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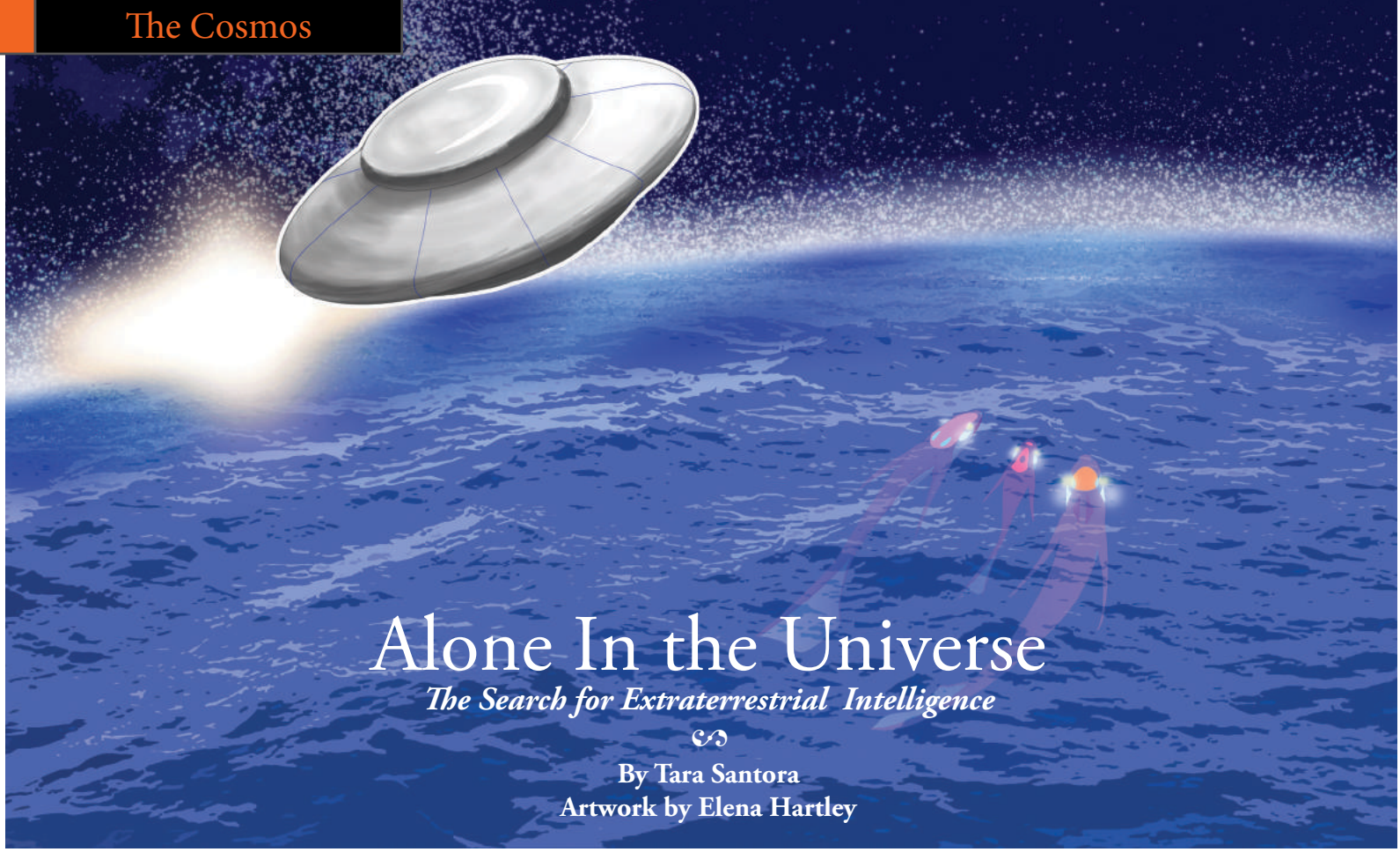

Alone In the Universe

The Search for Extraterrestrial Intelligence

By Tara Santora
Artwork by Elena Hartley

Look, there in the sky! It's a bird — it's a plane — it's a...UFO? Probably not. UFOs, or Unidentified Flying Objects, have been the objects of conspiracies since the first well-publicized sighting in 1947 (although some conspiracists claim that the sightings go as far back as 214 BCE). In the 1947 sighting, a pilot named Kenneth Arnold was flying a small plane near Washington's Mount Rainier. Arnold claimed that, during his flight, he witnessed nine crescent-shaped UFOs glowing blue and white, flying in a "V" formation, skipping through the air at thousands of miles per hour.

After this event, UFO sightings became increasingly reported, and the U.S. government decided to take action. In 1948, the U.S. Air Force began investigations into the sightings, and within four years these investigations turned into Project Blue Book, centered in Dayton, Ohio. From 1952 to 1969, Project Blue Book analyzed over 12,000 claimed UFO sightings. A team of physicists, the Robertson panel, met in 1953 to analyze the sightings recorded thus far. The scientists determined that 90% of the sightings could be conclusively dismissed as either natural phenomena such as bright stars and planets, meteors, auroras, and ion clouds or as human-made objects including aircraft, balloons, and searchlights. The other 10% of sightings did not contain enough information to make conclusions. A second committee released the Condon Report in 1968, which drew similar conclusions to the Robertson panel and led to the discontinuation of Project Blue Book.

Even though most scientists agree that we have not yet made contact with extraterrestrial life (especially not through UFO sightings), a significant amount do believe that intelligent life exists beyond Earth. Since the galaxy is so large, and humans have not even come close to discovering all of its mysteries, some find it difficult to believe that Earth is the only planet with the conditions necessary to host intelligent life. Those who believe this cite the Drake Equation, designed in the 1961 by the astronomer Frank Drake, which is used to calculate the probability of finding extraterrestrial intelligence, also known as ETI.

	The Drake Equation $N=(R^*)(f_p)(n_e)(f_l)(f_i)(f_c)(L)$
N	Number of civilizations in the Milky Way whose electromagnetic emissions we would be able to detect
R^*	Rate of formation of starts suitable for the development for intelligent life
f_p	Fraction of these stars with planetary systems
n_e	Number of planets per solar system with an environment suitable for life
f_l	Fraction of suitable planets on which life actually develops
f_i	Fraction of life-bearing planets on which intelligent civilizations develop
f_c	Fraction of intelligent civilizations with technology that emits detectable signs of their existence into space
L	Length of time such civilizations emit detectable signs into space

The original estimates used for the variables in the Drake Equation yielded the prediction that there are 18,750,000 communicating civilizations in the Milky Way. Using information that has been discovered since the original calculation, the current optimistic estimate is 72,800 while the current skeptical estimate is 1 communicating civilization in our galaxy. That 1 civilization would be us Earthlings. Of course, the values of the variables being used in the equation are all estimates and are highly debatable, so one cannot be sure of which prediction is the most accurate. Of the more optimistic scientists, some conclude that, if extraterrestrial intelligence does exist elsewhere in the galaxy, the extraterrestrials are likely to attempt to contact and communicate with other lifeforms such as us. This is one of the core principles that justify the search for extraterrestrial intelligence.

A physicist named Enrico Fermi, who once built a fully-functioning atomic reactor in a squash court, was one of the pioneers of the Search for Extraterrestrial Intelligence (SETI). In the 1940's, Fermi realized that any extraterrestrial society with decent rocket technology would, within a timespan of ten million years, be able to colonize an entire galaxy. This realization includes the Milky Way, our home galaxy. While ten million years may seem like an impossibly long time to us puny humans, the galaxy has been in existence for approximately ten thousand million years. This gives extraterrestrial societies quite a bit of wiggle room

to colonize the galaxy.

Obviously, we have not yet been colonized by aliens. But Fermi believed that extraterrestrial intelligence is probable. Why then have we not yet been contacted by otherworldly beings? In Fermi's words, "Where is everybody?"

The Fermi Paradox is the question of why we have not yet had communication with extraterrestrial intelligence if such beings exist. SETI researchers believe it is too simplistic to conclude that ETI does not exist from the fact that we have not had communication with extraterrestrials. Instead, there are many possible solutions to the Fermi Paradox. One possible solution is the Zoo hypothesis, which conjectures that extraterrestrial intelligence could be observing us without our awareness. Another potential explanation is that ETI are trying to communicate with humans, but we aren't listening properly. There are many more potential solutions to the Paradox, none of which can be proven since we have little evidence.

But SETI researchers are not giving up; instead, more scientists are searching for signs of ETI than ever before. Several methods are currently being used to look for these signs. One of the major methods SETI is using to find potential contact is by monitoring for transmissions in electromagnetic radiation (essentially radio signals). This technique began in 1960 with Project Ozma, named for the land of Oz and founded by the same Frank Drake of the Drake Equation. Project Ozma monitored electromagnetic radiation transmissions for a series of prime numbers or for uniformly patterned pulses, potential signs of intelligent communication. However, Drake's team found no evidence of this kind.

To be able to detect a message, the equipment that receives the radio signals must be pointing in the right direction, which makes this type of SETI extremely difficult. Another drawback to monitoring transmissions is that the machines that sense the radio signals must be programmed to the correct range of frequencies. If an ETI transmission was outside of a machine's particular range, the message would go undetected. Of course, ETI that wish to communicate may even choose a different medium of communication from radio signaling. Additionally, ETI may not have yet developed radio technology; after all, we humans have only had it for about 100 years.

One of the most famous SETI radio transmissions ever recorded occurred at the Ohio State University Radio Observatory, also known as the Big Ear. In 1977, the Big Ear's radio telescope picked up on a powerful signal, far too strong to be background noise while pointing towards 3 star systems named Chi Sagittarii. The signal lasted for 72 seconds and is the only signal of its magnitude ever recorded. The strength of the signal was so jarring that Jerry Ehman, the astronomer who had been monitoring the telescope at the time of the transmission, wrote in the margins of the printed transmission, "Wow!". Since then, this peculiar transmission has been known as the Wow! signal. However, as this extraordinary signal was the only transmission ever detected that could potentially be from ETI, most scientists dismiss it as a fluke. In fact, recent studies have hypothesized that the Wow! signal was transmitted by a comet that may have emitted neutral hydrogen (which is the same frequency of the detected signal) while passing through the Chi Sagittarii. Scientists plan to test this potential explanation as the same comet is projected to soon pass through the same location.

Another potential means of communication that has become increasingly monitored in recent years is optical SETI, which monitors lasers. Optic SETI is favorable because, unlike with radio transmissions, the laser detection equipment has no possibility of interference from Earth-bound sources. However, lasers only emit light on one frequency, so researchers searching at the wrong frequency would miss the signal. The ETI might combat this problem by emitting light in narrow pulses of various frequencies, which would increase the probability of detecting one of the emissions. Another problem with optical is that lasers are highly directional, even more so than radio waves, so there is a lesser likelihood that the laser-sensing technology will be pointing in the proper place to detect a signal. Additionally, radio signals could be accidentally emitted by ETI, which increases the chance of researchers finding signals, but optical SETI would only be released deliberately by other lifeforms.

Instead of simply waiting for ETI to contact us, some researchers would prefer to send deliberate signals, called active SETI, in hopes that another intelligent civilization will receive our contact. However, the ethics of this are highly controversial. Opponents of active SETI, including famous physicist Stephen Hawking, fear that alerting other intelligent civilizations of our presence could be dangerous in case the ETI are malicious or imperialistic. Supporters of active SETI argue that the potential benefits of active SETI outweigh the risks. One of these potential benefits is that an intelligent civilization may be younger than ours, and they may have not yet developed the technology that can send messages to other civilizations. If we make the first contact with these civilizations, the Earth messages could help the younger civilizations to produce a response. Additionally, if every intelligent civilization sits back and waits for signals from other lifeforms, never emitting their own messages, then the different civilizations will never become aware of one another.

Before the fierce international debate began, several active SETI projects did exist. The most famous of these is the Arecibo Message, the largest deliberate radio transmission ever released into space. The 3-minute message was launched from Puerto Rico and was aimed at the star cluster M13 near the edge of the Milky Way, approximately 21,000 light-years away. The signal was so strong that any SETI-detecting technology anywhere in the Milky Way would be able to detect the signal if the machine was as sensitive as the transmitter that sent the message and was searching at the correct frequency. The Arecibo Message included graphics of DNA, a stick figure drawing of a human, and the Arecibo telescope, among other things.

If the Arecibo Message differs from the content you would send to aliens, you are not alone. A company called Breakthrough Initiatives, a current SETI project, is hosting a contest called Breakthrough Message, an international competition to develop an active SETI message. As of now, the organization has no plans to send these messages, but only wishes to spark debate about what would be appropriate to send and what would be representative of Earth and Earthlings. Although the competition has not yet been launched, the organization has stated that the winner of the contest will receive a $1 million prize.

But what will happen if we do find aliens? Will civilians panic as if this was another War of the Worlds?

To ensure that any findings are approached in a calm and logical way, various SETI projects have agreed upon a Post-Detection Protocol. This protocol is updated periodically, and the latest version was agreed upon by SETI project leaders and the International Academy of Astronautics (IAA) in 2010. The Protocol mandates that all SETI projects be conducted transparently. Any detected signals that seem to be from ETI must first be verified by an outside institution; if and when the signal is confirmed, the discovery team must release a full report to the public and the scientific community. The signal data must be monitored, and if the received signal was a radio signal, the discovery team must work with World Administrative Radio Council to protect the related frequencies. Finally, before an active SETI return message is sent, there must be international agreement. This process will be overseen by the IAA SETI Permanent Study Group.

Are we alone in the universe? Or could we have neighbors, possibly even in our galaxy that are not only living, but intelligent enough to build a civilization and transmission devices? This idea may seem far-fetched, but some of the field's top minds believe that ETI is not only a possibility, but a reality. For them the question is not will we find extraterrestrials, but what will we say when we do find them?