chain, and a dry desert with an intelligent but primitive species nicknamed the Gummies that fights for survival in the harsh environment. When human scientists arrive and fly the



Flouwen to the dry region, they are shocked by the hardship the Gummies must face to survive, and demand that some be brought to their home to be “educated” and allowed to make better lives for themselves.

Although the humans object, they are forced to concede, but conclude that the Gummies’ superior physical prowess and aggressive nature will eventually allow them to replace the Flouwen. In this situation, an action that the Flouwen believe is benevolent is actually a major disruption to the ecosystem and will result in their eventual demise. Another, decidedly darker portrayal of first contact is the series *A Time Odyssey* by Arthur C. Clarke and

Stephen Baxter. In *A Time Odyssey*, a super-advanced alien race called the Firstborn determines that humanity is too wasteful of energy and that to delay the heat death of the universe for as long as possible, humanity and all other civilizations must be destroyed. With the complete opposite goal of the Flouwen in the previous example, the Firstborn are certainly in the wrong here. But not to them- indeed, they have a perfectly valid reason that they know will benefit the universe in the long run. What kinds of ideas might we have that aliens would think very differently about? If we do discover intelligent life on Venus, how can we avoid the mistakes the Flouwen and the Firstborn made? It may seem obvious which choices are moral and which ones are not. But it is easy for us to determine morality because we define it- our morality is attached to our society, our minds, and ultimately our biology. Because alien biology and intelligence are so different from our own, their morals and goals are likely unimaginably different as well. Therefore, the best thing we can do is to leave them alone. Unfortunately, humans are inherently curious creatures, and with a life-filled planet so tantalizingly close, it is impossible for us to resist the pull of knowledge. Thus, the next best thing we can do is try to be as un-invasive as possible: no mining, harvesting of resources, colonization, or trying to “help” the natives. All expeditions should be purely scientific and strive to leave the ecosystem as pristine as possible. A compelling example of



A drawing of a creature from Wayne Douglas Barlowe's *Expedition*, which focuses on illustrations of aliens instead of textual descriptions

this is depicted in the 94-minute Discovery Channel docufiction *Alien Planet*, which is based on the speculative fiction book *Expedition* by Wayne Douglas Barlowe. *Alien Planet* tells the story of a hypothetical realistic robotic mission to a life-filled planet. The robots are designed to be purely observers, controlled by a master computer in orbit and designed to provide as much scientific information as possible without touching any alien life or intervening in any alien activities. Another of Robert L.

Forward's works in his *Rocheworld* series also portrays this scientific objectiveness well. In *Ocean Under the Ice*, Forward tells the story of a group of human explorers encountering an intelligent alien species on a small ice-covered moon with a subsurface ocean. The alien society resembles the mid-1700s in advancement, with telescope technology, well-developed music, and a rigid social structure but limited in scientific knowledge. As the humans simultaneously explore their society and learn about their biology, they remain objective, avoiding presenting them with new technologies and electing to withhold potentially damaging scientific knowledge. They are simply observers there to gather data and enhance their own



knowledge, not to help the more primitive natives.

Ultimately, science fiction is not real- it is just fiction. But especially for alien life, science and speculative fiction often frame their universes in ways very similar to ours, preparing us for the true weirdness of alien bodies, minds,

and societies. When we visit Venus, we will probably find nothing living, but we could also find clouds of microorganisms, simple multicellular life, or even massive, complex animals suspended from biological balloons of gas. Regardless of what we discover, we can try our best to call upon the best minds of the past and present in both science fact and science fiction to ready ourselves for the strangeness of reality. If we can navigate it successfully, the discovery of life on Venus may be the most monumental event in human history.



An artist's depiction of life floating in a thick atmosphere

Phosphine gas in the cloud decks of Venus:

<https://www.nature.com/articles/s41550-020-1174-4>

Original discovery of sulfuric acid in the Venusian atmosphere:

<https://www.sciencedirect.com/science/article/pii/S0019103573900596>

Alien Planet documentary:

https://www.youtube.com/watch?v=fJlGcihiw2Y&t=4574s&ab_channel=AaronMaynard

Wayne Douglas Barlowe's *Expedition*:

<https://waynebarlowe.com/artwork/expedition/>

Works by Robert L. Forward:

<https://www.sciencedirect.com/science/article/pii/S1875389212025047>