From Astrochemistry to Astrobiology: for a change in paradigm?

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It is generally proposed that astrochemistry in molecular clouds and then protoplanetary disks, leading to a semi-complex organic chemistry observed in radio astronomy, may represent a possible very early first step towards prebiotic chemistry. The frantically search for so called "prebiotic" molecules such as formamide, urea, glycine or glycolaldehyde, often referred as precursors of molecular bricks of life, seems indeed to be the sole goal to validate the hypothesis that links astrochemistry to astrobiology. In our scenario, interstellar ices photo/thermo chemistry, simulated in the laboratory since more than 30 years, leads to a very rich organic solid-state chemistry. The formation of complex organic soluble (and insoluble) materials presenting a large diversity of organic compounds, among them amino-acids, sugars (including ribose), nucleobases and most probably short peptides, is now well documented in the literature. Similarities with the organic matter in primitive carbonaceous chondrites are suggested by various analytical methods and this establishes a more convincing link toward the onset of prebiotic chemistry at the surface of telluric planets where minimal conditions could be met (presence of liquid water, seeding of organic materials and availability of a low entropy free energy source (UV-Visible photons)). A global scenario considering this possibility has been described in [1] and constitutes the basis of our now classical MICMOC experiment supported by the PCMI and the CNES. However, as suggested by ourselves in a recent paper [2], we propose that the true approach for the study of the transition from inert to living must focus not on the chemical compounds themselves but on the process by which auto-organization may take place in a far from equilibrium evolution of the organic matter that may have been delivered on the early Earth. This is the basis for the new MICMOC-LE experiment designed and in construction at PIIM. The goal is to observe the emergence of chemical (replicative) systems that are able to mimic natural selection, in the chemical world, a minimal requirement for any "living" system.

References

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