

Defining Life in a Non-Geocentric Way

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Abstract

We will discuss and present problems of existing concepts of life definitions and propose a new working hypothesis for a non-geocentric life view.

1. Introduction and Background

During the recent months and years a large number of proposals for definitions of life have been published. Nevertheless, an international consensus on this question has not been achieved up to now due to the nature of the scientific fields under consideration, the difference between living and non-living systems as well as the main characteristics of life. There is also an ongoing discussion if it is possible to define life with only the terrestrial sample at hand and the fact that a general theory of life is necessary before defining life itself as a universal concept ([3], [9]). In [6] it is asked: *How can we find something, which we cannot define or describe?* Considering this background a 'definition' of life is not only of philosophical interest, but seems to be a necessary step for the detection of extraterrestrial life. Besides considering the question on the origin of life, modern astrobiology's focus also centers on questions like "Are we alone?" or "Is there life, intelligent or not, on other planets?". When we think of life on other planets also the question how to detect it will arise. Therefore it will be necessary to acquire knowledge on the concept of life, or at least to have a hypothesis on its most important parameters and strategies. Without such a working hypothesis it is not possible to design proper experiments to detect life in extraterrestrial environments as it is not clear for which markers to look for. An operative working hypothesis and theory of life should not only give an answer when asking for the parameters of life-as-we-know-it (now), but also on the scenarios for: life-as-it-initially-was and life-as-it-could-be (not only artificial) [5]. Nevertheless, looking for life-as-we-know-it is a first justifiable step, because we know this sort of life

exists [7], but we should be open-minded to the possibility that life also exists in unexpected forms.

2. Discussion

The NASA definition (life is a self-sustaining chemical system capable to Darwinian evolution, [4]) has recently been discussed in [2] and still poses a common approach for a life definition, but does not allow to derive specific parameters, which can be used in the search for extraterrestrial life. Life definitions based on summaries of terrestrial characteristics of life (e.g. [1]) offer only search strategies for life which is quite similar to terrestrial life with respect to its chemical and physical characteristics. Most definitions and working hypotheses for life used nowadays either list detailed characteristics of terrestrial life-forms or include general concepts of life-as-we-know-it. Consequently both approaches can be designated as geocentric conceptions of life. Evolution or reproduction often form such basic concepts, which accompany life-definitions as well as present search strategies for extraterrestrial life, although bringing an evidence for these system characteristics is far beyond our present technical capabilities. We will show that both evolution and reproduction are unsuitable arguments for life definitions, because when we strictly apply them to the species homo sapiens sapiens, then even humans cannot be counted as proper representatives for life (our need of microorganisms for maintaining the metabolism is only one argument for this). Furthermore, the discovery of the potential ability of GFAJ-1 [8] to grow with arsenic instead of phosphorus makes a more general definition of life mandatory, which is not based on the six key-elements of terrestrial life. As a consequence of all these arguments, not a strict and elegant definition of life has to be the focus of our present astrobiology agendas, but the formulation of a working hypothesis, which will allow to derive appropriate scenarios, which can be used for the search for extraterrestrial life.

3. Conclusion

As a consequence of the arguments which we are going to present we will propose a more general hypothesis for life – a list, which is related to the definition in [1] but generalizes some arguments (artificial life is not included in this concept):

- (1) Life is based on molecules which undergo chemical transformation (a metabolism, which is working either symbiotically or asymbiotically or both).
- (2) Life exploits a thermodynamic disequilibrium.
- (3) The macromolecules that enable the metabolisms, the building of structures, energy management and transfer of information, are a consequence of specific elements to form macromolecules with the ability to bound functional groups (organic and/or inorganic).
- (4) The macromolecules of life interact with a solvent to be soluble (or not) or to react (or not) in a way that confers fitness of the life-form.
- (5) Life has the ability to conserve itself.

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