

Prebiotic soup theory – August 13, 2015

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Home (edit)

Ideas (edit)

1 The idea of prebiotic soup

“The concept that life arose from a prebiotic soup or primeval broth that covered the Earth is generally attributed to Oparin [1] and Haldane [2]. The theory received support from Millers [3] demonstration that organic molecules could be obtained by the action of simulated lightning on a mixture of the gases CH_4 , NH_3 and H_2 , which were thought at that time to represent Earths earliest atmosphere. The organic compounds that were measured included hydrogen cyanide (HCN), aldehydes, amino acids, oil and tar. Additional amino acids were produced by Strecker synthesis¹ through the hydrolysis of the reaction products of HCN, ammonium chloride and aldehydes, and in later experiments polymerization of HCN produced the nucleic acid bases adenine and guanine. ” [4]

However there are difficulties with the polymerization of the precursor molecules. First of all, RNA molecule favours hydrolysis over polymerization in aqueous solutions and it wouldn’t survive if exposed to solution, especially at high temperatures[5]. The similar situation holds for proteins [6]

Several mechanisms to go around the problem were proposed: “evaporation of tidal pools, adsorption to clays, concentration in ice through eutectic melts and giant oil slicks. Temperature cycling might also have been a factor in peptide production, although cold to freezing conditions are now considered to be more favourable for prebiotic soup[7].” [4]

References

- [1] Aleksandr Ivanovich Oparin and Sergius Morgulis. *The origin of life*. Dover, New York, New York, USA, 1952.
- [2] John B S Haldane. The origin of life. *Rationalist Annual*, 148:3–10, 1929.
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¹ The Strecker amino acid synthesis, devised by Adolph Strecker, is a series of chemical reactions that synthesize an amino acid from an aldehyde or ketone. The aldehyde is condensed with ammonium chloride in the presence of potassium cyanide to form an α -aminonitrile, which is subsequently hydrolyzed to give the desired amino acid.

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 - [7] Jeffrey L. Bada. How life began on Earth: a status report. *Earth and Planetary Science Letters*, 226(1-2):1–15, September 2004.