OPARIN'S HETEROTROPHIC THEORY OF THE ORIGIN OF LIFE: A CONTEMPORARY REASSESSMENT

Antonio Lazcano
Facultad de Ciencias, Universidad Nacional Autónoma de México
Apdo. Postal 70-407, Cd. Universitaria04510 México, D. F., MEXICO
E-mail: alar@ciencias.unam.mx. Phone: 00.525.55.622.4823

The heterotrophic origin of life proposed by A. I. Oparin in the 1920's was part of a Darwinian framework that assumed that living organisms were the historical outcome of a gradual transformation of lifeless matter. Analysis of carbon-rich meteorites and laboratory simulations of the primitive Earth following the classical 1953 Miller-Urey experiment suggest that prior to the emergence of the first living systems the prebiotic environment was endowed with a large suite of organic compounds of biochemical significance, many organic and inorganic catalysts, purines and pyrimidines, i.e., the potential for template-dependent polymerization reactions, and membrane-forming compounds. Although it is not known the relative importance that the different sources of organic molecules played in the emergence of life, the available evidence suggest that the chemistry of the primitive environment was shaped both by exogenous and different endogenous sources of organic compounds.

The remarkable coincidence between the monomeric constituents of living organisms and those synthesized in Miller-Urey type experiments appears to be too striking to be fortuitous. However, how the ubiquitous nucleic acid-based genetic system of extant life may have originated from such a mixture is one of the major unsolved problems in contemporary biology. The discovery of catalytically active RNA molecules provided considerable credibility to prior suggestions that the first living entities were largely based on ribozymes, in an early stage called the RNA world. . There is convincing evidence suggesting that the genetic code and protein synthesis first evolved in such an RNA world, but at the time being the hiatus between the primitive soup and the RNA world is discouragingly enormous. Bioinformatics and comparative genomics provide important insights into some very early stages of biological evolution, but it is difficult to see how their applicability can be extended beyond a threshold that corresponds to a period in which protein biosynthesis was already in operation, i.e., the RNA/protein world. The evidence suggesting that ribonucleotide-derived coenzymes, alarmones, histidine and other imidazole-bearing compounds can be considered vestiges of such early epochs will be discussed.