The Search for Life

– Part 1

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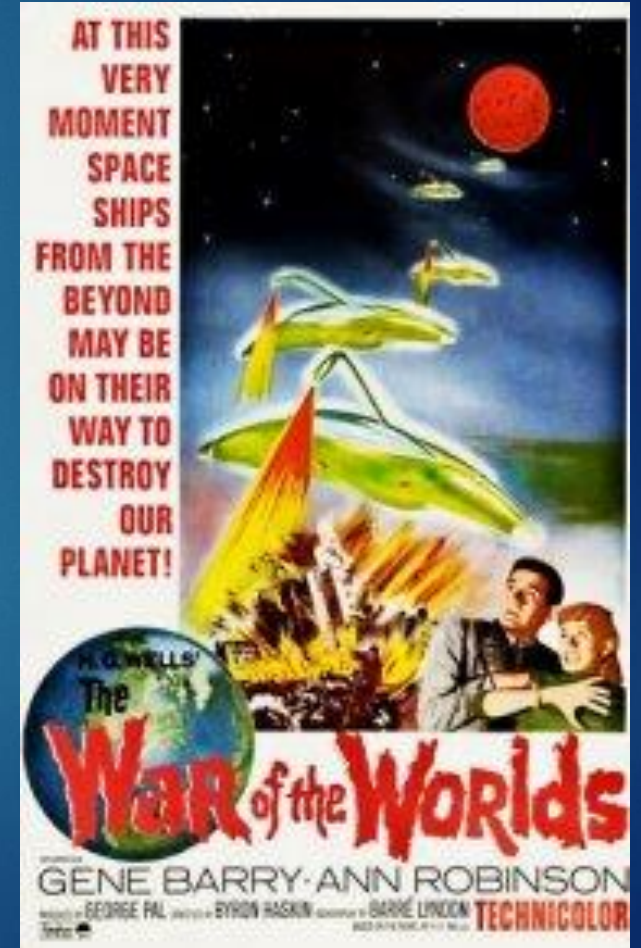MAY 2018

The Beginning
- sort of…

- My first encounter with extra-terrestrial life was sometime around the end of the 1950's or early '60s.

- I remember being scared out of my wits to the point that I hid behind the couch when the Martians came on screen.

AT THIS VERY MOMENT SPACE SHIPS FROM THE BEYOND MAY BE ON THEIR WAY TO DESTROY OUR PLANET!

H.G. WELLS' The War of the Worlds

GENE BARRY · ANN ROBINSON

TECHNICOLOR

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But it begins much earlier than that

- Although the original War of the Worlds movie was first shown in 1953, it actually was made famous by Orson Welles and his radio broadcast on Halloween Night, October 31, 1938.

- Since then, pretty much everyone has viewed Martians as invading little green monsters.
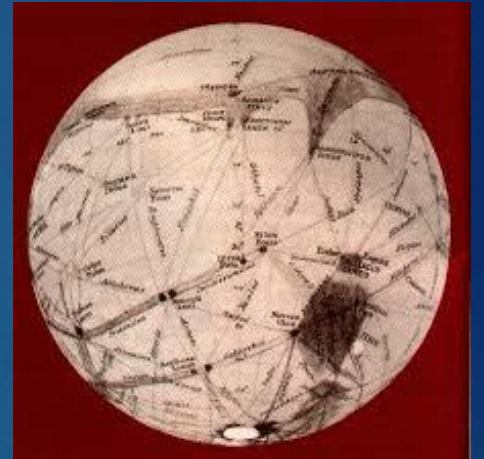
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Well, almost everyone!

The Real Beginning!

- Actually, Man has been pretty much fascinated with the sky, and what may be up there for centuries.

- Galileo first made observations of Mars in the early 1600's.

- Following improvements to telescope design, Mädler and Beer made detailed observations leading to the first map of Mars in 1840.

Mars' Canals

▶ By 1870, Schiaparelli, an Italian astronomer, had created an even more detailed map and first described the canali. This was mistranslated into English as canals.

▶ By the early 1900's, the canals of Mars had become the legend of science fiction and of the possibility of life on other worlds.
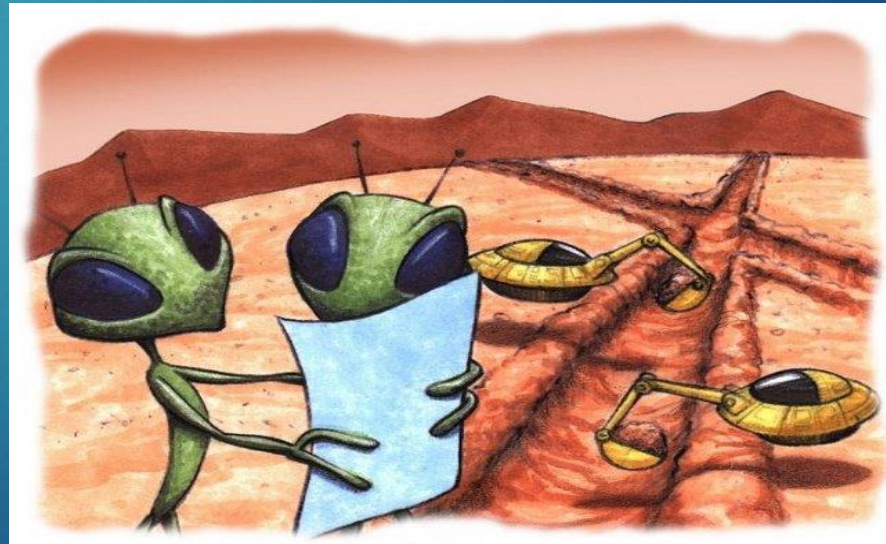
The Real Search - SETI

- The Search for Extra-terrestrial Intelligence (SETI) had its beginnings in 1959 when Cornell physicists Giuseppi Cocconi and Philip Morrison published an article in Nature in which they pointed out the potential for using microwave radio to communicate between the stars.

- Frank Drake, working independently came up with a similar idea and in 1960 used an 85 foot antenna in West Virginia to conduct the first microwave radio search for signals from other solar systems.

The Drake Equation

▶ In 1961 Drake tried to estimate the number of extra-terrestrial civilizations that could communicate with Earth.

The Drake equation states that:

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

where:

N is the number of civilizations in our galaxy with which we might expect to be able to communicate at any given time

and

	Histoical values
R^* is the rate of star formation in our galaxy	$R^* = 10/\text{year}$,
f_p is the fraction of those stars that have planets	$f_p = 0.5$,
n_e is average number of planets that can potentially support life per star that has planets	$n_e = 2$,
f_l is the fraction of the above that actually go on to develop life	$f_l = 1$,
f_i is the fraction of the above that actually go on to develop intelligent life	$f_i = 0.01$,
f_c is the fraction of the above that are willing and able to communicate	$f_c = 0.01$,
L is the expected lifetime of such a civilization	and L = 10,000 years.

▶ Using the historical values, it was suggested that up to **10 civilizations** may be present within our galaxy.
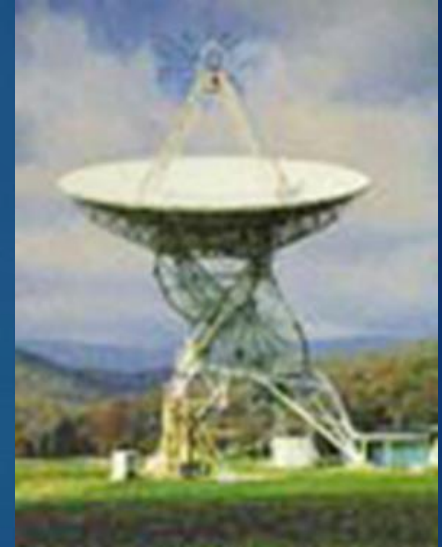
Project Ozma

- For the first SETI search, Drake chose two stars, Tau Ceti in the Constellation Cetus (the Whale) and Epsilon Eridani in the Constellation Eridanus (the River), some eleven light years away.

- Both stars are about the same age as our sun.

Project Ozma

- From April to July 1960, Drake tuned into both stars for six hours a day, using the 85-ft. Howard E. Tatel radio telescope at Green Bank.

- He tuned the telescope to listen to the 21-centimeter emissions (1420 MHz) coming from cold hydrogen gas in interstellar space. A single 100 Hz channel receiver scanned 400 kHz of bandwidth.

- The astronomers scanned the tapes for a repeated series of uniformly patterned pulses that would indicate an intelligent message or a series of prime numbers such as 1, 2, 3, 5 or 7.

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Project Ozma

- With the exception of a false alarm in early 1960 caused by a secret high-flying military experiment, the only sound that came from the loudspeaker was static and no meaningful bumps superimposed themselves on the formless wiggles on the recording paper.

- Although after 150 hours of listening **Ozma** drew a blank, it was to be the starting point for many more, increasingly sophisticated searches which continue to this day.

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Project Phoenix

▶ Project Phoenix, Ozma's successor, was an ambitious plan to search for extra-terrestrial life using the Parkes 210 foot radio telescope in New South Wales, Australia.

▶ It began to search the Southern sky in 1993.

Project Phoenix

▶ In 1996, the program moved back to the Northern sky using the National Radio Astronomy Observatory in Green Bank, West Virginia.

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Project Phoenix

- ► Finally, in 1998, Project Phoenix moved to Arecibo in Puerto Rico where the largest radio telescope on earth could be used.

- ► Scanning just a small section of the sky allowed researchers to examine approximately 800 likely stars, similar to our own, all within 200 light-years.

- ► By breaking the search into narrow 1 Hz wide channels, between 1200 and 3000 MHz, nearly 2 billion channels could be examined for each star.

The Results So Far…

▶ Absolutely Nothing!

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Well Not Quite…

- There was that false alarm in April of 1960 and…

- The WOW! Signal received in August of 1977 at the Ohio State University's Big Ear radio telescope (Just one of many other observatories throughout the world listening for extra-terrestrial communications).

- This signal, coming from the constellation Sagittarius, was discovered by Jerry R. Ehman. However, despite repeated attempts to find it again, or determine its actual origin, it has not been heard of again.
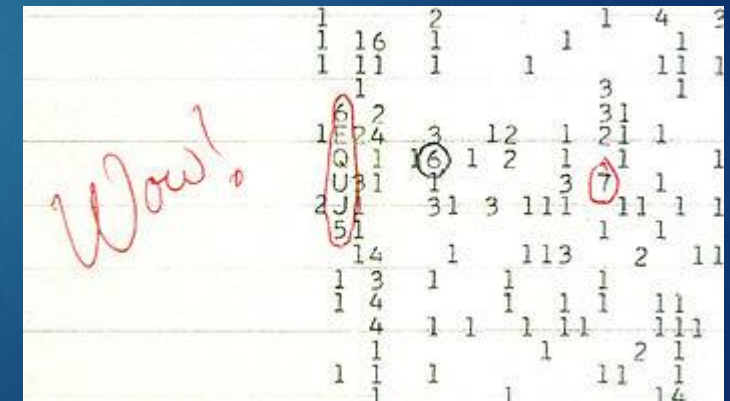
So is there Life Out There?

- In spite of many, many attempts to detect radio communications from extra-terrestrial civilizations, nothing has been detected with certainty.

- Are we looking for the right thing?

- Are we looking in the right place?

- Are we looking for something too simple or too complex?

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The Drake Equation Revisited

- Although the equation is fairly simple, the variables used are subject to much discussion and debate.

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

- For example, using the historical values, it was estimated that there may be as many as 10 civilizations within our galaxy likely to be able to communicate with us.

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- However, more recent analysis, using different estimates, suggest that there may be <1 intelligent civilization in our galaxy or as many as 100 or over 15,000,000.

- We simply just don't have enough data to answer this question for sure.

The Fermi Paradox

- *Given*
    - the billions of stars in our galaxy that are like our Sun,
    - the high probability that many have earth-like planets revolving around them,
    - and some of these may have intelligent life,
    - which may have developed interstellar travel,
- Earth should have been visited many times over the millennia, yet no evidence exists.

Where is Everyone?

- Although not the first to question the lack of evidence for extra-terrestrial life, Fermi's question hit a nerve.

Perhaps…

- Perhaps aliens have been less than impressed with our old radio and TV shows, such as "I Love Lucy" or "Gilligan's Island" and are reluctant to announce themselves.

Or…

- Perhaps extra-terrestrial life is very rare or non-existent.

- Perhaps no other intelligent species has arisen.

- Perhaps it is the nature of intelligent life to destroy themselves.

- Perhaps it is the nature of intelligent life to destroy others.

- Perhaps intelligent civilizations are too far apart in space and time.

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So what Now?

▶ When we look back at ourselves and our planet, we quickly realize that we are here perhaps because of two important things.

1. The presence of liquid water.

2. Our proximity to our Sun that allows that water to exist in any of its three states: liquid, gas and as solid ice. In other words, not too hot and not too cold but just right!

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The Presence of Water

- We know that water can exist in three states: liquid, gas and solid.

- We also know that there can be a very narrow temperature band where all three of the states can exist together.

- Recent explorations of our Solar System have revealed that water ice is more plentiful than we originally thought.

- And even research, here on Earth, has shown us that life can exist in some pretty hostile environments.

- This is causing scientists to re-examine their beliefs about where, and under what conditions, life can exist.

The Search for Life – Part 2

- In Part 2, I will examine some of the new ideas on where life can exist and describe the current search for exoplanets.

- In the meantime, you may wish to write to the entertainment business and suggest that they reduce the number of mind numbing shows on TV that are being broadcast into outer space.

After all, who's to say that alien lifeforms aren't listening to us?

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References

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  - https://www.seti.org/
- Wikipedia
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- Many of the images were willfully pilfered from the Internet via a Google search.