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An Approach to Communicate with E. I. of Distant Planets

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ABSTRACT: *Algorithmic communication has various advantages over the static pictorial and mathematical messages including: localized communication in algorithmic communication the recipient can probe and interact with the programs within a message without transmitting a reply to the sender and then waiting for a long period (years) for a response. It can forward error correction in the message and has the ability to embed proxy agents within the message. A sophisticated program when run on a fast enough computing substrate, may exhibit complex behavior and intelligence. The wow! Signal is the most likely candidate from an artificial extraterrestrial source first discovered. There is yet no credible evidence and its existence is still largely hypothetical. Out of the two strong hypotheses regarding the origin of extraterrestrial life, one proposes that its emergence occurred quite independently at different places in the universe. On Earth, life in the oceans took in carbon dioxide and turned it into limestone. On Venus, 30% closer to the Sun, any oceans boiled away and the water vapor added to the runaway greenhouse effect. Experts say that microbes could survive and reproduce; floating in the thick, cloudy atmosphere, protected by a sunscreen of sulfur compounds. It appears that around 60% of Stars lie up to a distance of 400 Ly. However, a random distribution of the occurrences of the stars have noted from the analysis. Suggested locations to host life include the planets Venus and Mars as well as natural satellites of Jupiter and Saturn (e.g. Europa, Enceladus and Titan). Subsequently discovered Gliese 581 c and d, apparently situated in the habitable zone of stars, have the potential to have liquid water. Pure water is essential as it has a neutral pH, owing to its continued dissociation between hydroxide and hydronium ions. The probable alternative of carbon is the silicon. The life forms of silicon are proposed to have a crystalline morphology. Theoretically, they are able to exist at high temperatures, such as on planets which are very near to their star. It should also be pointed out that some have suggested that life forms are based in NH3 rather than water.*

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I. INTRODUCTION

It is generally believed that intelligent beings might live on some planets other than earth. Improved attempts have been made in recent years to signal the extraterrestrials. Communication with Extraterrestrial Intelligence (CETI) is a branch of Search for Extra Terrestrial Intelligence (SETI) that focuses on composing and deciphering messages that could theoretically be understood by technological civilization situated at other planets at some other parts. CETI research has broadly focused on four broad areas, viz., mathematical languages, pictorial systems (e.g. the Arecibo message), algorithmic communication systems (ACETI) and computational approaches for detecting and deciphering 'natural' language communication. Out of the four pictorial communication systems, basic mathematical or physical concepts through simplified diagrams sent as bitmaps. These messages consider that the recipient has similar visual capabilities and can follow fundamental mathematical and geometrical knowledge. This is definitely a very strong assumption as both are prerequisites for building the optimal shape for a radio or optical telescope. However, this may not be the case with a species with substantially different vision. As a very successful attempt two Pioneer probes were launched (Pioneer 10 and Pioneer 11) in 1972 and 1973, depicting the location of the Earth in the galaxy and the solar system, and the form of the human body. Subsequently, the Voyager probes, launched in 1977, carried two golden records that were inscribed with diagrams depicting the human form, our solar system as well as its location. It further included recordings of pictures and sounds from Earth. It is the purpose of this chapter to present the different ways of transmitting messages to extraterrestrial intelligence and the probable results that can achieve when

radio signal transmission is employed to distant stars.

II. TRANSMITTED MESSAGES

The object of the scientists working in this field was to transmit signal by some means or other and thereafter to receive an echo signal directly or indirectly from other planet [1]. Some of the important techniques already applied are noted below:

2.1 The Arecibo message

The Arecibo message (transmitted in 1974) was a 1679-pixel image with 73 rows and 23 columns. It exhibits the numbers one through ten, the atomic numbers of hydrogen, carbon, nitrogen, oxygen and phosphorus, the formulae for the sugars and bases in the nucleotides of DNA, the number of nucleotides in DNA, the double helix structure of DNA, a figure of a human being and its height, the population of Earth, a diagram of our solar system, and also an image of the Arecibo telescope with its diameter [2].

2.2 Cosmic Call messages

These messages consisted of few digital sections - "Rosetta Stone", copy of Arecibo Message, Bilingual Image Glossary and the Braastad message. It further includes text, audio, video and other image files submitted for transmission by people throughout the globe. The "Rosetta Stone" represents a multi-page bitmap to build a vocabulary of symbols for representing numbers and mathematical operations. The message begins with basic mathematics to progressively more complex one, including physical processes and objects like hydrogen atom. The message is specially designed with noise resistant format and characters for making it resistant to alteration by noise. Messages of these categories were transmitted in 1999 and 2003 from Evpatoria Planetary Radar [3]. Table 1 shows the stars where cosmic call messages were sent.

Table 1. Stars where cosmic call messages were sent

Name	Designation	Constellation	Date sent	Arrival date	Message
16 Cyg A	186408HD	Cygnus	May 24, 1999	November 2069	Cosmic Call 1
15 Sge	190406HD	Sagitta	June 30, 1999	February 2057	Cosmic Call 1
	178428HD	Sagitta	June 30, 1999	October 2067	Cosmic Call 1
Gl 777	190360HD	Cygnus	July 1, 1999	April 2051	Cosmic Call 1
	4872Hip	Cassiopeia	July 6, 2003	April 2036	Cosmic Call 2
	245409HD	Orion	July 6, 2003	August 2040	Cosmic Call 2
55 Cnc	75732HD	Cancer	July 6, 2003	May 2044	Cosmic Call 2
	HD 10307	Andromeda	July 6, 2003	September 2044	Cosmic Call 2
47 UMa	95128HD	Ursa Major	July 6, 2003	May 2049	Cosmic Call 2

Cosmic Call 2 (Cosmic Call 2003) message contained text, images, video, music, the Dutil / Dumas message. In fact, it is a copy of the 1974 Arecibo message, at least to some extent. The arrival dates of the cosmic call messages have shown in the table including their sending dates.

2.3 Algorithmic messages

Algorithmic communication systems are a relatively new field in CETI to build upon early work on mathematical languages. In these messages the sender describes a small set of mathematics and logic symbols to form the basis for a rudimentary programming language that the recipient can run on a virtual machine [4]. Algorithmic communication has various advantages over the static pictorial and mathematical messages including: localized communication in algorithmic communication the recipient can probe and interact with the programs within a message without transmitting a reply to the sender and then waiting for a long period (years) for a response. It can forward error correction in the message and has the ability to embed proxy

agents within the message. A sophisticated program when run on a fast enough computing substrate, may exhibit complex behavior and intelligence.

2.4 Natural Language Messages

It is mainly concentrated on the event to receive a signal / message that is either not directed at us or one that is in its natural communicative form. In order to minimize the difficulty methods are being developed for first detecting a signal that has intelligent-like structure. It then categorizes the type of structure detected and subsequently investigates its content from its physical level encoding internal and external ontology [5, 6]. Basically, this structure modeling reveals on the search for generic human and inter-species language universals to devise computational methods by which language can be discriminated from non-language and core structural syntactic elements of unknown languages can be identified [7]. The main object of these attempts is to understand language structure and the detection of intelligent language-like features in signals. In this way, it can help to search for extraterrestrial intelligence. The object is primarily to separate language from non-language without dialogue and learn something about the structure of language in the passing. The language may not necessarily be human but may be animals, computers, aliens, etc. The perceptual space can be unknown, and we cannot assume human language structure but must start somewhere [8].

2.5 Teen-Age Message

This Message was composed jointly by the Russian scientists and teens. It was transmitted from the 70-m dish of Yevpatoria Deep Space Center to six Sun-like stars in the months of August and September in 2001. The message consists of three parts: (i) the first section is related to a coherent-sounding radio signal with slow Doppler wavelength tuning to imitate transmission from the center of the Sun [9]. This signal was transmitted to assist extraterrestrials for detecting the radio propagation effect of the interstellar medium; (ii) the second section represents analog information and mainly covers musical melodies. This electric musical instrument is used to produce a quasi-monochromatic signal for detecting conveniently across interstellar distances. There were altogether seven musical compositions in the first Theremin Concert for Aliens; (iii) the third section is the familiar Arecibo-like binary digital information: bilingual Russian and English Greeting to Aliens, and Image Glossary.

Table 2. Stars where Teen-Age Messages were sent

Name	HD Designation	Constellation	Date sent	Arrival date
	197076	Delphinus	August 29, 2001	February 2070
47 UMa	95128	Ursa Major	September 3, 2001	July 2047
37 Gem	50692	Gemini	September 3, 2001	December 2057
	126053	Virgo	September 3, 2001	January 2059
	76151	Hydra	September 4, 2001	May 2057
	193664	Draco	September 4, 2001	January 2059

III. EXTRATERRESTRIAL LIVES IN THE SOLAR SYSTEM

Search for Extra Terrestrial Intelligence (SETI) is a subject of great interest to the scientists for a long time. Frank Drake received a strong signal by the Radio Telescope he developed. Circling the indication on a printout Jerry Ehman [10] scribbled the phrase “Wow!” (Figure 1).The wow! Signal is the most likely candidate from an artificial extraterrestrial source first discovered. There is yet no credible evidence and its existence is still largely hypothetical. Out of the two strong hypotheses regarding the origin of extraterrestrial life, one proposes that its emergence occurred quite independently at different places in the universe. The second hypothesis suggests that life emerges in one location and then spreads between habitable planets [11].

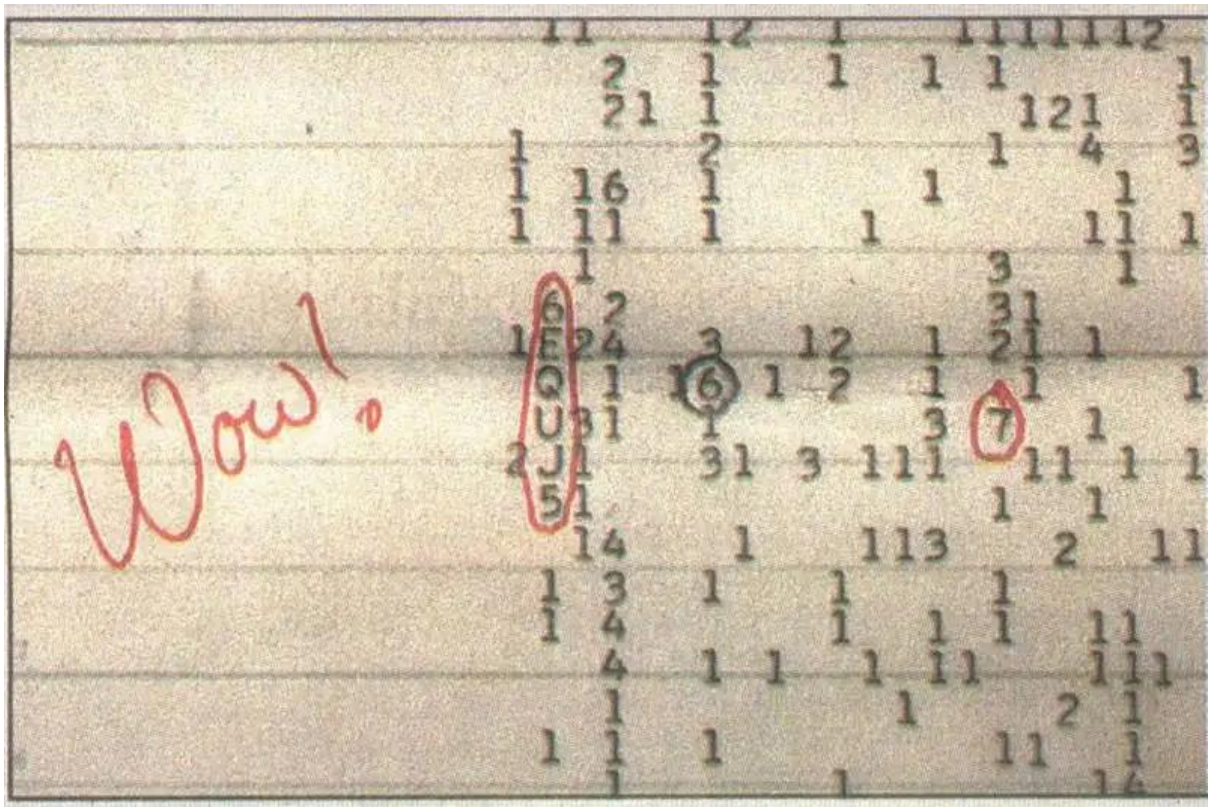

Fig. 1. The" Wow!" Signal [10]

Many bodies in the solar system have been suggested as being capable of containing conventional organic life. Of these, five of the nine are moons, and are thought to have large bodies of underground liquid, where life may have evolved in a similar fashion to deep-sea vents. Figure 2 reveals a planetary habitability chart where life might exist on extrasolar plane. It is based on our own solar system and life on earth.

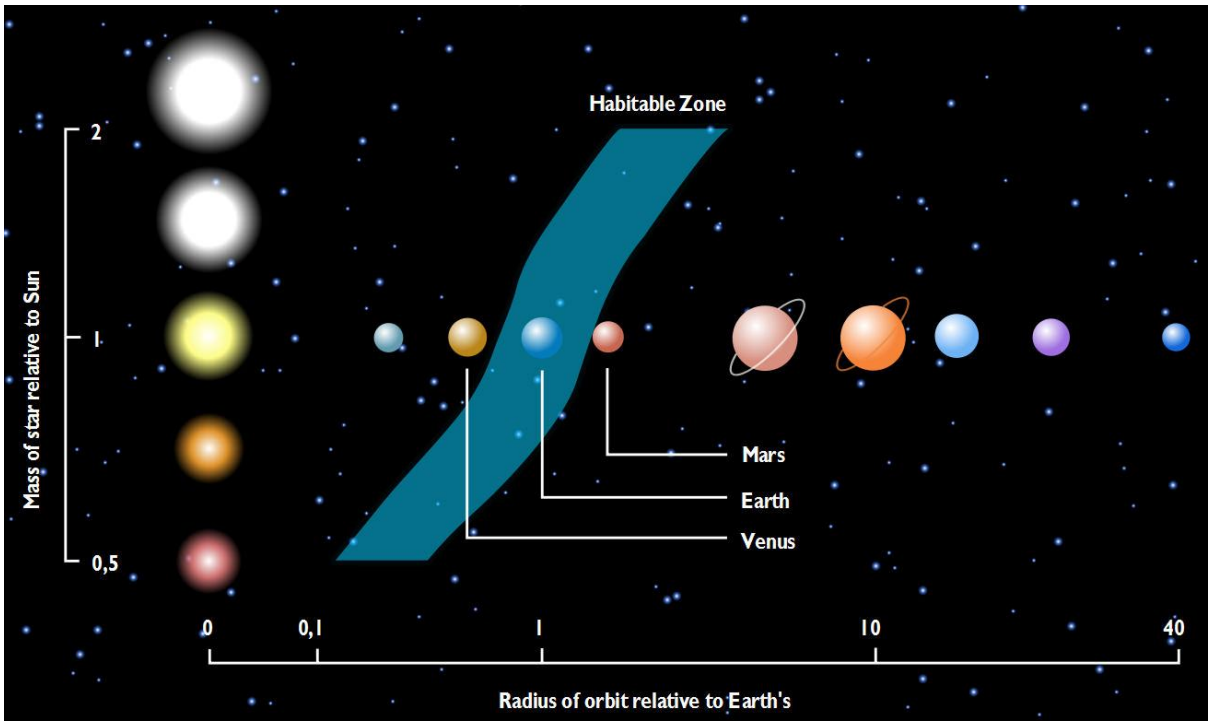

Fig. 2. Planetary habitability charts showing where life might exist [11]

The following information largely supports that the concerned planets/satellites are Capable of Containing Conventional Organic Life:

Mars: Methane was found in the atmosphere of Mars. Liquid water is widely thought to have existed and there may be liquid water beneath the surface. Photographs show evidence of recent flows of liquid on the red planet's frigid surface [12-13].

Europa: May contain liquid water beneath its 100-mile-thick ice layer. It is capable of supporting microbes and simple plants [14].

Jupiter: Possible supporter of floating animals. This point of view is somewhat controversial because these creatures would not be water-based, but ammonia-based.

Titan (Saturn's largest moon): The only known moon with a significant atmosphere was visited by the Huygens probe. Latest discoveries indicate that seasonal liquid hydrocarbon lakes are present on the surface (the first liquid lakes discovered outside the Earth).

Venus: Venus's thick cloud may be able to support life. Current theories suggest that Venus and the Earth may have started out alike. There might have been a lot of water on Venus and there might have been a lot of carbon dioxide on Earth. But all that was to change. On Earth, life in the oceans took in carbon dioxide and turned it into limestone. On Venus, 30% closer to the Sun, any oceans boiled away and the water vapor added to the runaway greenhouse effect. Experts say that microbes could survive and reproduce; floating in the thick, cloudy atmosphere, protected by a sunscreen of sulfur compounds [15]. The Venusian clouds are high in the atmosphere wherein the temperature and pressure are quite earth-like [16]. There is even water present, though it is in the form of a concentrated Sulphuric acid. It may well have been Earth-like long past for life to either emerge or be transported there.

IV. KNOWN STARS/CONSTELLATION AND TIME REQUIRED BY THE RADIO SIGNAL

We have considered the Reported Star/Constellation including their corresponding distances [17]. Using the values of the distances given I have calculated the time taken by the radio signal to reach the concerned Star and also the total time taken by the signal to back to the Earth. These data we have presented in Table 3 up to a distance of 500 Ly, in Table 4 between 500 ly to 1500 ly and in Table 5 whose distances are greater than 1500 Ly.

Table 3. Time taken by the radio signal to arrive at the known stars and back. Data of columns 1, 2 and 3 have been taken from the published data. Distances are up to 500 Ly

Star	Constellation	Distance (Ly)	Time taken by signal to reach the Star (year)	Total time taken by sig nal to back top the Earth (year)
Epsilon Eridani	Eridanus	10.5	11.09	22.18
Gliese 876	Aquarius	15.3	16.17	32.34
Gliese 581	Libra	20.3	21.45	42.9
Fomalhaut	Piscis Austrinus	25	26.42	52.84
Gliese 436	Leo	33.48	35.38	70.76
GJ 1214	Ophiuchus	40	42.27	84.54
55 Cancri	Cancer	40.3	42.59	85.18
Upsilon Andromedae	Andromeda	43.9	46.4	92.8
Beta Pictoris	Pictor	62.9	66.48	132.96
HD 189733	Vulpecula	63.4	67.01	134.02
HR 8799	Pegasus	120	126.83	253.66

HAT-P-11	Cygnus	123.5	130.53	261.06
HD 209458	Pegasus	154	162.77	325.54
WASP-8	Sculptor	160	169.11	338.22
2M1207	Centaurus	173	182.85	375.7
HD 80606	Ursa Major	190	200.82	401.64
HD 17156	Cassiopeia	255.2	269.74	539.48
HD 149026	Hercules	257	271.64	543.28
WASP-29	Sculptor	263	277.98	555.96
WASP-10	Pegasus	290	306.52	613.04
WASP-18	Phoenix	330	348	696
HD 15082	Andromeda	377	398.48	796.96
WASP-11/HAT-P-10	Perseus	408	431.25	862.5
HD 147506	Hercules	440	465.07	930.14
ADS 16402 B	Lacerta	453	478.81	957.62
2M J044144	Taurus	455	480.93	961.86
HAT-P-3	Ursa Major	457	483.04	966.08
WASP-7	Microscopium	460	486.21	972.42
HAT-P-12	Canes Venatici	465	491.5	983
1RXS J160929.1-210524	Scorpius	470	496.78	993.56
XO-2	Lynx	486	513.69	1027.38
COROT-7	Monoceros	489	516.86	1033.72
WASP-2	Delphinus	493	521.09	1042.18

Table 4. Time taken by the radio signal to arrive at the known stars and back. Data of columns 1, 2 and 3 have been taken from the published data. Distances are from 500 Ly to 1500 Ly

Star	Constellation	Distance (Ly)	Time taken by signal to reach the Star (year)	Total time taken by signal to back to the Earth (year)
WASP-13	Lynx	509	538	1176
GSC 02652-01324	Lyra	512	541.18	1082.36
WASP-14	Boötes	520	549.63	1099.26
WASP-25	Hydra	550	581.34	1162.68
XO-1	Corona Borealis	600	634.19	1268.38
HAT-P-15	Perseus	619	654.27	1308.54
HAT-P-6	Andromeda	650	687.04	1374.08
XO-3	Camelopardalis	660	697.61	1395.22
HAT-P-14	Hercules	670	708.18	1416.36
HAT-P-13	Ursa Major	698	737.78	1475.56
GSC 03549-02811	Draco	718	758.92	1517.84

WASP-3	Lyra	727	768.43	1536.86
HAT-P-8	Pegasus	750	792.74	1585.48
WASP-21	Pegasus	750	792.74	1585.48
HAT-P-16	Andromeda	766	809.66	1619.32
WASP-26	Cetus	820	866.73	1733.46
WASP-4	Phoenix	851	899.5	1799
WASP-12	Auriga	871	920.64	1841.28
XO-5	Lynx	880	930.15	1860.3
COROT-2	Serpens	930	983	1966
WASP-22	Eridanus	942	995.68	1991.36
XO-4	Lynx	956	1010.48	2020.96
WASP-5	Phoenix	967	1022.11	2044.22
PSR B1257+12	Virgo	980	1035.85	2071.7
WASP-6	Aquarius	1001	1058.05	2116.1
WASP-15	Hydra	1005	1062.27	2124.54
HAT-P-4	Boötes	1010	1067.56	2135.12
WASP-1	Andromeda	1031	1089.75	2179.52
HAT-P-7	Cygnus	1044	1103.5	2207
WASP-24	Virgo	1062	1122.52	2245.04
WASP-28	Pisces	1090	1152.12	2304.24
HAT-P-5	Lyra	1110	1173.26	2346.52
COROT-10	Aquila	1130	1194.4	2388.8
COROT-8	Aquila	1250	1321.24	2642.48
GSC 02620-00648	Hercules	1400	1479.79	2959.58
COROT-9	Serpens	1500	1585.48	3170.96

Table 5. Time taken by the radio signal to arrive at the known stars and back. Data of columns 1, 2 and 3 have been taken from the published data. Distances are greater than 1500 Ly

Star	Constellation	Distance (ly)	Time taken by signal to reach the Star (year)	Total time taken by signal to back to the Earth (year)
COROT-1	Monoceros	1560	1648.91	3297.82
HAT-P-9	Auriga	1560	1648.91	3297.82
Kepler-4	Draco	1631	1723.95	3447.9
OGLE-TR-113	Carina	1800	1902.58	3805.16
COROT-11	Serpens	1820	1923.72	3847.44
Kepler-9	Lyra	2120	2240.82	4481.64
Kepler-6	Cygnus	2522	2665.73	5331.46
OGLE2-TR-L9	Carina	2935	3102.27	6204.54
MOA-2007-BLG-192L	Sagittarius	3000	3170.97	6341.94

Kepler-7	Lyra	3377	3569.46	7138.92
COROT-12	Monoceros	3760	3974.29	7948.58
Kepler-5	Cygnus	4167	4404.49	8808.98
COROT-13	Monoceros	4270	4513.36	9026.72
Kepler-8	Lyra	4338	4585.23	9170.56
COROT-14	Monoceros	4360	4608.48	9216.96
OGLE-TR-56	Sagittarius	4892	5170.81	10341.62
OGLE-2006-BLG-109L	Sagittarius	4920	5200.4	10400.8
OGLE-TR-111	Carina	5000	5284.96	10569.92
OGLE-TR-10	Sagittarius	5000	5284.96	10569.92
OGLE-TR-211	Carina	5300	5602.06	11204.12
OGLE-TR-132	Carina	7110	7515.22	15030.44
OGLE-2005-BLG-169L	Sagittarius	8800	9301.53	18603.06
Lupus-TR-3	Lupus	8950	9460.08	18920.16
OGLE-2005-BLG-071L	Scorpius	9500	10041.43	20082.86
PSR B1620-26	Scorpius	12400	13106.71	26213.42
OGLE-TR-182	Carina	12700	13423.81	26847.62
OGLE-2003-BLG-235L	Sagittarius	19000	20082.86	40165.72
OGLE-2007-BLG-368L	Scorpius	19230	20325.97	40651.94
MOA-2007-BLG-400L	Sagittarius	20000	21139.86	42279.72
OGLE-2005-BLG-390L	Scorpius	21500	22725.35	45450.7
SWEEPS J175853.92−291120.6	Sagittarius	22000	23253.85	46507.7
SWEEPS J175902.67−291153.5	Sagittarius	22000	23253.85	46507.7

We have drawn histograms in Figures 3 and 4 showing the occurrences of stars at different distances and at different time zone required by the radio signal to arrive. It appears from Figure 3 that around 60% of Stars lie up to a distance of 400 Ly. However, Figure 4 suggests a random distribution of the occurrences of the stars.

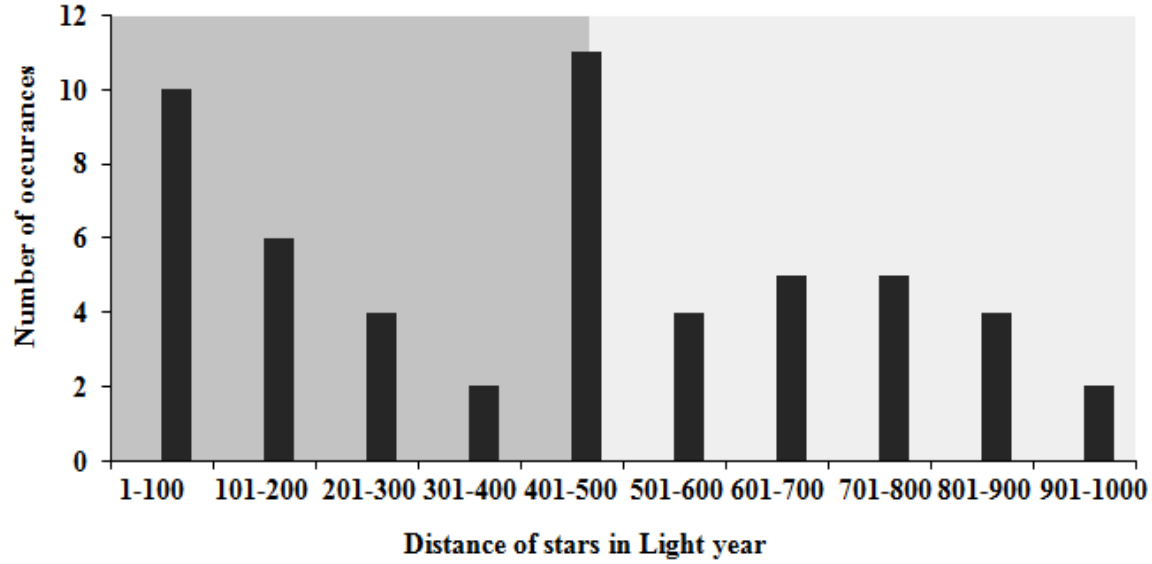

Fig. 3. Distance of stars (in Light year) and the corresponding number of occurrences

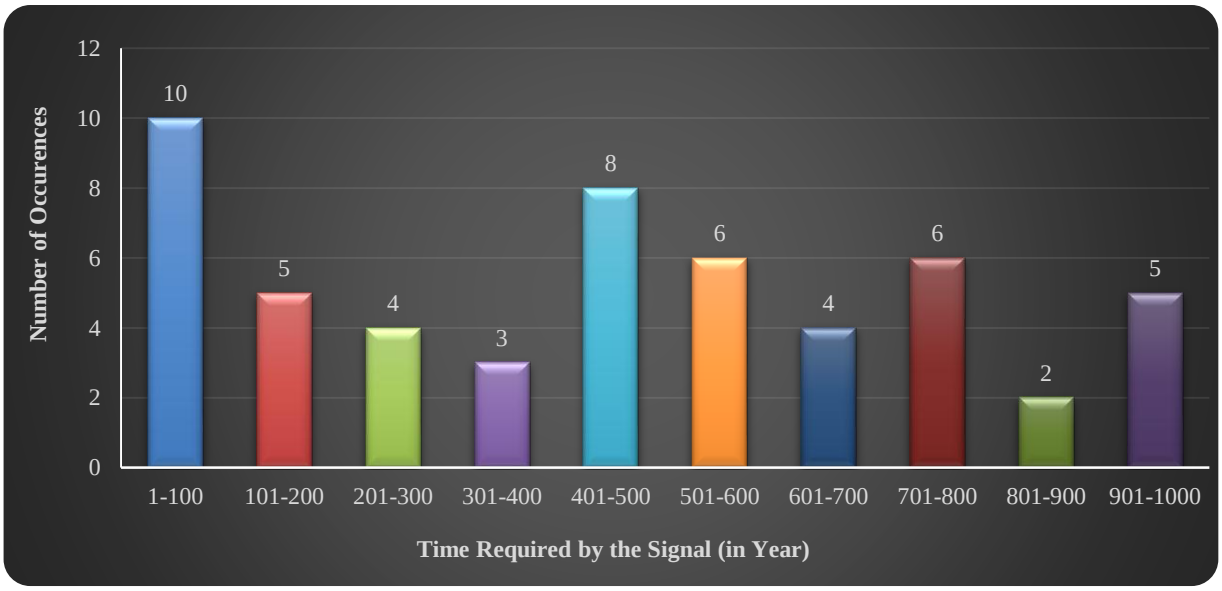

Fig. 4. Time required by the signal (in year) against the number of occurrences of stars

V. DISCUSSION

By extraterrestrial life we mean life originating outside the earth. Suggested locations to host life include the planets Venus and Mars as well as natural satellites of Jupiter and Saturn (e.g. Europa, Enceladus and Titan). Subsequently discovered Gliese 581 c and d, apparently situated in the habitable zone of stars, have the potential to have liquid water. Pure water is essential as it has a neutral pH, owing to its continued dissociation between hydroxide and hydronium ions [18]. Consequently, it can dissolve both positive metallic ions and negative non-metallic ions with same ability. Moreover, as the organic molecules can be either hydrophobic (repelled by water) or hydrophilic (soluble in water) they can create the ability of organic compounds for orienting themselves to form water enclosing membranes. The solid water (ice) being less dense than liquid water it floats and thus preventing earth's oceans from slowly freezes solid. In addition, the van der Waals forces between water molecules supply it an ability to store energy with evaporation, which is released upon condensation. This causes moderate climate and hence cooling the tropics and warming the poles maintaining a thermodynamic stability required for life.In terrestrial life carbon is the most fundamental for its flexibility in creating covalent chemical bonds with many non-metallic elements like nitrogen, oxygen and hydrogen. Carbon dioxide and water combines to store solar energy in sugars, e.g. glucose. The oxidation of glucose releases biochemical energy essential to fuel all other biochemical reactions. The ability to produce

organic acids (–COOH) and amine bases (–NH2) provides the possibility of neutralization dehydrating reactions to build long polymer peptides and catalic proteins from monomer amino acids. In fact, with phosphates it builds not only the information storing molecule of inheritance, viz. DNA but also builds adenosine triphosphate which is the main energy 'currency' of cellular life. Owing to their relative abundance and requirements in sustaining life, one may hypothesize that in the formation of life elsewhere in the universe these basic materials would have utilized. Of course, other elements and solvents could also provide a basis for life. The probable alternative of carbon is the silicon. The life forms of silicon are proposed to have a crystalline morphology. Theoretically, they are able to exist at high temperatures, such as on planets which are very near to their star. It should also be pointed out that some have suggested that life forms are based in NH3 rather than water. In practice, life is something more than any self-replicating reaction which arises due to various ingredients and many conditions, though carbon-oxygen within the liquid temperature range of water appears most conducive. It has also suggested that self-replicating reactions could occur within the plasma of a star. About life in the universe one can conclude that it took a very long time to go from cells to multi-cell beings, which may act as a necessary precursor to intelligence.

VI. CONCLUSION

It should be noted that optical search for extraterrestrial intelligence (popularly called optical SETI) is a different approach to the search for extraterrestrial intelligence. The optical SETI seeks to detect pulsed and continuous wave laser beacons signals in the visible and infrared spectrums. If other intelligent races exist in space, the chances are high that some of them will prove to be much more scientifically and technologically advanced than we are ourselves. The rapid progress and development of computers over the past few decades shows what dramatic strides can be achieved by a technologically ambitious race in a relatively short period of time. Given another century or so, humankind may have acquired capabilities in genetic engineering, nanotechnology, life prolongation, artificial intelligence, space propulsion, and other fields that, at present, we can barely imagine.

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