

Life is a Self-Organizing Machine Driven by the Informational Cycle of Brillouin

Denis Michel

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Abstract Acquiring information is indisputably energy-consuming and conversely, the availability of information permits greater efficiency. Strangely, the scientific community long remained reluctant to establish a physical equivalence between the abstract notion of information and sensible thermodynamics. However, certain physicists such as Szilard and Brillouin proposed: (i) to give to information the status of a genuine thermodynamic entity ($k_B T \ln 2$ joules/bit) and (ii) to link the capacity of storing information inferred from correlated systems, to that of indefinitely increasing organization. This positive feedback coupled to the self-templating molecular potential could provide a universal basis for the spontaneous rise of highly organized structures, typified by the emergence of life from a prebiotic chemical soup. Once established, this mechanism ensures the longevity and robustness of life envisioned as a general system, by allowing it to accumulate and optimize microstate-reducing recipes, thereby giving rise to strong nonlinearity, decisional capacity and multistability. Mechanisms possibly involved in priming this cycle are proposed.

Keywords Thermodynamics · Information · Positive feedback · Microstates reduction · Nonlinearity · Multistability · Organization

Introduction

A recently conducted experiment of accelerated evolution (Marlière et al. 2011) revealed that the structure of DNA from contemporary cells is purely contextual and could have been different if conditions had been different. This instructive study, ruling out previous speculations about the rational of nucleotide composition, shows that life has the potential to take many different molecular forms. Hence, in order to analyse life as a general phenomenon, not restricted to particular terrestrial circumstances, one is led to examine the innermost physical principles underlying this puzzling form of matter organization. Even if current

D. Michel (✉)

Université de Rennes 1 IRSET U1085 Transcription, Environment and Cancer, Campus de Beaulieu, Bat.
13, 35042 Rennes Cedex, France
e-mail: denis.michel@live.fr