A Brief Consideration of Early Panspermia Based on Astronomical and Celestial Mechanical Arguments

(Commentary on: Genetics Indicates Extra-Terrestrial Origin of Life: The First Gene)

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Joseph and Wickramasinghe (2011) have concluded in their work that an extraterrestrial origin of life seems to be reasonable when taking into account the duplication rate of genes. The authors stated that the first genes may have originated more than 10 billion years ago and consequently they will predate the formation of Earth and the whole Solar System. In their article the authors excluded other explanations as an ex-nihilo creation of genes or an accelerated rate of duplication. We share the opinion that an ex-nihilo origin can be excluded as an argument against their hypothesis that the first genes are older than 10 billion years, but why exclude an accelerated rate of duplication per se?

When we consider the Universe 10 billion years ago, then the following scenario will arise: the first generation of galaxies has ended due to merging and forming of the first elliptical galaxies which still exist in present days. The bulge of the Milky Way has evolved too (at least 3 billion years ago) and our galactic disc starts to build up.

When the origin of life or its predecessor molecules are phenomena that can also take place in the interstellar medium and which are not restricted to (terrestrial) planets, then the observation of interstellar molecular clouds should yield at least amino acids as building blocks for life and consequently proteins. Even though spectroscopic investigations of a large number of different molecular clouds have revealed various complex molecules, no amino acids have been observed up to now. This lacking evidence leads to the same question as the physicist and Nobel laureate Fermi has replied to the missing evidence of (intelligent) life in the Universe (Fermi paradox): When the origin of life can take place in the interstellar medium and is not restricted to planetary environments, where is its observational evidence? If the origin of life and its existence is linked to a (terrestrial) planet and to a mechanism as possibly shown by the Miller-Urey-experiment (Miller, 1953), then the missing observations can be explained, because we are not able to resolve such chemical details on (exo)planetary surfaces. If the origin of life and consequently of genes happened more than 10 billion years ago, then only an exoplanetary surface could count as a host. Thus the question arises how these molecules were able to reach Earth?

Several experiments have successfully been performed to show the ability of bacteria to survive the harsh conditions in space for a very long time (e.g. Horneck et al., 1994). This fact is of high importance when we discuss transpermia scenarios as a potential transfer of life or its molecules between neighboring planets, but when we consider the transfer into a planetary system another problem will arise. We have performed a brief and rough estimation of the travelling time of an object which carries gene-based molecules to Earth (and we assume that the conditions in space as well as the entry into the terrestrial atmosphere will not harm the genes). With an age of the Earth of about 4.6 billion years, assuming that the first genes arrived on Earth 4 billion years ago and that the onset of the first genes happened 10 billion years ago, then the resulting travelling time is about 6 billion years. With a velocity of 40 km/s (comparable to the mean velocity of comets) the maximal distance the object can travel is about 800,000 ly (under the simplified assumption of a straight-line trajectory). This maximal distance is much larger than the diameter of the Milky Way, so even when taking into account celestial mechanical laws for the trajectory, then the place of origin for the first genes is located outside of our Galaxy. For such a scenario the object not only has to be able to leave its host planet and planetary system, but also its host galaxy. When using for these systems similar mass values as for our Solar System and for our Galaxy, we can calculate the resulting escape velocity of a planetary system to be 42.1 km/s (or when including the revolution velocity of a planet like the Earth to be 12.3 km/s). For a galaxy like the Milky Way an escape velocity of about 320 km/s (or when assuming the optimal use of the revolution velocity of a star to be at least 100 km/s) will result. We know from several scenarios that it is possible (e.g. for impact ejecta) to attain an escape velocity of a planet like the Earth, but it is very unlikely that such an object will become so fast that it can leave its host galaxy.

When thinking of these arguments and celestial mechanical and astronomical restrictions the question will arise, if it is not more likely that an accelerated rate of gene-duplication was given on early Earth. Finally, one more argument against an extraterrestrial origin of life is given by paleomagnetic investigations which show only evidence for the existence of a protective Earth magnetic field since about 3.2 to 3.9 billion years (Tarduno et al., 2007). As a consequence of the lacking magnetic field on early Earth as well as an enhanced solar activity compared to present days and consequently an increased radiation environment, the duplication as well as the mutation rate of the very first emergence of life (or its predecessor molecules) could have been quite higher compared to the time following the onset of a shielding magnetic field.

References:

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