

ULTRAMETRICITY IN THE ORIGIN OF LIFE AND EVOLUTION

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“Biological specificity is most likely a saved choice among almost equally probable alternatives.” This judgment is not exactly what Henry Quastler wrote in “The Emergence of Biological Organisation”, it is merely a familiar translation from the Russian edition of this book with holding of the original meaning. This linguistic example illustrates simple thing: just as translation, origin of life and evolution must yield to processes keeping specificity via randomness.

Which kind of stochastic processes is responsible for selection of biological information? Could the "random choice" under the selection be preserved through subsequent evolution? We consider these questions from the viewpoint of that how the evolution depends on the geometry of the genomic space. We speculate about two evolutionary paradigms: the Darwinian-type-evolution based on familiar diffusion, and the ultrametric-type-evolution based on ultrametric diffusion. In these contexts, we discuss "a bottleneck" for the biological specificity emergence, which is referred as "the error catastrophe". It is widely discussed problem know, that there is no way to avoid the error catastrophe under the Darwinian-type-evolution. We show, in contrast, that such a way may be found under the ultrametric-type-evolution. Some relationship between the ultrametric-type-evolution and the Kauffman model of evolution is discussed.

Selected publications:

on the origin of life and evolution:

1. Avetisov V. A. Origin of biomacromolecular homochirality: In search of evolutionary dynamics. In *Progress in Biological*. Eds. Gyula Palyi, Claudia Zucchi, Luciano Caglioti (Elsevier, Oxford (GB), 2004).
2. Avetisov V.A. Biomacromolecular homochirality emergence: complexity, hierarchicity and dynamics. In *Fundamental of life*. eds.. L. Caglioti, G. Palyi, C. Zucchi (Elsevier; Amsterdam, 2002)
3. Avetisov V.A., Goldanskii V.I. Mirror symmetry breaking at the molecular level. *Proc. Natl. Acad. Sci. USA* 93 11435 (1996)
4. Avetisov V.A., Goldanskii V.I., Kuzmin V.V. Handedness, origin of life and evolution. *Physics Today* 44, 33 (1991)

on the ultrametric diffusions:

1. Avetisov V.A., Bikulov A.Kh and Osipov V.A. p -adic models of ultrametric diffusion in conformational dynamics of macromolecules. *Proceedings of the Steklov Institute of Mathematics*, 245, 48 (2004).
2. Avetisov V.A., Bikulov A.Kh and Osipov V.A. p -adic description of characteristic relaxation in complex systems. *J. Phys. A: Math. And Gen.* 39, 4236 (2003).
3. Avetisov V.A., Bikulov A.Kh and Kozyrev S.V, p -adic models of ultrametric diffusion constrained by hierarchical energy landscape. *J. Phys. A: Math. And Gen.* 35 177 (2002)
4. Avetisov V.A., Bikulov A.Kh and Kozyrev S.V, Application of p -adic analysis to models of breaking of replica symmetry. *J. Phys. A: Math. And Gen.* 32 8785 (1999)