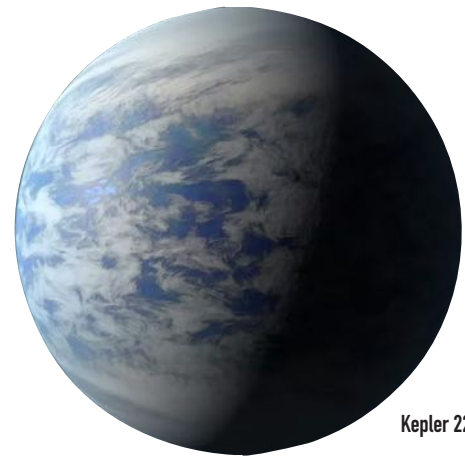


# AD ASTRA PER EDUCARE

THE ASTRONOMY MAGAZINE OF  
NEW HAVEN SCHOOL



Kepler 22 b

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**The Search for Extra Terrestrial Intelligences**

## **My UFO (or is it UAP?) Encounter**

It was just past sunset on a cold, clear winter evening in early December. I was driving south down I-15 past the small town of Mona, Utah and the small reservoir nearby. I was teaching at a residential treatment center in Provo, Utah but living in a small town 40 miles south called Nephi, and this was my normal evening commute. I wasn't really thinking about anything, just listening to music, when I saw it: a glowing object to the right and above my pickup truck, following me. It didn't have any definite edges, and I couldn't tell how large it was but it appeared to be keeping pace with my truck. The hackles rose on the back of my neck. For about five seconds I was completely freaked out. I was having a UFO encounter!

Then I realized what it was. It was a sun dog, the frequent explanation given by the air force for many UFO sightings, but literally true in my case. You see, the sun had just set from my position at the bottom of the valley, but

it was still shining a few hundred feet above Mona Reservoir. The day was cold, one of the first cold days of the year, but the water in the reservoir was still warm. Water vapor rising above the warm water was hitting a cold air layer a few hundred feet up and crystallizing into tiny ice crystals, which were reflecting the sunlight down into my truck window. It seemed to be following me because it wasn't really

as near my truck as it appeared – it was miles away and the reflection moved with me. Another possibility is that the ice crystals were much higher, part of a thin veil of cirrus clouds and the reflection part of a parahelic arc.

As soon as I moved beyond the reservoir, the sun dog disappeared. Some people report seeing these objects suddenly vanish as if they are moving hundreds of miles per hour

when really it is just the ice pocket no longer reflecting the sun. I know a teacher who once saw a UFO, and from her description it was pretty clear what she saw was St. Elmo's fire, or ball lightning, as it appeared as a ball of light following along a fence line after a thunderstorm.

There have been many historic accounts of sun dogs; the term itself means an object that dogs (or follows) the sun. The Nuremberg Chronicles, a rare book full of wood cut illustrations, includes an image of a sun dog, and to the plains Indians of North America they were considered omens of bad weather and blizzards to come. There is quite a bit of truth to this, as the cirrus clouds that cause them often do precede a warm front which in the high plains can turn into a blizzard.

Other natural phenomena that are mistaken as UFOs include swamp gas, or pockets of methane with traces of phosphine that can bubble up from methanogens deep in a swamp that decompose organic material. Once the



A complex sun dog with double rings and parahelic arcs.

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phosphine hits the air, it ignites and causes the methane to burn with a bluish light. These fairy lights are called will o' the wisps and are thought to be impish spirits leading the unwary to their doom. Of course, following a blue



A stacked lenticular cloud over a symmetrical mountain. Rapidly rotating winds around the peak produce the lens-shaped clouds.

glowing light into a swamp is not a very safe activity. Yet another explanation for UFOs is lenticular clouds. When clear air containing some water vapor is forced to rise up over a conical-shaped mountain it will condense to form a cloud which then is whipped in a circular pattern around the peak, creating a lens-shaped cloud formation that can consist of several layers spinning around the peak. They can look like flying saucers.

Does this mean that all UFO/UAPs are no more than lenticular clouds, St. Elmo's fire, sun dogs, or swamp gas? Or do the many reports of sightings actually have a kernel of truth to them? What about the recent video footage of Navy and Air Force fighter pilots showing some kind of ill-defined objects tracking along with carrier groups? Like any extraordinary claim, for UFOs to actually be alien spacecraft would require extraordinary proof, as Carl Sagan liked to say. Unidentified flying objects only stay such until they are identified or explained.

During our astrophysics class at New Haven School this summer, students chose from various famous sightings and investigated them with a critical thinking lens. Does the claim make sense? Is there any indisputable evidence? Did more than one person see it, and were they credible witnesses? Their short essays on their chosen sightings are included in this edition of *Ad Astra Per Educare*, in which we will explore the possibilities of extra-terrestrial intelligences and our search for them, starting with the Drake Equation and ending with the recent sightings by air force and navy personnel. We will look at various methods for detecting exoplanets, and which ones are the most likely to be Earth-like and in the Goldilocks Zone, or Habitable Zone, of their stars. We'll also look at an intriguing experiment to detect galaxy-wide civilizations by their waste heat signatures, called the G-Hat project.

I was contacted last year by a reporter for a news outlet

called *The 74*, meaning the 74 million students who are in school in the United States, regarding how I use my UFO encounter in the classroom. She wanted to capitalize on the rash of press about the navy and air force sightings and congressional investigation, and she had contacted people I know at SETI, who put out the word for any volunteers. I said yes so she called me up and I told her my story. And thought nothing more about it.

Then later in the year I had a parent of one of my students say he had seen an article about me in *The Guardian*, a British world news magazine that I often read for international perspectives. I thought he must mean a different David Black, because there are quite a few of us around. But no, he said it also mentioned New Haven School. Intrigued, I found the article and it was a reprint of the one done by the reporter for *The 74*. It seems strange to me that my little UFO incident went international.

Here is a link to the *Guardian* article if you want to read it:

<https://www.theguardian.com/education/2021/jun/09/ufo-science-classes-us-students>

I think I've pretty much used up my 15 minutes of fame.



Sundogs and parhelic arcs over Fargo, North Dakota

As a separate but related assignment, my students created exoplanet paintings similar to the ones shown in our previous editions. I had 12 students in the class, used better equipment, and most students did two paintings, so I have more to choose from. Their paintings provide most of the illustrations in this edition.

I hope you enjoy the readings and student analyses. This is the fourth of seven editions that use articles written by students at New Haven School. Because of the nature of the school, I cannot provide the students' full names due to privacy concerns. In most cases the students have worked through three drafts of their essays with peer and teacher review. I think they have done a marvelous job. Enjoy!





A spray painted representation of the Epsilon Indi star system, where an orange dwarf star is orbited by two co-revolving brown dwarfs.

develop it. With the different types of extremophiles we have found on Earth it looks like life could exist in very hostile environments. This means that  $f_l$  approaches 1 or 100% with enough time.

$f_i$  is the fraction of life-bearing planets that have intelligent life on them, finding out the value of  $f_i$  is really hard since we only have one example: humans. Some anthropologists still argue on why one of the branches of the ape family evolved into the human species. We don't really know if this is really unavoidable or just a coincidence. Scientists think that there are other species that could potentially evolve into intelligent beings such as dolphins and chimpanzees. Scientists think that if life could evolve then intelligent life could too, given enough time, since it has happened on Earth and there is no reason to think Earth is a special case.

## What We Know About the Drake Equation

Lily M.

August 12, 2020

In 1961 an astronomer Frank Drake created the Drake Equation. He created it for a way to understand the factors involved in finding life outside our Earth in our galaxy and to roughly calculate the amount of life that can communicate with us. The equation he developed is the following:

$$N = R^* \cdot f_p \cdot n_e \cdot f_l \cdot f_i \cdot f_c \cdot L$$

It is a complicated equation and contains quite a few variables.

$N$  means the number of extraterrestrial civilizations we as humans can communicate with.

$R^*$  is the rate of star formation, which we now know to be about 1.5 stars per year.

$f_p$  is the fraction of stars that have planets. When our Sun was born our solar system organized as a natural consequence with planets forming inside eddies of the solar accretion disk. Astronomers feel that this process would occur around other stars as they formed, and that on average every star should have at least one planet, so this factor approaches 1 or 100%.

$n_e$  means the number of planets per star that could possibly support life, or be like Earth.  $n_e$  is even more difficult to figure out than  $R^*$  and  $f_p$ , but was assumed by Drake to be around 3, since there are three planets in our solar system that are or were within the habitable zone.

$f_l$  is the fraction of planets that support life and can

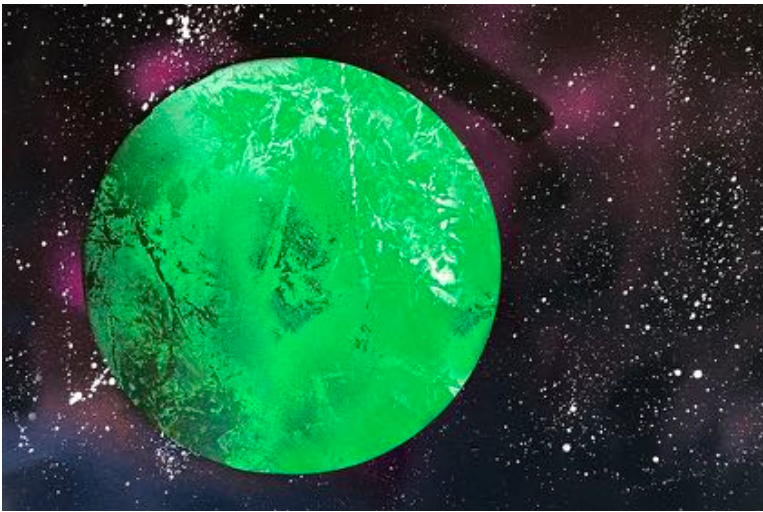
$f_c$  is that fraction of planets with intelligent life where that life is willing and able to communicate with us across interstellar space. Scientists believe that if there is intelligent life out in our galaxy that they will eventually advance to a technology level to send out a signal into space. Knowing the human species, we can only guess that if there is another human-level species they would have either deliberately or accidentally shown that they exist by now. Which could mean that  $f_c$  could be as high as 1.

Finally, the last letter  $L$  means the time span that the other life can communicate with us. The Earth's population has grown so much over the past few centuries that the human species has the potential to destroy itself with man-made catastrophes, wildlife disasters, diseases, and nuclear war. If we all start to have a pessimistic view on this then we cannot be sure that human race will live through to the next century, that we will destroy ourselves and our advancement in technology will only have existed for a couple of centuries. It is difficult to say if another species will have the same rate of technological advancement or will have the same tendencies for self-destruction. Scientists think that  $L$  is approximately 200 to 10,000 years.

Putting in all the estimates for these variables we come up that  $N$  would be about 50, or 50 communicating civilizations per year would arise in our galaxy. The Drake Equation does not have a concrete solution yet because the last four variables are very hard to figure out. You may also have heard of the Drake Equation as the Green Bank equation or Green Bank formula, as the first meeting of astronomers interested in SETI, or the Search for Extra-terrestrial Intelligence, occurred at the Green Bank radio telescope facility in West Virginia. Carl Sagan was one of the astronomers at that meeting, and brought up the Drake Equation in his television series Cosmos. The Drake Equation has been a very popular equation to help us identify the factors we need to solve to look for intelligent life in our galaxy.







A painting of a green exoplanet

enough to become part of some great Encyclopedia Galactica, a galactic storehouse of the wisdom of all civilizations.

If we do want to estimate the total communicating civilizations, I would suggest a modification of the Drake Equation. Here is my own version of it:

$$N = S_{\text{tot}} \cdot f_m \cdot f_{\text{FGK}} \cdot f_p \cdot f_{\text{HZ}} \cdot f_i \cdot f_c \cdot L$$

$N$  = the total number of communicating civilizations at any one time.

$S_{\text{tot}}$  = the total number of stars in our galaxy, which is around 200 billion based on mass estimates.

$f_m$  = the fraction of those stars that have high metallicity, such as our sun. These are primarily Population I stars compared with the metal poor, older Population II stars. For life to exist, the proper elements including metals must be present, and the older metal-poor stars are poor candidates. That gets rid of about half the stars, as  $f_m$  is about 0.5.

$f_{\text{FGK}}$  = the fraction of those stars that are like our sun, with long enough life spans for intelligence life to evolve and stable enough to not have UV flares or small habitable zones like red dwarf stars. Counting the number of such stars in the space around us out to 15 light years (this is where we pulled out our 3D model), we see there is one F type star, three G stars, and five K stars out of about 45 nearby stars, or 9/45 or 0.2.

$f_p$  = the fraction of those stars that actually have planets, which we know is near 100%, probably about 0.9 to be conservative, based on all the planets we are currently finding.

$f_{\text{HZ}}$  = the fraction of those planets found inside the habitable zone (HZ) of that star. Based on various planetary systems we have detected, it appears this number is about one in four or 0.25.

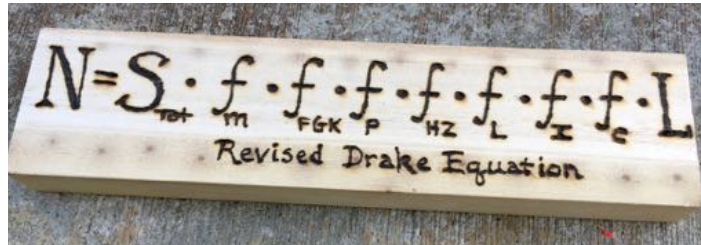
$f_i$  = the fraction of those planets that actually evolved life on them. This becomes hard to estimate since we only have one example of life evolving so far. However, we do

## A Modification of the Drake Equation

by David Black

It has been two years since Lily wrote the article above and I am only now putting together this 4th edition of our *Ad Astra Per Educare* student newsletter which will include her article. At the time that Frank Drake created the equation in 1961, hardly anything could be answered about any of the variables in the equation except perhaps the first variable about the rate of star formation per year in the Milky Way galaxy, which at the time was estimated to be about three stars per year. With additional data and the advent of space telescopes, we are beginning to get ever better estimates of some of the variables.

One thing that has always puzzled me about Drake's equation is the inclusion of this first term. Since it is a yearly estimate, the final answer must be the number of communicating civilizations that come into existence per year, which seems an odd way of looking at it. We want to know the total civilizations out there that we might converse with, not just the newbies like us. Carl Sagan spoke of how, given how many of these factors were considered to be close to 1 (or 100%) if given enough time, the truly limiting factor is the final one, the life-span of a civilization where they are able and willing to communicate over interstellar distances. This is why he was so adamant about preserving the Earth and getting rid of nuclear weapons. He wanted us to last long





know that as soon as conditions settled down after the Late Heavy Bombardment ended, life evolved rather quickly within a hundred million years or so. So this number also approaches 1, given enough time. To be conservative, let's say it is about 0.8.

$f_i$  = the fraction of planets with life that evolve intelligent life. This is where I disagree with Drake's initial estimate that if life hangs on long enough, it will eventually evolve into intelligence. There is no proof of that and it took a rather lengthy time to happen on Earth, despite several near misses. Certainly there was impetus for intelligence during the Mesozoic, what with large predators running amok, but the rodent-like creatures were too small (a necessity to avoid the large predators) and intelligence never happened. So there have been intelligent creatures capable of using tools for the last three million out of 3.8 billion years since life first evolved. This gives us a limiting factor of about  $3/3800$  or 0.00079.

$f_c$  = is that fraction of intelligent creatures that develop technology capable of sending messages over interstellar distances, which for us occurred in 1932 with the first television broadcast capable of reaching beyond the ionosphere. It was sent from the opening ceremonies of the summer olympics, were held in Berlin that year, and hosted as master of ceremonies by none other than Adolf Hitler himself, with a parade of goosestepping Nazis. Yes, Hitler is our ambassador to the stars and there is nothing we can do about it. That gives us 90 years that we've had the technology to send signals, or 90 out of 3 million years, a factor of 0.00003.

$L$  = the number of years a civilization will be capable of sending out or detecting signals. If it is only a hundred years or so for us, if we destroy ourselves sometimes soon, then the numbers look grim. But if we can overcome our adolescent tendencies for self-destruction then we might keep radio technology around for a long time, perhaps 10,000 years. This is the real kicker – it all depends on

surviving long enough to become a part of the intragalactic conversation.

Putting all these numbers together, we get:



$200,000,000,000 \cdot 0.5 \cdot 0.2 \cdot 0.25 \cdot 0.9 \cdot 0.8 \cdot 0.00079 \cdot 0.00003 \cdot 100$  which solves out to: 8532 communicating civilizations in our galaxy. That's still a decent sized number. Tweak the numbers such as adding to the lifetime of a civilization and there could be more. Other estimates put the number at less than 1.0, which would mean we are an oddity and possibly alone in the galaxy.


Enrico Fermi was famous for asking a question that is now known as the Fermi Paradox: If there are so many civilizations out there, why haven't we heard from them by now? Why the great silence?



If you take 8532 worlds and spread them out randomly throughout the spiral arms of the Milky Way (where the metal-rich stars are found), which is 100,000 light years in diameter and is basically disk-shaped, you can use the formula for the volume of a cylinder with a radius of 50,000 light years and a thickness of about 1000 light years. This gives an overall volume of about 7.85 trillion cubic light years. In all that space, 8532 civilizations will

be greatly spread out, probably thousands of light years apart. The answer to Fermi's Paradox becomes obvious: we haven't heard from anyone because our little Nazi parade has only been traveling for 90 years. No one has heard us yet, if our signal is even strong enough to be picked up. Maybe that's a good thing.



There have been proposals to send out other, stronger signals and to send them in a tight beam to probable star systems instead of broadcasting in all directions. We've sent plaques out on the first space probes to go beyond the solar system, the Pioneer 10 and 11 and Voyager 1 and 2 probes. But it will take tens of thousands of years for them to reach even the closest star systems. We may have to wait awhile before we join the conversation. 



## Astrobiologists and Astronomers

### Frank Drake

by Cate

Frank Drake was born on May 28th, 1930 in Chicago, Illinois. He received a scholarship that took him away to the University of Cornell in Ithaca, New York, at the age of 17. He decided to major in engineering physics teaching about the communication with life outside of planet Earth. He was also the one who came up with the idea of the Drake Equation, which is a way to guess the number of intelligent civilizations in our galaxy. Drake was one of the main founders for the search for extraterrestrial intelligence (SETI). Along with his SETI work he was also the first person to chart the center of the Milky Way galaxy. After graduating at Harvard University, he went on his way to work at the National Radio Astronomy Observatory (NRAO) in April of 1958, in West Virginia. He was one of the very first astronomers to set up millimeter-wave telescopes in the Search for Extraterrestrial Intelligence. On April 8, 1960, SETI started the Project Ozma, where they thought they had a signal from space, but they didn't. They're still trying to look for any signs of activity in our galaxy, and if they ever did get a signal it will change the world.

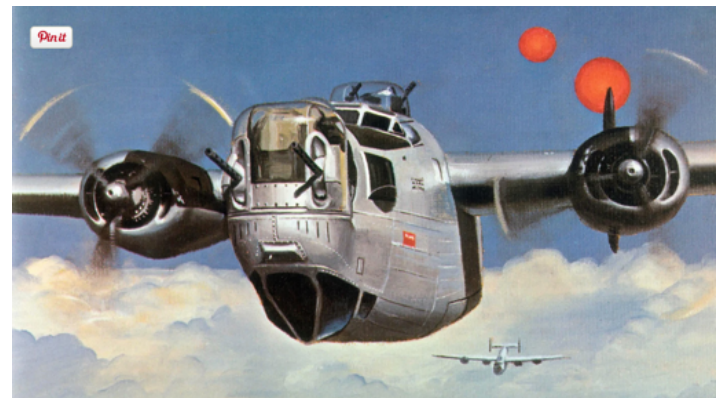


Dawkins, and others. Jill has published lots of articles and lectures about extraterrestrial life. Her most famous lectures are, "Are we Alone," on a podcast in 2006, and "Intelligent Life in the Universe: Is Anybody Out There," in 2011, at the first Starmus Festival in the Canary Islands. 🌌

### The Foo Fighter Sightings

by Lola

During World War II there were strange sights that had been observed by airplane pilots. There had been multiple sightings saying that there would be eight to ten lights that would follow the planes; the lights would be orange, green or red. The reports said that the lights would show up alongside them but would mysteriously disappear and would never show up on the pilots' radars. Each sighting had an unusual way of the lights approaching the air-



planes. The lights would fly alongside, follow behind, close in on the pilots or rise to the planes. The pilots would set their planes to defense, attempt to flee, or try to take defensive maneuvers but each time the lights would follow and eventually disappear.

When the sightings had finally made it to the public, theories attempted to find a reason for these strange lights. None of the theories would match up because of all the things that were unusual about the sightings. It would be easy to produce a theory but it would be shut down by the fact that the lights would not appear on the pilots' radars and how they could easily keep up with the planes and move faster and easier than the airplanes. The strangest part was the lights disappearing and reappearing.

The UFOs were named 'Foo Fighters' by the pilots that sighted the lights. The UFO was named after a cartoon comic strip called Smokey Stover. Smokey was a fire man that had a catch phrase that said: "Where there's a foo, there's a fire."

I had heard the name "Foo Fighter" before but I did not know what it was. I was not expecting the sightings to take place in World War II, I thought that the Foo Fighter sightings would have been more recent. UFO sightings have been seen for many years, we must keep wondering and exploring the possibilities of what could be outside of our world. 🌌



### Jill Tarter

by Libby

Born on January 16, 1944, Jill Cornell Tarter became a famous American astronomer. Jill grew up in New York and graduated from Eastchester High School in 1961. As a child, her dad died when she was twelve, Jill's father was a big inspiration to her. He encouraged her interest in astrology and

helped her to become the person she is today. After graduating high school, Jill Tarter went to Cornell University and earned her Bachelor's degree of engineering physics as an undergraduate. After, she got a master's degree and PhD in astronomy at Berkeley University. This is when she became more interested in astrobiology. After Jill finished her education, she became the director for SETI Research by the Cyclops Report. In 1992-1993 she was project scientist for NASA's high-resolution microwave survey and became director of Project Phoenix of the SETI institute. Jill Tarter later joined the Starmus Board of Directors, along with physicist Stephen Hawking, evolutionary biologist Richard

## Battle of Los Angeles

by Fizzy

On February 25, 1942, admits World War 2, US military radars picked up an unidentified aircraft fly over Los Angeles. During this time Pearl Harbor had caused tensions to rise and Americans believed the Japanese were going to attempt to invade. A few months early in December 9, 1941, false reports of aircraft had caused some invasion anxiety in New York City. At the time lots of untrained pilots had been making calls of Japanese warships and submarines when later found to be fishing boats, logs, and even whales.

A few days before on February 23rd a Japanese submarine surfaced and fired at the mainland. This attack caused minor damage but scared the armies in California. With the armies on high alert, a radar scanning reported that an aircraft was approaching Los Angeles and was 120 miles away. Immediately troops prepared to fire and swept the night sky with a spotlight.



About an hour later the army started shooting. Not long after many coastal city's weaponry joined in. The LA Times wrote, "Powerful searchlights from countless stations stabbed the sky with brilliant probing fingers while anti-aircraft batteries dotted the heavens with beautiful, if sinister, orange bursts of shrapnel." Soldiers claimed they shot down one of the six reported planes but the next day nothing was found but shrapnel from the attack of the night before. Coastal artilleryman, Charles Patrick later wrote, "I could barely see the planes, but they were up there all right. I could see six planes, and shells were bursting all around them. Naturally, all of us fellows were anxious to get our two-cents' worth in and, when the command came, everybody cheered like a son of a gun." Even the next day some soldiers claimed they saw nothing but smoke and clouds.

Later that morning they called it off after firing 1,400

rounds of anti-aircraft ammunition. When they searched for bomb sites of enemy planes they were met with no proof of an attack from the night before. "Although reports were conflicting and every effort is being made to ascertain the facts, it is clear that no bombs were dropped and no planes were shot down," said the Army's Western Defense Command.

This 'attack' was shoved off and said to be a false alarm. Secretary of the Navy Frank Knox said it was just nerves triggered by the ongoing war. Japanese leaders say that they did not fly any aircraft over the city. It was later claimed to be a weather balloon mistaken for enemy planes in the dark. This balloon could have reflected light from the moon, catching the eye of the service members.

I believe that 'The Battle of Los Angeles' was merely a strange accident. The whole country was on the balls of their feet from the war going on and seeing a plane would have sent them into a frenzy. The fact there is proof a weather balloon was sent just before this all happened was and when the soldiers thought they shot down a plane they merely saw the balloon get shot and fall into the ocean. 🌐

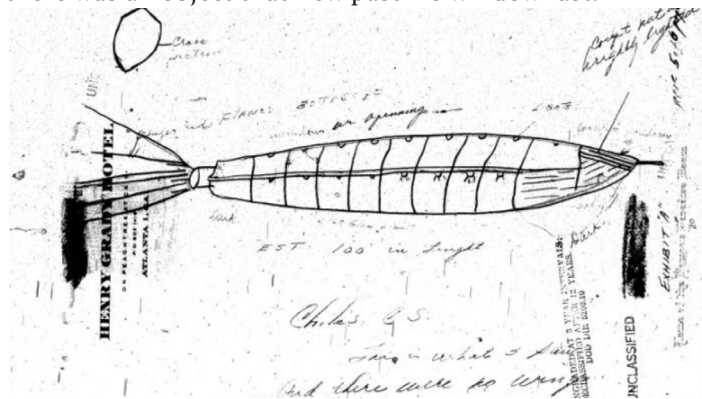
## Chiles- Whitted sighting

by Ali

One may have heard a lot about aliens, from movies to sightings, but are they real? One could argue both ways, however there are multiple sites where it makes it almost impossible to not believe in aliens.

On July 24, 1948 around 2:45 am there was an incredible sighting while two different American commercial pilots were doing their normal flights over S Those commercial pilots nearly collided with a strange torpedo shaped flying object.

He could not describe much other than the fact that there was an object that flew past his window fast.



One of the pilots (Chiles) saw a flying object for 10 seconds before he lost sight in the clouds. He described what he saw in an official statement about a week later: "It was clear there were no wings present, that it was powered by some jet or other type of power, shooting flame from the rear some 50 feet. There were two rows of windows, which



indicated an upper and lower deck, [and] from inside these windows a very bright light was glowing. Underneath the ship there was a blue glow of light.” (Daugherty, 2018)

The other pilot (Whitted) offered a similar description “The object was cigar shaped and seemed to be about a hundred feet in length. The fuselage was about three times the circumference of a B-29 fuselage. It had two rows of windows, an upper and a lower. The windows were very large and seemed square. They were white with light which was caused by some type of combustion.... I asked Capt. Chiles what we had just seen and he said that he didn’t know.” (Daugherty, 2018)

At first The Pentagon had suggested that it was a weather balloon, however this was quickly disputed. The interpretation of what the three people saw was quickly discussed and dismissed as a crazy story. A common modern theory was it was a German V2 buzz bomb where the windows was a reflection.

This is a buzz bomb from the 1940’s and one can see it looks remarkably like the drawing of the UFO (Bundesarchiv, 2022).



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## Haneda Airbase Sighting

by Hannah

August 5th, 1952 Japanese USAF operators noticed something off in the sky. They saw a blueish- white light across the way from the control tower. Quickly the operators took action, they called the GCI radar unit. The GCI unit is a group of people who work with a ground-controlled interceptor. Initially formed to help train pilots. It uses a remote-controlled drone or a piloted aircraft that works to train officials to use a ground interceptor in a combat or high-risk situation. The GCI gives a 360-degree view around where it is stationed. It is a commonly used defense tactic. At Haneda airport the GCI team called in an F-94, an American made all weather jet interceptor that was used for air defense and carried no guns. The F-94 created a radar scramble. Their radar then got returns from the area of the blueish light. The GCI then vectored, directed (an aircraft in flight) to a desired point, the F-94 towards the light. They then picked up an unknown orbiting target. Furthermore, the F-94 picked up an unknown radar. After 90 seconds there was an airborne pursuit where the target moved out of radar range and the pursuit was followed by another GCI radar. The unknown light/radar source then disappeared.

Scientifically it makes little sense because why would an alien species come to an airport on Earth to simply just look. They also did not stay for an extended period of time, why make a long trip to only stay a little over a minute? Also, assuming they were developed enough to make a craft that can travel to Earth, why would they have run away when the radar was scrambled. Assuming the level of development necessary and the fact that they supposedly had a radar system it is confusing as to why then they would turn and leave. Applying human logic to the situation this becomes confusing as to why something would travel so far, how advanced I’d have to be to do this, and why no contact would be made. This does become confusing though. The sighting took place at an airport. This means there is high air security. Meaning it is harder to just ‘see’ an aircraft with no evidence. There also is evidence of a radar system being detected. This is harder to fake than just a pure sighting. Furthermore, this sighting and action was taken place by USAF operators, as well as people working with the GCI and F-94’s. The more people involved the harder the sighting is to be dismissed. It is harder to convince 20 people to lie about a sighting than it is for one person to just make a claim.

In my belief the sighting may have been real, an unidentified flying object was seen; this object may not have been aliens though. It seems highly unlikely all these people would lie about an object somewhere as secure as an airport, but it seems more unlikely that this object would be sent by another species. Therefore, it may have been sent by another human, perhaps as a prank or a mistake or even something more sinister. That we may not ever know.





## The Roswell Incident

by Ari

The Roswell Incident occurred near Roswell, in south-eastern New Mexico, in 1947.

Unlike many UFO sightings, the Roswell incident had no witnesses of the observance of sky. In 1947 a rancher named William “Mac” Brazel found debris in one of his pastures. The debris included, “metallic rods, chunks of plastic and unusual, papery scraps” (Waldek, 2017, para. 6). He believed that the remains were related to the stories of flying discs and flying saucers that had been published

addition, another theory was argued by Charles Berlitz and William L. Moore. According to Britannica, “They argued that the original debris, which they believed was from a crashed flying saucer, had been flown to Wright Field (later Wright- Patterson Air Force Base) near Dayton, Ohio, and material from a weather balloon was ‘hastily substituted’” ( In order to spread their argument in 1980 they published ***The Roswell Incident***, a book supporting their beliefs about the incident. Furthermore, some conspiracists forged a document by the name of Majestic 12 (MJ-12), a document supposedly authorized by Harry S Truman that explains, “... how the crash of an alien spacecraft at Roswell in July 1947 had been concealed, how the recovered alien technology could be exploited, and how the United States should engage with extraterrestrial life in the future” (Wikipedia, 2022). Afterwards, the documents were determined to be fake due to the lack of evidence to support the existence of the MJ-12.

As a result of all the widespread news coverage of the Roswell incident, other media sources ceased this opportunity to produce more content. The articles that were released were by, but are not limited to, ***The Roswell Morning Dispatch***, ***The Roswell Daily Impact***, and more. In addition, numerous books were published, such as, ***The Roswell Incident*** by Charles Berlitz and William L. Moore, ***Area 51: An Uncensored History of America's Top Secret Military Base*** by Annie Jacobsen, ***The Roswell Legacy*** by Marcel Jr., ***The Roswell UFO Crash: What They Don't Want You to Know*** by Kal K. Korff, and many more. Fur-

thermore, movies and films used the Roswell incident as inspiration or as the main plot. Some popular examples being: *Independence Day*, *Indiana Jones and the Kingdom of the Crystal Skull*, *Roswell: The Aliens Attack*, etc.

Because of the widespread news coverage that this incident had on the public, it sparked interest among the city. For instance, Roswell became known as a major hotspot for UFOs and aliens. According to *Britannica*, “In 1992 the International UFO Museum and Research Center opened in Roswell, and since 1996 Roswell has been the site of an annual UFO festival” (Britannica, 2022). Due to the Roswell Incident, it stimulated and became a significant part of the city's economy.



previously before the discovery. He reported what occurred to Sheriff George Wilcox of Roswell, which was then brought to the attention of Colonel William Blanchard, the commanding officer of the Roswell Army Air Field (RAAF). The day after, the RAAF released a statement hinting at the wreckage being part of a flying disc. However, when the ***Roswell Daily Record*** attempted to write a story about the RAAF's claim, the RAAF retracted their previous statement, stating that it was actually the remains of a weather balloon. In 1994, the U.S Air Force admitted via a report that the weather balloon story was fake. Their explanation was that the scraps were actually from a classified project named Project Mogul, which was testing a new spy device. Their reasoning for lying was to ensure that no details of the project would be leaked, thus ruining the classified nature of the project.

Despite the evidence, many people formed their own opinions about what happened. Conspiracy theorists worked hard to prove that the wreckage Brazel discovered was the result of an extraterrestrial. Ray Santilli, a conspiracy theorist with the belief that the wreckage was extraterrestrial, released a video in 1995 of a supposed “alien dissection” that occurred after the incident. Later, in 2006, Santilli confessed that the video was staged, however, he continued to claim that it was based on real footage. In



## Maury Island UFO Incident

by Eva

On June 21, 1947, Fred Crisman and Harold Dahl made a claim that the two saw unidentified flying objects in the sky over Maury Island, and soon after received threats from the men in black. In popular UFO conspiracy theories, men in black are described to be men dressed in black suits, who supposedly are government agents. These “agents” harass, threaten or assassinate UFO witnesses to keep them quiet. After his supposed sighting in 1947, Harold Dahl claimed to have been approached by a man in a dark suit and was warned not to talk about his alleged UFO sighting on Maury Island. Three days after Crisman and Dahl made the Maury Island claim, private pilot Kenneth Arnold allegedly saw a string of nine UFOs flying past Mount Rainier at an estimated speed of 1,200 miles per hour. Arnold’s report led to nationwide news coverage and caught the attention of editor Raymond A. Palmer. Palmer quickly contacted Arnold and passed on the story of two harbor patrolmen, Crisman and Dahl, who supposedly had pieces of these flying objects. Palmer suggested that Arnold fly to Tacoma to investigate and on July 28 the investigation began.

When arriving in Washington, Arnold first interviewed Harold Dahl. During the interview Dahl said, “On June 21, 1947 in the afternoon about two o’clock, I was patrolling the east bay of Maury Island [...] I, as captain, was steering my patrol boat close to the shore of a bay on Maury Island. On board were two crewmen, my fifteen-year-old son and his dog. As I looked up from the wheel of my boat I noticed six very large doughnut-shaped aircraft.” Dahl continued to claim the one of the flying objects began emitting what seemed like “thousands of newspapers” from the center of the object. These “newspapers” ended up being a light weight white metal and fell to Earth. A substance resembling lava rocks fell onto the ship and ended up breaking a crewman’s arm and killing their dog. Dahl said he brought in Fred Crisman to investigate, who reported that he was able to recover debris from Maury Island. Both Crisman and Dahl continued to claim their sightings were concrete as the investigation continued.

When reading this article, I was skeptical. It turns out that I was not the only one and there were others who felt the same. As the investigation furthered, evidence began to appear that contradicted the two men’s claims. Crisman later showed this “white metal” to Arnold and it was concluded that it was inconsistent with Dahl’s story. Lt. Frank Brown of Military Intelligence was brought into the investigation along with Captain William L. Davidson. Davidson and Brown held interviews and collected fragments. Eventually the officers planned to return to California

and not further the investigation. On their way back, their B-25 Bomber crashed outside of Kelso, Washington and the two died. The FBI then took over the case and continued the investigation. The FBI was able to quickly come to the conclusion that the Maury Island UFO Incident was a hoax. They noted that during Dahl’s interview he said that “if questioned by the authorities he was going to say it was a hoax because he did not want any further trouble over the matter.” Crisman and Dahl were also found to have shared different stories to different newspapers and media outlets. It was concluded that they had shared their stories with many publications with the hope of building their story and earning a profit. The “Tacoma Harbor Patrol”, the organization both Dahl and Crisman allegedly worked for, was revealed to be a for-profit business who charged owners of vacation homes in exchange for the security of their home while they were gone. The two men just wanted money any way they could get it.

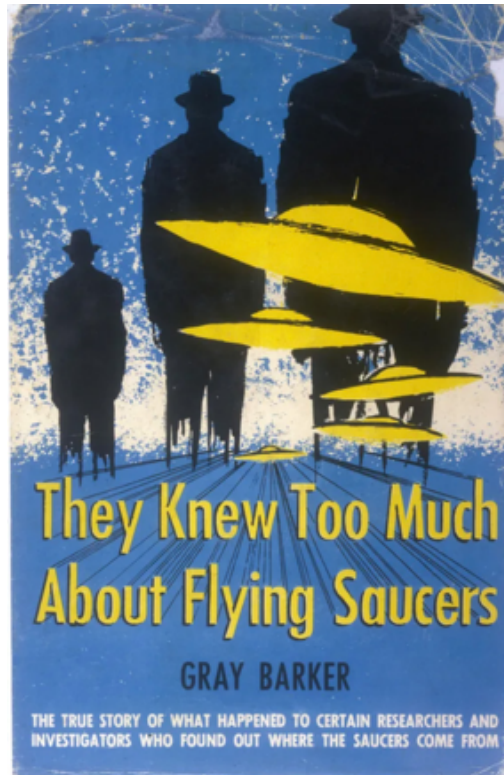
The case was then closed, having been proven that it was a fake story. Written later in 1956, Air Force officer Edward J. Ruppelt stated “the whole Maury Island Mystery was a hoax. The first, possibly the second-best, and the dirtiest hoax in the UFO history.” The conclusion of this case had many opinions. The majority of people who believed in the UFO story felt it was

true because the government never prosecuted or exposed the two hoaxers. It was later stated that the reason for the thorough investigation was that the government had full intent to prosecute them for the death of Lt. Brown and Capt. Davidson. After talking to Dahl and Crisman, they decided that the hoax had no ill intent and the death of Davidson and Brown could not be placed on the hoaxers. The story ultimately brought popularity to the men in black theory, and the concept of flying saucers, just as Dahl and Crisman had hoped for. In the end, the scientific evidence discovered provides enough to agree with the FBI’s claim, the Maury Island Incident was a hoax.

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## Flight 105

by Gillian

Throughout human history, there have been countless reported sightings of extra-terrestrial interactions. Perhaps the most famous of these are the identifications of these alien's modes of transportation; they are known as "Unidentified Flying Objects," or, more simply, "UFOs." UFO sightings are often the butt of jokes made at the expense of hillbillies, hicks, and red necks. But what happens when the witnesses of an extraordinary occurrences are reported by educated members of society? The Flight 105 incident gives us some insight.



On July 4th, 1947, United Airlines flight 105 departed Boise, Idaho at 9:04 PM. After eight minutes, Co-pilot Stevens

turned on the aircraft's landing lights. He did this because he saw two groups of objects ahead of the plane, and thought that they were other planes. Upon further investigation, Stevens and Captain Emil J. Smith realized that the objects had neither fins nor wings. They called a flight attendant into the cockpit to get a third opinion and witness. After attempting to receive ground-confirmation from Ontario, Oregon, they watched the objects for a few more minutes before they spurted "ahead and disappear(ed) at high speed off to the west (Statement on Unidentified Flying Objects, James E. McDonald, 1968)."

When considering the reliability of a report of something scientifically disputable, there are many factors to consider. For instance, the reputability of the witnesses, the conditions in which the incident was reported, outside influences on perceptions, and more. We can consider these closely. To provide some context on potential outside influences, we look to the sensational reported sighting by private pilot Kenneth Arnold, not a week before. This certainly creates potential for susceptibility to influenced conclusions on the part of the Flight 105 witnesses. However, when being interviewed by James E. McDonald, (Senior Physicist, Institute of Atmospheric Physics, and professor, Department of Meteorology, The University of Arizona), "Smith emphasized that he had not taken seriously the previous week's news accounts... But, after seeing this total of nine unconventional, high-speed wingless craft on the evening of 7/4/47, he became much more interested in the matter. Nevertheless... he stressed that he would not speculate on their real nature or origin (Statement on Unidentified Flying Objects, James E. McDonald, 1968)." An additional factor to consider is the reputability of the

witnesses themselves. Had the witnesses been known for eccentric and sometimes fanciful beliefs, it would be easy to pass off the report as nothing more than a fantastic feat of imagination. However, Emil J. Smith's "complete reputability" was vouched for firmly by interviewed United Airlines employees who had known Smith for years (Statement on Unidentified Flying Objects, James E. McDonald, 1968). A final factor worth considering is the environment in which the sighting was reported. Natural weather phenomena such as Arora Borealis, or Northern Lights, have been cited in past as explanations for "UFOs." In this specific instance, though, the witnesses reported "no cloud phenomena to confuse them (Statement on Unidentified Flying Objects, James E. McDonald, 1968)," and that the weather was completely clear.

The Flight 105 incident is, "by no means the most impressive UFO sighting by an airliner crew, nevertheless, it is a significant one. It occurred in clear weather, spanned a total time estimated at 10-12 minutes, was a multiple-witness case including two experienced observers familiar with airborne devices, and was made over a 1000-ft altitude range (climb-out) that, taken together with the fact that the nine objects were seen well above the horizon, entirely rules out optical phenomena as a ready explanation. It is officially listed as Unidentified (Statement on Unidentified Flying Objects, James E. McDonald, 1968)."

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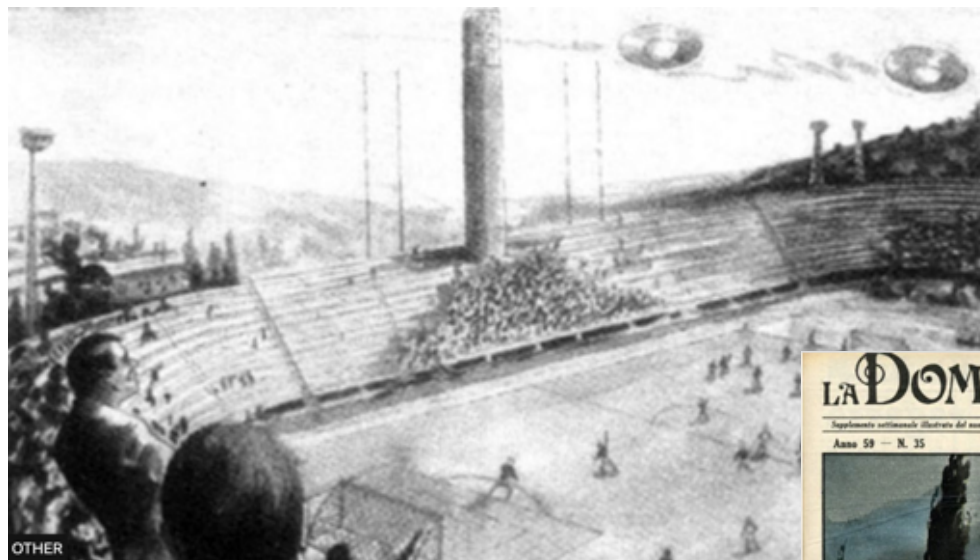
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## Fiorentina Stadium Mass UFO Sighting, 1954

by Lilly

On October 27, 1954, the Fiorentina club soccer team was playing against their rival Pistoiese. There were about 10,000 spectators sitting in the concrete bowl of The Stadio Artemio Franchi Stadium that fall day. In the second quarter, Fiorentina was in the lead at 6-2 when the game came to a pause because of a sudden shift in the crowd of spectators. Their normal competitive frenzy turned to something more like hysteria. Everyone in The Stadio Artemio Franchi Stadium turned their eyes to the sky. Adrico Magnini, a defender for Fiorentina, described the sight as he saw it: "I remember everything from A to Z," he says. "It was something that looked like an egg that was moving slowly, slowly, slowly. Everyone was looking up and also there was some glitter coming down from the sky, silver glitter." Every one of the ten thousand other viewers described similar events, details altering slightly from person to person.



Many concluded that the only explanation for this event was that the objects in the sky were UFOs.

This was not a case of mass delirium experienced in the stadium that day, there were many other sights of these strange egg-like, presumed spacecraft all over Tuscany, Italy. Another of the players, Romolo Tuci, years later when asked about the event stated, "In those years everybody was talking about aliens, everybody was talking UFOs and we had the experience, we saw them, we saw them directly, for real." But what are the possibilities of that being truth?

We know now that these UFOs were not Martians as many people at the time believed, but what if they truly were some types of extraterrestrial intelligence, something that cannot be explained by anything on Earth. One of the most mysterious parts of this sighting is the substance that fell from the flying objects, what Magnini described as glitter. This substance was hard to study because it seemed to disintegrate quickly after landing from the sky. Many

recounted this material to look like cotton or spiderwebs. A journalist for the Fiorentino newspaper, Giorgio Batini, was able to collect the mystery glitter carefully with a matchstick and brought it to the Institute of Chemical Analysis at the University of Florence. Many types of analysis were performed on the substance and the only conclusion made was that it contained boron, silicon, calcium, and magnesium, and was not radioactive. This information did not tell us much about the possible origin of the material. James McGaha, former U.S. Airforce Pilot and now astronomer, came to his own conclusion that it was nothing but migrating spiders. This theory could also explain the cigar shaped flying objects. He claims that the UFOs were a mass of spiders, similar to a school of fish. This theory seems plausible because September and October are the months in which spiders in that area begin migration. These peculiar spider migrations still make headlines to this day.

Still, people are not convinced. They are adamant about the idea that the Stadio Artemio Franchi was visited by alien life that afternoon in Tuscany, even with sufficient evidence against that claim. Seventy years since the event, it has become something of a legend for the stadium, and will no doubt be debated for decades longer.

<https://www.bbc.com/news/magazine-29342407>

[https://www.trattoriazaza.it/the-ufos\\_cheer\\_for\\_fiorentina/](https://www.trattoriazaza.it/the-ufos_cheer_for_fiorentina/)





## Zeta Reticuli Alien Abduction Incident

by Maya

The Betty and Barney Hill case, also known as the Zeta Reticuli case is one of the most known and credible alien abduction records in the world. Many people have researched and been informed about this case in the 1960s. People of today do not know much about this incident if they are not into the topic of extraterrestrial beings. There is not any solid evidence of whether there was some sort of abduction with extraterrestrial life involved.

The background on this case starts out simple. It seems like any beginning to a normal story. Betty and Barney Hill



were a biracial couple in the 1960s. They both had busy lives with intense tiring jobs. Barney worked a night shift at a post office located 60 miles away from home. He made the tough commute to work every day. Betty worked a lot in the child welfare field. Which can be brutal. The couple spent most of the time doing their jobs. In the little free time they acquired

they spent most of it working at church in the civil rights movement. They were married for 16 months before they were able to take a 3-day break for their honeymoon. The couple decided to take a trip to Montreal and Niagara falls. On September 19, 1961 they were at a diner nearing the end of their trip. They decided to stop and eat before they continued the journey home to Portsmouth, New Hampshire. They left the diner at about 10 p.m. to avoid all the hurricanes and storms that were supposed to hit. They planned to get home at around 2 or 3 a.m. While driving home they noticed a strange light hovering over them. Barney was an ex-WWII vet and he just assumed that it was a satellite going off course. Betty, not knowing much, was worried that it was something more. The light grew closer and closer with each mile. Eventually, the light was straight above their heads. That was the last thing either of them remembered before the end of the night.

They came around two hours later and surprisingly 35 miles down the road. They both felt dirty and could not recall anything that had happened in the past 2 hours.

They drove all the way home. They both tried to remember what happened but could not seem to. Throughout the next month Betty and Barney developed an increasing amount of anxiety surrounding the incident. They both decided to seek help from a mental health specialist. They met with a psychologist and neurologist named Benjiman Simon. He specialized in hypnosis. He was able to recover memories for the couple through intense therapy. They claim to have remembered being abducted. After the light hovered over them, they recalled being taken into the ship where they were stripped and evaluated. They say they were taken by grey-looking aliens.

**Barney Hill is a witness to a known alien abduction case in the 1960s. Barney was born on July 20th, 1922 in Newport News, VA. He grew up being the youngest with three siblings. His father was said to be a shipyard worker. At some point the family moved to Philadelphia where he graduated and attended Templeton University and later enlisting in the army. After working in the army Barney was employed as a postal worker. His first marriage was to a women named Ruby Horn, with whom he had two children. They later divorced and he married Betty Hill. After marriage they moved to Betty's hometown of Portsmouth NH.**

The real question though is: Is this incident real? We also must find credible evidence that points to an alien abduction. Betty and Barney Hill have a lot of believers and credibility. However, I have done a lot of research on many different websites and I have not found any credible sources. Most websites just explain the story in similar ways that other websites explain the incident. I have seen



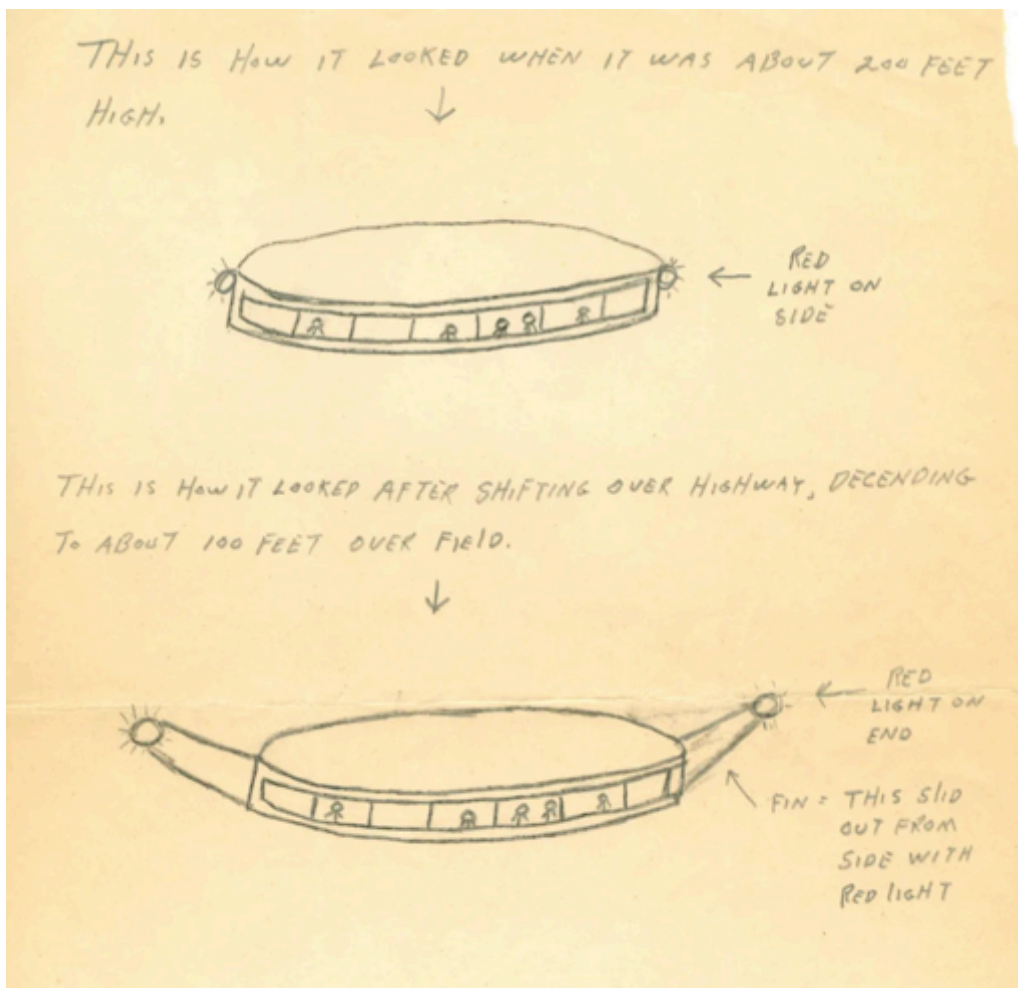
**Betty Hill was born on June 28, 1919. Born as Eunice Elizabeth Barret. She lived in Newton, NH. Where she graduated from the University of New Hampshire. She worked as a social worker for many years before meeting Barney. She is most known for her alien abduction claim. She claims to have been abducted by aliens. She drew a map that is well known across this case. She also was the last known witness of the Zeta Reticuli case after her husband passed away in 1969. She survived for years longer telling stories to reporters and giving information about her claimed abduction. She later died in 2004, leaving her stories and mystery of alien abduction behind.**

quotes directly from the Hill's. Everything they are saying is being believed with no solid evidence. The only piece of evidence that we had is a star map drawn by Betty.

A teacher named Marjorie Fish studied the map in a magazine. She spent a lot of time researching stars like our sun, then creating a 3D model by hanging beads on thread and viewing the model from various angles to see if they would line up with Betty's drawing of alien star map. Since there are many stars in the radius of the situation (Estimated to be around 1,000 stars) Fish spent a lot of her time sorting stars into various categories. She eventually came down to 46 stars. It took Fish 5 years to find a



match. The view point was right above Zeta 2 Reticuli. She stated "Since we did not have the data to make such a map in 1961 when Betty saw it, or in 1964 when she drew it, it could not be a hoax. Since the stars with lines to them are such a select group, it is almost impossible that the resemblance between Betty's map and reality could be coincidental. Betty's map could only have been drawn after contact with extraterrestrials" (Fish).



Fish concluded that this would give us major evidence that we need to help conclude whether the abduction really happened. If the map had not been created when Betty drew it, it would have to conclude that something had happened that night. However, if you look back at Betty's map today and line it up with a more accurate map using data from the Hipparcos satellite you can see that the stars on Betty's map do not line up very well. Another piece of evidence that is critical is the fact that using hypnosis to recover memories is not a credible way to regain lost memory. Laboratory research has shown this. (See Sidebar #3)

My conclusion on this incident is that there was something that happened the night of September 19, 1961. Alien abduction seems a little stretched. However, there really is not an explanation for the map Betty drew that did not even exist yet at the time. I do believe there was an interaction between Betty, Barney, and



something else. It could be aliens and it could be something different.

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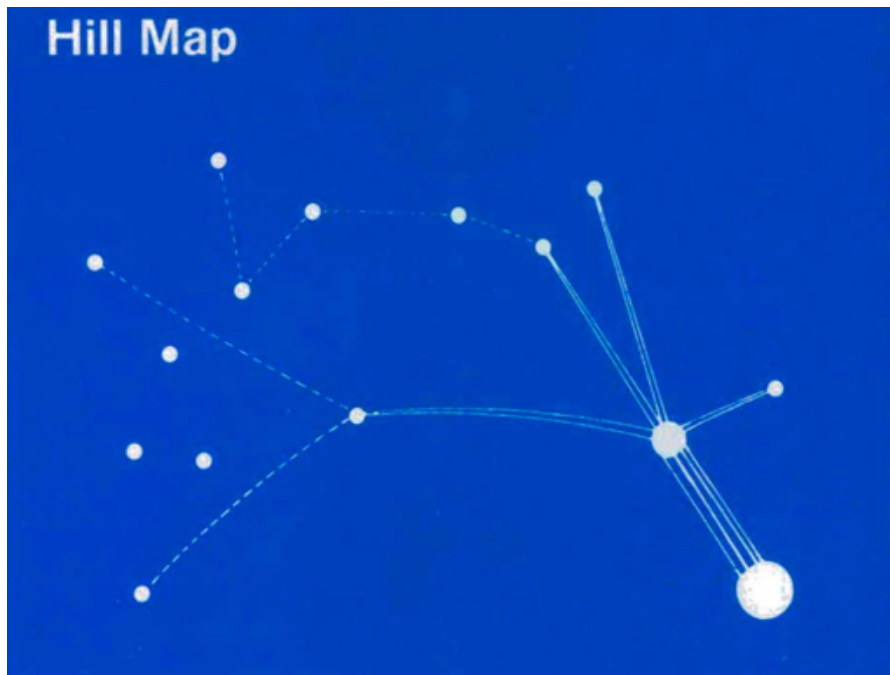
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### The Travis Walton Abduction

by Emma

On November 5th 1975, a lumber jack from Arizona named Travis Walton allegedly went missing while at work, in the Apache-Sitgreaves near Snowflake Arizona. After going missing for five days and approximately six hours. Scent dogs were called in and helicopters were issued to

***Is hypnosis therapy for memory retrieval effective? Research points to no. While hypnosis like that seems exceptionally reliable, research says hypnosis is not a reliable method for memory recovery. People who undergo hypnosis therapy tend to be super confident in their memories which can lead to “persistence of false memories.” There have been laboratory studies that prove that someone can be influenced into believing something that did not happen is real. People believe that therapists can plant memories in the patient’s minds. There is not any legitimate science found behind unlocking memories through hypnosis. All together there is no solid evidence that hypnosis therapy to unlock memories works.***

try to find Walton. Investigators thought that Walton’s co-workers had murdered him, but this was false. Once found, his story was told.

On November 5th a crew of seven men, including Walton, went to work on timber stands in the national forest. While riding out to the timber stands, the group allegedly saw a hovering mass that looked like a saucer. The “saucer” was thought to be approximately 110 feet away from the truck with the seven crew men. They claim to have heard a loud buzzing noise. Walton exited the truck and approached the object when a light came down on him and he lost consciousness. The six other crewmen were frightened off and left Walton behind.

When Walton returned to town, he told the story of waking in a room that resembled a hospital room surrounded by small creatures that were bald who seemed to be studying Walton. He noted that the creatures weren’t humanlike at all. Walton claimed to have fought the creatures until a human intervened while wearing a red helmet.

The man took Walton to a different room. In the second room, Walton claims to have been approached by three other human men that covered Walton’s face with a plastic mask. He then blacked out losing all consciousness. Walton stated that he remembered nothing else following the moment that he blacked out in the room with the three men. He claims to only remember waking up five days later walking down the side of the highway while he watched the saucer disappear into space. Walton had gone missing near Heber, Arizona.

While considered a hoax, Walton’s story raises some interesting questions. All crew members passed the polygraph test but one which was determined too not be conclusive. Their stories were congruent with that told of Walton.

How could this be if it is really a hoax? It makes me question the credibility of the story. I ask myself, could this

be true? I do think this story is most likely a hoax, but I do believe that there very well could be true UFO incidents. One thing that leads me to the conclusion that Walton's story is a hoax is the cash prize of \$5,000 that was awarded to Walton for the best UFO case. There was obviously an incentive for such an elaborate story. A movie was even made about the story following the event. It is called *Fire in the Sky*, making the Walton case a very famous story. These lead to my suspicions about the variability of Walton's story.

The Travis Walton case is a puzzling incident. While the story was deemed a hoax, the workers' stories all lined up with Walton's. Could Walton be telling the truth? I don't believe so, but the possibility is still an interesting mystery to look into.

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#### A Note on UFOs:

Now that you've read through some of the most famous and perhaps credible UFO cases, what do you think?

Are UFOs as alien spaceships real? Or at least credible or possible given the evidence presented here?

In the 1960s, because of so much UFO hysteria, the Air Force opened Project Blue Book, a serious investigation of UFO encounters and alien abduction incidents. By far the majority of such reports were shown to be no more than sun dogs, lenticular clouds, ball lightning, or St. Elmo's fire. Or just someone's photograph of a Frisbee dressed up to look like a flying saucer. Some of these incidents are considered to be hoaxes. Travis Walton was in serious financial trouble at the time of his "abduction" because he was about to forfeit a logging contract with the Forest Service. Claiming it was too dangerous to go back to the woods would have been a way out, not to mention the financial incentive of the National Enquirer's \$5000 reward for best (but not necessarily true) story. When the Enquirer sent out a reporter to investigate, his conclusion (told after leaving the magazine) was that it was a hoax. Walton was back in town several hours before reporting anything to police. But the Enquirer stood to get some good circulation from the story and he was told to drop skepticism.

As for the other incidents, my own story shows how hard it can be to tell scale and distance with no visual references. Just how big and far away are these objects? They could be miles away or just off the wing tips of the airplane, in which case they could be St. Elmo's fire, a static discharge at the ends of airplane wings and sailing ship masts. I thought my sun dog was right by my truck, but it was miles away.



The Fiorentina stadium incident was seen by thousands of people, but it has been explained as an interesting form of spider migration. During the fall in Tuscany, a species of spiders will migrate to new territory by thousands of spiders joining themselves together in a large ball stuck together by spiderweb, then blown by the wind at heights of up to 14,000 feet. The people there that day reported seeing web-like material trailing from the orb-shaped UFOs.

Of course, the Air Force has a vested interest in poo-pooing the stories if they are real. On the other hand, some of the reports might be real aircraft - such as the SR-71 or other stealth airplanes developed at the Lockheed Martin Skunkworks and tested at Area 51. Providing weak denials adds credence to UFOs as the explanation and diverts attention from the truth of stealthy aircraft.

In the final analysis, the Fermi Paradox still holds. If aliens are visiting us, then why? What is their purpose, and why would they bother coming so far for no good reason? Just saying that their purposes are inscrutable begs the question. Scientifically, our best bet for alien communication still rest with SETI and not with capturing some funny-shaped cloud. Carl Sagan was right when he stated that extraordinary claims require extraordinary proofs. Until the aliens come out of the clouds and announce their existence on the White House lawn and tell us their purpose is to serve mankind, I will remain skeptical.





# The G-HAT Search for Galactic Civilizations

by David Black

A final note on the possibility of alien civilizations is an unusual attempt to detect civilizations at the galactic level, called the G-HAT (Glimpsing Heat from Alien Technologies) project and co-directed by Drs. Steinn Sigurdsson, Jason Wright, Roger Griffith, and originally proposed by Freeman Dyson in the 1960s.

According to the project, a galaxy should contain enough intelligent, technological civilizations (even if N from the Drake Equation is only one) that given the long age of a galaxy it is inevitable that a civilization will eventually colonize the entire galaxy. It might take hundreds of thousands of years to accomplish, but that is a drop in the bucket compared to the billions of years a galaxy will last.

Alien civilizations have been classified by Russian astrophysicist Nikolai Kardashev according to the amount of energy required by the civilization to run its technology. It is indirectly a scale of the level of technical knowledge a civilization has. We are currently not on the scale or a Type 0 civilization - we can't yet harness all of the energy that reaches or is available on Earth. Not even close. We're still using fossil fuels and dead plants for our energy needs. How primitive!

A Type I civilization can harness all of the energy available on its planet including all that reaches it from its parent star, which would be about  $10^{16}$  watts, or about 100,000 times the energy we currently use.

A Type II civilization would be able to harness all of the energy being emitted from its star, possibly in the form of a Dyson Sphere, or a hollow ball completely enclosing the star. If you want to get a feel for the enormity of such a project, watch the Star Trek: The Next Generation episode "Relics" for a possible Dyson Sphere (good episode, by the way). Having so much energy at our disposal would mean we would be able to prevent any possible extinction of humanity. They have  $10^{26}$  watts at their disposal.

A Type III Kardashev civilization would be able to harness all the energy of their home galaxy and travel between its stars. They could harness  $10^{36}$  watts. Of course, provided the speed of light is the ultimate speed limit (as it seems to be) then such spreading throughout an entire galaxy would take hundreds of thousands of years and probably require humanity evolving into something entirely beyond what we are now, possibly by merging with technology to become immortal cyborgs that can handle spaceflights with durations of centuries or millennia.

Such a civilization, as it travels between the stars, must convert energy to drive their spaceships. The laws of thermodynamics show that the result of such energies will be the production of waste heat, since no energy conversion process is 100% effective. We should be able to detect

that waste heat, at wavelengths not common for natural processes, such as the mid infrared.

"What??" you say, "We can detect alien civilizations in distant galaxies?" In theory, yes. In practice the signal would be very weak. It would require a very sensitive infrared detector, probably in space. But that is exactly what we have with the WISE (Wide-field Infrared Survey Explorer) satellite and the Spitzer Space Telescope. And now we have the James Webb Space Telescope that is finally operational at the L2 point beyond the Moon. Could it be used to detect Type III Kardashev civilizations?

That is the purpose of G-HAT. I had the opportunity to talk with Dr. Sigurdsson at the American Astronomical Society's annual conference in 2014 and again in 2015. In 2014 he explained what they were trying to do and it blew my mind. The next year he reported to me the preliminary results, which were negative so far. But now, with better tools and instruments, we can try again.

We have not yet detected any reliable evidence of alien civilizations, either from radio signals or waste heat or other possibilities. Yet we know there is at least one intelligent civilization in our galaxy: us (although compared with a Type III Kardashev civilization, calling ourselves intelligent is rather presumptuous). So nature has done it once. The Rare Earth hypothesis states that we are somehow special in the unlikely set of circumstances that allowed us to survive and evolve as a species. Yet the chemistry of Earth cannot be different than chemistry elsewhere. We are not the center of existence or even the universe, and the laws of nature hold true everywhere. What happened once should happen many times, even if highly improbable.

Perhaps there is a world flying through space shaped like a disc riding on four elephants on top of a giant turtle. Perhaps Rincewind the Incompetent is cheating DEATH while guiding Twoflower the Tourist around, followed by the Luggage. Anything is possible in infinite space. If it happened once here, it ought to happen many times, according to the odds of the Drake Equation.

I refuse to concede that we are alone in the universe. If we can survive our technological adolescence and make it past the Great Filter, we could spread throughout the galaxy and aspire to become the type of civilization that G-HAT is trying to detect. We are at an inflection point, a cusp, between the children we have been and the mature species we can become. Reaching this potential requires a vision shared by our entire species. We're not there yet; we cannot yet agree on even the necessity of mitigating climate change, let alone put all of our energies into a bold reach for the stars. But there have been glimmers of hope for our species. We took the bold reach to land people on the Moon less than ten years after Kennedy's challenge. We have our sights on Mars.

Someday, to the stars. For my part, I am contributing to this effort by educating others: Ad Astra Per Educare.

