

ARE WE ALONE?
MILAN ĆIRKOVIĆ, "THE ASTROBIOLOGICAL LANDSCAPE.
PHILOSOPHICAL FOUNDATIONS OF THE STUDY OF COSMIC LIFE",
CAMBRIDGE UNIVERSITY PRESS, 2012 (pp.266)

P. Grujić

Institute of Physics, Belgrade, Serbia

E-mail: *petar.grujic@ipb.ac.rs*

(Received: February 18, 2014; Accepted: February 24, 2014)

Astrobiology shares with cosmology many features, in particular those concerning its historical evolution. Like cosmology human interest for life outside our planet underwent various phases, from a mere wondering if we are alone, to the present day of the astrobiological revolution, started two decades ago with the discovery of first extra solar planets (exoplanets). Cosmology, which used to be a purely speculative exercise, a philosophical contemplative matter, acquired with the advent of the theoretical constructs, like Einstein's General Relativity and deep space astronomical observations, all attributes of a hard science.

Similarities between two disciplines do exist, but there are points of difference, which make them dissimilar both from the ontological and epistemological sides. Both disciplines appear neither of experimental nor of purely speculative nature. But if the cosmology relies on the astronomical evidence, astrobiology has yet to acquire empirical support for theoretical considerations. What makes it at present an epistemological issue *par excellence*. This in its turn, makes epistemological insight an essential feature of the investigations of a possible presence of life in other corners of our universe. It is this fact that makes astrobiology pre-eminently a philosophical issue.

Life as a concept belongs to those notions we all well understand at the communicational level, but are unable to define them rigorously. We mention here two of these: *God* and *time*, Plato never at-

tempted to define his God, and St Augustine's remark on the evasive nature of time is well known.

The life phenomenon appears a perplexing affair in the realm of the physical world. At first sight the life defies second law of thermodynamics - the overall increase of entropy, as a measure of disorder, accompanying any process occurring in Nature. In his famous essay *What is life?* (1943) Ervin Schrödinger emphasizes the most general characteristic of living matter: its production of entropy, feeding from the inert environment by negentropy (negative entropy). Living organisms live by building complex structures during their growth and then maintaining it during the life span all the time by destroying existing structures of the inert matter. Its increasing order arises at the expense of the decreasing order of the ambient. Living creatures appear thus machines for producing chaos. If we imagine an isolated system (which may be the entire Universe) as a living organism, the life it may contain can be regarded as a disease of the inert matter.

This appears fine and satisfactory at the most fundamental, thermodynamic level, but it can hardly help in recognizing living matter in the cosmic space. Even here on Earth we are not quite sure where to draw line between inert and living matter. Similar uncertainty appears when singling out the intelligent beings from the rest of living creatures.

The consequence of these uncertainties is that the search for life outside Earth appears doubly sus-

picious: we don't know what are we looking for, and are not certain even if there is life in the form we understand and what are the chances to encounter and recognize it. Hence astrobiology has at least two questions to answer: (i) Is there life outside our Earth, and, if there is, (ii) what are the chances that we detect it. It is these, and some other questions, the author of this monograph endeavours to analyze and discuss.

As the author defines his subject in the introduction, the book is devoted to "philosophical exploration of perplexing issues arising from contemporary research on the origin, existence and future of life in its widest cosmological context". The author is an active researcher in the field of astrobiology and cosmology, what is of utmost importance in this fast advancing discipline. Since the subject appears tightly bound to cosmology, good acquaintance with present day state of art is crucial too. Author starts by sketching development of cosmology, delineating principal phases of the advent of human understanding of the physical reality in the broadest sense. Both inert and living matters are subject to the phenomenon of evolution and as such appear tightly mutually bound, both from the phenomenological and the epistemological aspects. The concept of evolution makes the search for an extraterrestrial intelligent life prosperous in the perspective. It would be sufficient to discover any form of life to estimate the probability of the intelligent beings to exist somewhere in the deep space. So, if we encounter prokaryotes only, time and evolution will take care for the rest.

In the absence of empirical support, it is not an easy task to swim between Scylla and Haridba of the current astrobiological controversies, which often take the form of severe disputes. The author manages to present the last both in a more or less exhaustive and objective manner. In particular his rebutting of the notorious sceptics, who deny both the justification and prospects of the search for the extraterrestrial intelligence (SETI). At the present formative stage astrobiology faces many paradoxes, which those sceptics do not fail to promote.

The very term from the title *landscape* has been borrowed from the quantum field theory, more specifically from the theory of strings. Its purpose is to stress the enormous number of possibilities which the Nature may make use of in building complex structures, we call life. As another parallel with cosmology, the concept of multiverse is often invoked in the book. In an epistemological sense, author extensively makes use of the concept of multiple universes within an abstract logical or methodological space. In a somewhat narrower sense, from the modern perspective, the concept was in air long time ago, from Democritus to Bruno etc, to attain today extreme form of worlds based on different fundamental physical laws and even different physical constants. In biology this would imply different basic constituents of living mater, different genetic codes etc.

In the absence of relevant empirical data the present stage astrobiology is mainly occupied by estimating probability that the life exists anywhere in our cosmos. The etalon is, of course, Earth and con-

ditions which it provides to appearance of living, biotic matter. In a sense, our planet serves as a laboratory which runs experiments on her own. What are the chances life to appear in our universe, outside Earth? If we take into account the extraordinary set of coincidents met in our solar system and Earth within it, the probability appears incredibly small. On the other hand, number of planets in our universe appears enormous, what enhances arbitrarily the chance for life. The overall number of life supporting planets turns out thus to be of the form $(\infty \times 0)$, what may result in any probability habitable planet to exist within interval $(0, 1)$.

In the absence of hard material evidence astrobiologists often resort to another tool - that of science fiction (SF). Author, who is himself engaged in this branch of literature turns often in this direction. The previous predictions SF made successfully justify this adventure into imaginary world. It broadens our expectation domain concerning the life phenomenon and helps future empirical examinations to recognize entities which may be classified as biotic. Thus SF can be taken as a sort of cognitive simulator of the search for alien civilizations, if not even of the scientific and technological advance itself.

The book presents the astrobiological issue in many aspects, including the cognitive ones, like the selection effects, which play often decisive role in separating real from biased. The anthropic principle is often invoked, as an example of the selection bias. The fact that life exists in our universe, that is that we are alive, does not necessarily imply the probability of life appearing anywhere in the universe different from zero. The existence of observers is a sure prerequisite to the existence of the astrobiological issue and it does not preclude an absence of life in the rest of the universe, what makes the search for life both nontrivial and exciting.

The Astrobiological Landscape is primarily concerned with philosophical aspects of astrobiology, as the subtitle indicates. It analyzes the fundamental issues of the phenomenon of life and its possible distribution within our universe. It may be taken as a methodological and epistemological preparation for the future investigations, both empirical and theoretical ones. The book covers all relevant aspects of the field and discusses many original ideas put forward by the leading authorities. The author appears in possession of enormous evidence, both historical and factual, what makes the reading rewarding in many aspects. The cover of relevant literature is impressive and the index makes the monograph a useful handbook. The content is exposed at two levels: the main text and very reach endnotes in addition. My only regret is the use of endnotes, instead of footnotes, which, in my experience greatly facilitate easy reading. The book is well equipped by references and one must notice the drawings by S. Popovic, which render a somewhat medieval flavour to the subject.

Astrobiology steers by necessity many theological, ideological and teleological issues and they are amply discussed in the book. The tension is spanned between two extremes: (i) Copernican principle (the thesis of mediocrity) and (ii) rare-Earth

thesis, which favours exceptional position of our Earth and its biosphere. Author's sympathies lie with Copernicus, and his, albeit implicit, reliance on the antique notion of *isonomy*.

The book is aimed at biology and astrophysics students, but the active researches in the field will profit the most. The author has achieved the goal of putting the entire field of astrobiology under the unique cover, what is *raison d'être* of philosophy indeed. I consider this monograph the splendid contri-

bution to the field of astrobiology, which itself may well be taken as the front of the science of today and the near future. This is not an easy reading text, to be sure, but the reward is gratifying. At least I felt like this upon reading it.

Petar Grujić

Institute of Physics, Belgrade