Field-control, phase-transitions, and life's emergence

Gargi Mitra-Delmotte, A. N. Mitra

(Submitted on 10 Apr 2012 (v1), last revised 21 Aug 2012 (this version, v3))

Instances of critical-like characteristics in living systems at each organizational level as well as the spontaneous emergence of computation (Langton), indicate the relevance of self-organized criticality (SOC). But extrapolating complex bio-systems to life's origins, brings up a paradox: how could simple organics--lacking the 'soft matter' response properties of today's bio-molecules--have dissipated energy from primordial reactions in a controlled manner for their 'ordering'? Nevertheless, a causal link of life's macroscopic irreversible dynamics to the microscopic reversible laws of statistical mechanics is indicated via the 'functional-takeover' of a soft magnetic scaffold by organics (c.f. Cairns-Smith's 'crystal-scaffold'). A field-controlled structure offers a mechanism for bootstrapping--bottom-up assembly with top-down control: its super-paramagnetic components obey reversible dynamics, but its dissipation of H-field energy for aggregation breaks time-reversal symmetry. The responsive adjustments of the controlled (host) mineral system to environmental changes would bring about mutual coupling between random organic sets supported by it; here the generation of long-range correlations within organic (guest) networks could include SOC-like mechanisms. And, such cooperative adjustments enable the selection of the functional configuration by altering the inorganic network's capacity to assist a spontaneous process. A non-equilibrium dynamics could now drive the kinetically-oriented system towards a series of phase-transitions with appropriate organic replacements 'taking-over' its functions.

Comments: 54 pages, pdf file
Subjects: **Other Quantitative Biology (q-bio.OT)**; Biological Physics (physics.bio-ph)
Cite as: **arXiv:1204.2525 [q-bio.OT]**
(or **arXiv:1204.2525v3 [q-bio.OT]** for this version)

Submission history

From: Dr A. N. Mitra [view email]
[v1] Tue, 10 Apr 2012 17:07:06 GMT (1048kb)
[v2] Fri, 10 Aug 2012 18:31:03 GMT (2213kb)
[v3] Tue, 21 Aug 2012 20:10:09 GMT (1209kb)

Which authors of this paper are endorsers?