Life and Astrobiology

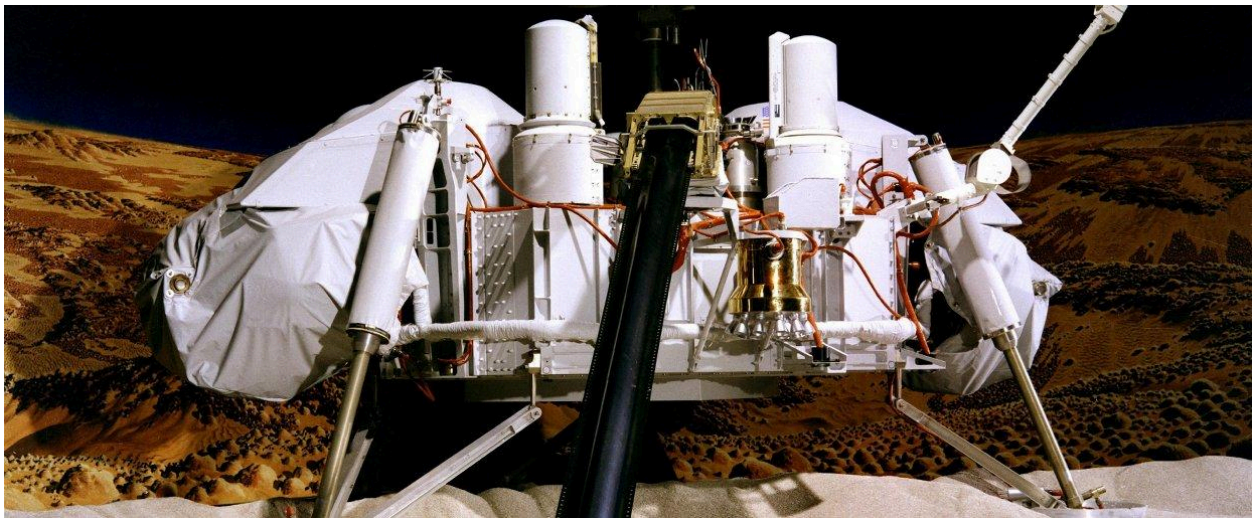

Figure 1. NASA's Viking lander used in the first mission to Mars

Note. From ASTROBIOLY: The Study of the Living Universe, by Christopher F. Chyba and Kevin P. Hand, 2005, Annual Review/10.1146/annurev.astro.43.051804.102202. Copyright 2005 by Annual Reviews.

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INTRODUCTION

Have you ever wondered about the existence of aliens? Astrobiology is defined as "the study of the living universe" (NAI, 2004), which includes the search for extraterrestrial life, spectroscopy of solar and extra solar planetary atmospheres, and the search for extraterrestrial intelligence (Chyba & Hand, 2005). This article seeks the definition of life, the origin of life, and extraterrestrial life.

LIFE

"What is life?" (Erwin Schrödinger, 1945) is a fundamental question that is crucial for exploring complex issues in astrobiology. There has been several attempts to define life; however, a broadly accepted definition of life has not yet been established. The way we define this word can affect the experiment for further study. For example, the Viking project was NASA's first mission to Mars to search for biosignatures. Yet, it was unable to detect organic molecules. During that period, this result was regarded as the absence of life on Mars. In effect, a search that implicitly applied a biochemical definition trumped a search that applied a metabolic definition (Chyba, Whitmire & Reynolds 2000).

To answer the question “What is life?” we require not a definition but a scientific theory (Chyaba & Hand, 2005). For instance, before molecular theory was developed, scientists defined water based on its properties. Subsequently, water is characterised as H_2O.

TERRESTRIAL LIFE AND EXTRATERRESTRIAL LIFE

A thorough comprehension of life is required to search for extraterrestrial life. Nevertheless, it is not possible for us. Hence, scientists typically search for ‘life as we know it,’ meaning life based on liquid water, a suite of so-called ‘biogenic’ elements (most famously carbon), and a usable source of free energy (Chyba & Hand, 2005). Liquid water is essential for life because it serves as an internal medium where molecules can dissolve and chemical reactions can take place. A few other comparably good polar solvents exist, such as liquid ammonia, and it may be possible to construct biomolecules with ammonia as their solvent (Haldane, 1954). However, surface conditions on Titan permit the non-polar molecules methane (CH_4) and ethane (C_2H_6) to exist as liquids (Lunine, Stevenson & Yung 1983). Moreover, there is a possibility that there is life based on silicon rather than carbon, which have similar chemical properties and is cosmically abundant (Feinberg & Shapiro, 1980).

EXISTENCE OF EXTRATERRESTRIAL LIFE

Aristotle (De Caelo) distinguished radically between the celestial and terrestrial realms. However, Newton (with anticipation by Descartes and Hooke) demonstrated that the same laws of physics apply to the heavens as well as the Earth (Kuhn, 1957). The familiar matter that makes up Earth only accounts for roughly four percent of the universe's mass-energy, which is a paradox (Hu & Dodelson 2002). Despite this, the universe is optimally configured for life as we know it (Henderson 1913, Blum 1962, Carter 1974, Leslie 1996). A severe observer selection, however, would make us think like this as we are living on Earth full of lives. The so-called anthropic principle (Carter 1974, Barrow & Tipler 1986) is sometimes invoked to illuminate this remarkable fact. Consequently, life may exist only on the Earth or also on other planets.

CONCLUSION

In conclusion, the understanding of life is a key requirement for developing astrobiology. This will guide the search for traces of extraterrestrial life, both familiar and potentially novel forms beyond Earth. The existence of extraterrestrial life remains a significant challenge for astrobiologists.

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