Prebiotic polymerization: experiment – August 11, 2015

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1. There has been some success at synthesis of macromolecules in the laboratory under aqueous conditions using exotic condensing reagents [1]??. But such chemistry is far from the facile reactions that likely sparked life.

2. "A major stumbling block is the fact that biological polymers generally are formed by dehydration, the removal of water, to form a peptide bond in the case of protein or a phosphodiester bond in the case of nucleic acids. However, because of the high concentration of water (55 M) in a fully aqueous environment, hydrolysis, not polymerization, is overwhelmingly favored. The origin of life seems inconsistent with fully aqueous chemistry, particularly at high temperature." [2]

3. Problems with RNA world: "If it ever existed, however, the RNA world was not exposed to free solution. The ribose 21-OH group that renders RNA, in contrast to DNA, catalytic also renders the RNA chain particularly susceptible to hydrolysis. The RNA phosphodiester in aqueous solution is highly labile to hy- drolysis promoted by the ribose 2'-OH group, which forms the 2',3'-cyclic phosphate and breaks the RNA chain. This reaction is accelerated by high pH, high temperature, and the presence of divalent (or other multivalent) cations, which bind to and polarize phosphates, enhancing reactivity. The early hydrosphere would have contained substan- tial concentrations of many multivalent cations. RNA mole- cules of much complexity could not have survived if exposed to solution in that environment, particularly if at high temperatures."[2]

References

[1] G F Joyce. RNA evolution and the origins of life. *Nature*, 338(6212):217–224, 1989.

[2] N. R. Pace. Origin of life - Facing up to the physical setting. *Cell*, 65(4):531–533, 1991.