The Search for Extraterrestrial Life, and Extraterrestrial Intelligence

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Abstract

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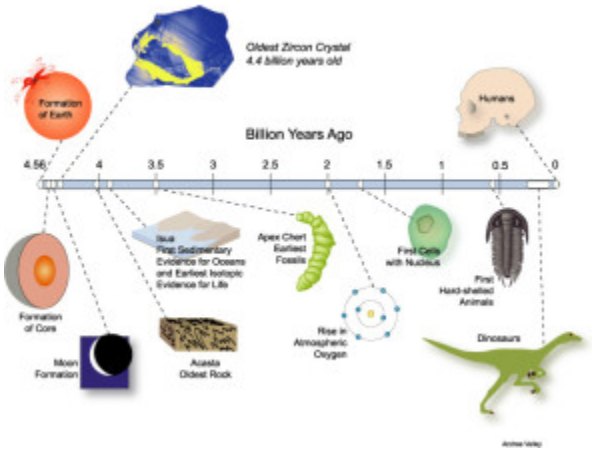
We have overlooked an important source of information in our search for life on Earth-like planets in the galactic Universe. There is at least one such a planet in the Universe, with information that is well known, viz. Earth. Using this planet, it is possible to establish some limits on the probability of discovering life and also of discovering intelligent life elsewhere.

The age of the Earth is about 4.5 billion years. The age of our Sun is similarly about 4.6 billion years. By comparison, the age of the Milky Way galaxy is about 12 billion years and that of the known Universe is about 13.8 billion years. Thus it is reasonable to believe that Earth is likely to be a rather common type of planet in our Galaxy and likely in other galaxies. The origin of the first single-cell life form on Earth is thought to have occurred about 3.6 billion years ago. More complex forms of life developed sequentially with finally the development of animals, apes, etc. This culminated in the origin of the branch of the tree leading to Homo sapiens about 3 million years ago. Thus the origin of intelligent life on our planet occurred only very recently compared to the age of our planet i.e. in the last 0.1% of the age of our planet).



There are two important questions concerning extraterrestrial life upon which well-known terrestrial observations can shed light.

Question 1: What is the probability that life will exist in a planet that has the same physical and chemical properties as the Sun-Earth system, e.g., geometrical distance apart, energy flux to planet, atmosphere surrounding planet, etc.?

Answer to Question 1: It is almost a certainty that life in some form has existed on such a planet. The reason is that a wide variety of life forms have originated on the planet Earth at a vast number of widely dispersed locations, in the most challenging terrestrial environments such as deep in the oceans or extremely hot environments or in difficult chemical environments, and have originated very early and over a large time period during the existence of Earth.

Question 2: What is the probability that “intelligent” life will exist in a planet with the same conditions as postulated in Question 1?

Answer to Question 2: We first define the meaning of “intelligent” life. Intelligent life is defined here as life which has reached, as a minimum, the same capability as Homo sapiens to communicate with other planets in the Milky Way Galaxy. In other words, intelligent life is defined as the existence of life equivalent to Earth’s Homo sapiens. Such intelligent life originated on the planet Earth one time and only one time, very recently in the life of our planet, in one place and only one place on our planet.

Thus, the probability of intelligent life on another planet is not zero, since there is already one such planet that has intelligent life.

On the other hand this probability is not close to 1, since it only happened at one time and in one place on the entire planet. Based on one data point, a zero-order estimate of intelligent life on a sister planet would be 50% +/- 49%. As stated above the time elapsed between the origin of single-cell life, and the branch in the evolutionary tree culminating in Homo sapiens, is about 3.6 billion years. Thus Homo sapiens arose once and only once on this planet and it happened very recently, about 4.5 billion years after the formation of planet Earth. If we make the reasonable assumption that evolution will occur in a similar time in planets similar to Earth, then we must conclude that all planets substantially younger than Earth will probably not have intelligent life.

Another requirement for the production of Homo sapiens is that the planet must have sustained the chemical and physical properties conducive to life, without any total interruption resulting in the destruction of all life forms, for the entire 3.6 billion years. This has been true for Earth, although there has been at least one major catastrophic impact of a good sized meteor resulting in wide-spread but not total extinction of all life forms. Also there has been at least one catastrophic volcanic eruption also causing worldwide but not total extinction of all life forms. 3.6 billion years is a significant fraction of the life of the Universe. It would not be surprising if someone calculated that there is only a small probability of a planet in our Galaxy to have 3.6 billion years of reasonable tranquility, and so we are likely a lucky planet. I suggest that it

is possible to make a useful calculation based on impact data and volcanic activity on our neighboring planets.

From the above considerations one can conclude that there is not a high probability that a particular planet meeting all of the physical and chemical requirements will have intelligent life. But given the reality that there are probably billions of such planets, and we have the data that one of us exists, we must conclude that, excluding the possibility of divine intervention, we are possibly not alone.

On the other hand, if we find even one other planet that meets many of the physical, chemical and temporal requirements for the generation of life forms, and no life forms of any kind are discovered anywhere on this other planet, then we would indeed have to reconsider our belief in a universe totally explained by science alone!

Martin Annis received his Ph.D. in Space Physics from MIT, in 1951. He founded and was the first president of American Science and Engineering. During his tenure the company discovered the first X-ray star, Scorpius X-1, for which a Nobel Prize was given to his employee, Ricardo Giaconni. He is the inventor of the X-ray system that is used to inspect passengers at airports and has 32 patents.