Medical Hypotheses (1996) **46**, 183–187

Pros and Cons in the Search for Extraterrestrial Intelligence

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Abstract — I propose a new term, 'galactic organism with distinct intelligence', for the extra-terrestrial forms, with which humans can make contact. This is because, among the three existing terms: (a) 'the search for extraterrestrial intelligence' 'excludes biology and is inelegant'; (b) 'extraterrestrial' does not distinguish between the micro-organisms and highly-evolved intelligent life-forms; and (c) 'unidentified flying object' projects a sense of mysticism. On the presence of galactic organisms with distinct intelligence, scientists belong to three camps. Astronomers, physicists and some biochemists belong to the believers group. Evolutionists are in the doubters category. The third camp is represented by the 'uncommitted'. Approaches for contacting galactic organisms with distinct intelligence would take three steps. These are: (a) radioastronomical observations in the galaxy and interstellar space for the presence of organic matter; (b) initiating radio contact and listening to any transmitted message, as set out by the search for extraterrestrial intelligence program, and (c) landing instruments and humans in the galaxy.

Introduction

Gilbert Levin, in 1968, aptly summarized the dilemma facing the investigators involved in extraterrestrial (ET) research as follows: 'Any treasure hunt should begin with a description of the object sought. Yet in the search for extraterrestrial life, the greatest treasure hunt in history, this is not possible. (1) We are still clueless about the physical form of the ETs, their nearest location from the earth, and the mode of contact we could use to achieve the objective.

We are also not sure about what to call the ET life-forms. Freitas has noted that the acronym SETI (search for extraterrestrial intelligence) 'excludes biology and is inelegant' (2). Of the other two popular acronyms, unidentified flying object (UFO) projects a sense of mysticism, and ET does not distinguish between the bacteria-type micro-organisms and the highly-evolved, intelligent human-like life-forms. Is it possible for us to communicate with an ET which resembles a micro-organism, lowlier than an earth-worm? For want of a better acronym, I wish to introduce one: 'GODI', which stands for 'galactic organism with distinct intelligence'. GODI could form the basic criterion of an ET, with which humans can engage in communication when one gets a chance to identify it. An ET which is a non-GODI will not be of much use in terms of communication.

Date received 10 July 1995
Date accepted 23 August 1995

Views on galactic organisms with distinct intelligence

According to their beliefs on the existence of GODIs, scientists can be grouped into (a) believers, (b) doubters, and (c) the uncommitted. To grasp the pros and cons related to the search for GODIs, a summary of diverging views from some prominent members of each of the three groups is provided below.

a. Believers

Cyril Ponnamperuma: 'There are 10^{23} stars in the universe. If that is the case, there are 10^{23} possibilities for life. Optimistic calculations, such as Al Cameron, at Harvard, say that 50% of all stars may have around them conditions suitable for life. More conservative estimates say 5%. Whether 5% or 50% – or even 1% – of 10^{23}, it is still a very big number' (3).

Francis Crick: 'Life on Earth originated from microorganisms sent here, on an unmanned spaceship, by a higher civilization elsewhere' (3,4).

Isaac Asimov: 'Because the universe is so vast, evidence of far-away life cannot yet be detected, and may never be detected. But precisely because the universe is so vast, such far-away life must exist, even intelligent life, perhaps in many millions of varieties' (5).

b. Doubters

George Gaylord Simpson: 'The assumption, so freely made by astronomers, physicists and some biochemists, that once life gets started anywhere, humanoids will eventually and inevitably appear is plainly false. The chance of duplicating man on any other planet is the same as the chance that the planet and its organisms have had a history identical in all essentials with that of the earth through some billions of years. Let us grant the unsubstantiated claim of millions or billions of possible planetary abodes of life; the chances of such historical duplication are still vanishingly small' (6).

Ernst Mayr: 'Those who think deterministically assume that once life has originated somewhere, intelligence will surely follow, but only one of the approximately 50 billion species that have lived on Earth was able to generate civilizations. Among these approximately 20 civilizations only one developed electronic technology' (7,8).

c. Uncommitted

Arthur C. Clarke: 'The detection of extraterrestrial life and the detection of extraterrestrial intelligence, either could happen tomorrow or a thousand years from now. We have no hard facts on which to base even a guess, still less a reasonable extrapolation' (9).

It is evident from these opinions that astronomers, physicists and biochemists believe in the presence of GODIs. However, currently available evidences have not convinced the evolutionists on the presence of GODIs.

Drake's formula

The total number of stars in the known universe, according to Asimov, ...'is estimated to be at least 1×10^{21}. Our own galaxy contains well in excess of 1×10^{11} stars'... (5). This sheer number encourages the astronomers to believe that GODIs should be present in the galaxy and universe. The well-known theoretical formula presented by astronomer Frank Drake to project the number of GODIs (10), is as follows:

$$N = R_* F_p n_e f_l f_i f_c L$$

where

- N = number of extant technical civilizations in the galaxy
- R_* = average rate of star formation over the life time of the galaxy
- f_p = fraction of stars with planetary systems
- n_e = mean number of planets per star that are ecologically suitable for origin and evolution of life
- f_l = fraction of such planets (n_e) on which life in fact arises
- f_i = fraction of such planets (f_l) on which intelligent life evolves
- f_c = fraction of such planets (f_i) on which technical civilization develops
- L = mean lifetime of a technical civilization

Carl Sagan had estimated that if ...'about one percent of developing civilizations make peace with themselves, then there are about one million technical civilizations in the galaxy. If they are randomly distributed in peace, distance from Earth to the nearest such civilization will be several hundred light years' (10).

Approaches for contacting the galactic organisms with distinct intelligence

Since the galaxy is diverse and involves astronomical distances, the approaches taken to contact the GODIs can be categorized as follows:

1. Radioastronomical observations in the galaxy and interstellar space for the presence of organic matter;
2. Initiation of radio contact and listening to any transmitted message (as set out by the SETI program);

3. Landing of instruments (computers, sensors, etc.) and humans in the galaxy.

1. Detection of interstellar molecules

Radioastronomical observations made since 1968 have revealed the presence of ammonia (11) and water vapor (12) in the galaxy. Some researchers have also reported the existence of organic molecules such as formaldehyde (13,14) and polyaromatic hydrocarbons (15) in the interstellar space. These findings suggest that at least the molecules essential for chemical evolution are present in the galaxy and interstellar space. However, the availability of whole range of environmental parameters in the galaxy which support the existence of life (as we know in the earth) has not been clarified. Table 1 presents a NASA assessment profile of environmental parameters which are essential for supporting life (16). As of 1992, about 90 distinct molecular species plus about 30 variations containing different isotopes of carbon, oxygen or hydrogen have been identified (17).

2. Initiation of radio contact

The pioneer project in listening to the possible radio signals from the galaxy (called Project OZMA, with reference to the princess of the mythical kingdom of Oz) commenced in 1960. It was focused in the direction towards Epsilon Eridani, Tau Ceti, Omicron-2 Eridani, Epsilon Indi, Alpha Centauri, 70 Ophiuchi and 61 Cygni. However, this search was abandoned after two months of negative results (5). It is apparent that a two-month observation period was inadequate, since it would take years for a released message from these stars to reach the earth. Papagiannis (18) has reviewed the progress made in SETI radio contacts between 1960 and 1985. Drake and Sagan (19) as well as Pace and Walker (20) have commented on the problems of frequency selection for interstellar radio communication.

Table 1 Essential environmental parameters needed for supporting life

Parameter	Range compatible with life
Temperature	Growth: 255–377°K Survival: < 79–377°K
Ultraviolet radiation	3×10^5 erg $cm^{-2}sec^{-1}$
Oxygen	0–100 PO_2 (%)
Liquid water	10–100 (% by weight)
Salinity	0–35 (% NaCl)
pH	0–13
Mechanical abrasion	Abrasive particles < cell size (in dimension)
Nitrogen	Absolute requirement
Sulfur	Absolute requirement
Phosphorus	Absolute requirement
Carbon	Absolute requirement
Hydrogen	Absolute requirement

Adapted from Reference 16.

According to Kuiper and Morris (21), the failure of successful radio contacts with GODIs could be explained in many ways. These include:

a. absence of technological civilizations in the galaxy, advanced beyond our own;

b. if such technological civilizations to exist, for some reason which is presently beyond comprehension, they are unable to engage in interstellar colonization;

c. such technological civilizations are not attempting overt contact with us.

d. their 'communication signals', if present, are not coded in a simple pattern.

There are also some wild assumptions one needs to make for the success of such radio contact with GODIs. Billingham and Tartar (22) indicated that the success of the renovated SETI project assumes that (a) the humans in the earth are only in the eavesdropping mode, and (b) the transmitting civilization is at the same level of technological evolution as ours in the earth. In addition, Pearson (23) has hypothesized that the earth and the moon constitute a unique 'double planet' and the past evolutionary pattern in the earth was tremendously influenced by the moon. Because of the expected rarity of 'double planets', humans may be alone in the Milky Way galaxy. Therefore, the SETI project may be more successful if directed towards the nearby galaxies, than in the Milky Way.

The SETI project which was initiated in October 1992 (to celebrate the quincentenary of the landing of Colombus in the 'New World') picked up only '15 false alarms' during its first two months of listening to the radio signals from the 1000 nearest stars (24). Why such a poor response? I believe that the range of the search was not wide enough. According to Sagan (10), the nearest technical civilization (based on the probabilities derived from Drake's formula) should be 'several hundred light years' away from the earth. However, the SETI project initiated in October 1992 had focused its search 'on the nearest 1000 sun-like stars, within 80 light years of earth' (25). Despite the criticism from evolutionists, the advocates of the SETI project (astronomers, physicists and engineers) seem optimistic about the eventual success of the mission in which they have placed their bets (26–28). For instance, on the success of interstellar radio contacts, Tipler (29) has presented a skeptical view, for which Tarter (30) provided a rebuttal.

Landing of instruments and humans in the galaxy

Arthur C. Clarke was included above as belonging to the 'uncommitted' category on the existence of GODIs. However, he is a foremost futurist of this century, who to his credit published in 1945 the first technical paper which laid down the principles of satellite communications. Table 2 shows the chances of occurrence of some events, as formulated by Clarke (31), in his 'Chart of the Future'. Regarding this chart, first formulated in 1959–60, Clarke had noted that it should not be . . . 'taken too seriously, but it is both amusing and instructive to extrapolate the time-scale of past scientific achievement into the future'.

From 1962 onwards, NASA has successfully conducted quite a number of planetary missions within the solar system (32). The main limitation we experience now for interstellar travel is the limitation on the speed of travel, due to astronomical distances. The units light year and parsec are employed for measuring astronomical distances. One light year equals the distance traveled by light in a year, at the speed of 300 000 km/sec. Parsec, defined as the distance at which a star would have an annual parallax of one second of arc, is equal to approximately 30×10^{12} km. One parsec equals 3.26 light years.

According to Einstein, the whole universe has a diameter of about 100 million light years (33). Currently, the conventional rocket travels at the velocity of 28 000 km/hr to orbit Space. Considering that the nearest star, Proxima Centauri, is located nearly four light years from the earth, to complete a journey to Proxima Centauri by the conventional rocket would take more than 100 000 years (34). Kuiper and Morris (21) postulated that interstellar travel by humans is possible, if the rocket velocity is increased to one-tenth the speed of light (i.e. 30 000 km/sec). This means that the current rocket velocity of 28 000 km/hr needs to be increased by nearly 3600-fold to reach the one-tenth speed of light.

Some of the sources that are capable of providing propulsion power to increase the rocket velocity have been suggested as well (34). These include photon rockets (which use intense beams of light as a means of propulsion), ramjets (that scoop interstellar hydrogen and use it as fuel) and nuclear fusion rockets (propelled by mini-hydrogen bomb explosions). Solar sail is another model which has been proposed for interplanetary travel (35), though NASA is not in favor of this design.

Kuiper and Morris (21) also presented an argument for intergalactic travel by humans in preference to the SETI project. They have proposed that, . . . 'given a somewhat more advanced technology, it may be possible to construct spaceships of sufficient sophistication to permit several generations to live in circumstances not significantly less comfortable than those encountered in crowded cities'. They also suggested that such a long-distance voyage may be undertaken 'in a state of suspended animation'.

Table 2 Arthur C. Clarke's Chart of the Future

Date (Year)	Occurrence of event
2020–2030	Interstellar probes
2030–2040	Contact with extraterrestrials
2070–2080	Near-light speeds
2080–2090	Interstellar flight
2090–2100	Meeting with extraterrestrials

Adopted from Reference 31.

Conclusion

The evolutionists doubt the existence of the ET life-forms or GODIs (the acronym I have introduced in this paper). They feel that, even if life had originated in an extraterrestrial environment, the chances of development of intelligence in those life-forms are extremely remote. But astronomers, physicists and biochemists believe in the presence of GODIs. This belief is mainly based on the theoretical possibilities for existence of intelligent life in the universe (36).

Acknowledgements

I would like to thank Dr Ernst Mayr, Harvard University, for providing me with an English translation of his 1992 paper entitled 'Suche nach extraterrestrischer Intelligenz'. An early draft of this paper was submitted to a Space Research Essay Contest sponsored by the Yomiuri Shimpun (Japan) in 1992, and I express my appreciation to the sponsors of this contest, for inspiring me to think on this topic.

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