

ABOUT SPONTANEOUS MOLECULAR GENERATION

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Life is made of the intimate interaction of metabolism and genetics, both built around the chemistry of the most common elements of the Universe (hydrogen, oxygen, nitrogen, carbon). The transmissible interaction of metabolic and genetic cycles results in hypercycles of organization and de-organization of chemical information, of living and non-living. The origin-of-life quest has long been split in several attitudes exemplified by the aphorisms "genetics-first" or "metabolism-first". Overstepping the opposition between these approaches by a unitary theoretical and experimental frame and taking into account energetic, evolutionary, proto-metabolic and ur-environmental aspects, we propose a simple pathway leading to a complete prebiotic reactive system. Specifically, we analyze the synthetic reactions leading from the one-carbon atom compounds HCN and its hydrolyzed form NH_2COH formamide to prebiotically relevant compounds in the presence of catalysts. We observe the formation of all the extant biological nucleic bases, of carboxylic acids, of aminoacids and of condensing agents in the presence of tens of catalysts of terrestrial origin and of 12 meteorites. We also observe in the same chemical frame the formation of cyclic nucleotides and their spontaneous polymerization to oligonucleotides, their terminal ligation yielding longer polymers, a ribozyme activity causing the terminal transfer of nucleotides between in vitro abiotically generated oligomers. In vitro generated oligonucleotides thus automatically increase the chemical information of the system.

These results entail that the spontaneous generation of proto-metabolic and proto-genetic systems did not require exceeding complexity. Rather, it was probably the result of the interplay between combinatorial casuality and thermodynamic necessity of the existing most abundant atoms.