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Homochirality through Photon-Induced Melting of RNA/DNA: the Thermodynamic Dissipation Theory of the Origin of Life

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The homochirality of the molecules of life has been a vexing problem with no generally accepted solution to date. Since a racemic mixture of chiral nucleotides frustrates the extension and replication of RNA and DNA, understanding the origin of homochirality has important implications to the investigation of the origin of life. Here we suggest a novel solution to the homochirality problem based on a recently proposed thermodynamic dissipation theory for the origin of life. Homochirality is suggested to have been incorporated gradually into the emerging life as a result of asymmetric right- over left-handed photon-induced denaturation of RNA/DNA occurring when Archean sea surface temperatures became close to the denaturing temperatures of RNA/DNA. This differential denaturing success would have been promoted by the somewhat right-handed circularly polarized submarine light of the late afternoon when surface water temperatures are highest, and a negative circular dichroism band extending from 220 nm up to 260 nm for small segments of RNA/DNA. A numerical model is presented demonstrating the efficacy of such a mechanism in procuring 100% homochirality of RNA or DNA from an original racemic solution in less than 500 Archean years assuming a photon absorption threshold for replication representing the hydrogen bonding energies between complimentary strands. Because cholesteric D-nucleic acids have greater affinity for L-amino acids due to a positive structural complementarity, and because D-RNA/DNA+L-amino acid complexes also have a negative circular dichroism band between 200 - 300 nm, the homochirality of amino acids can also be explained by the theory.

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