

**THE CURSE OF CONTINGENCIES: ON THE ROLE OF CHANCE AND DIRECTIONALITY IN PREBIOTIC EVOLUTION.** Loris Serafino, Australian College of Kuwait, [l.serafino@ack.edu.kw](mailto:l.serafino@ack.edu.kw).

**The many faces of chance:** In a totally deterministic universe everything has been decided at the instant  $t = 0$ . On the other hand if we accept that chance plays an irreducible role, this leaves open the possibility of the “unexpected”: different paths of evolution are possible. If the fate of the Universe is predetermined or not is a metaphysical mystery without answer. From the human beings perspective, Reality looks the realm of a complex dialectics between chance and mechanical predestination. From a teleological stance, Anthropropic Principle arguments can give some answers in so far as we assign a privileged status to Life (and mind) in the Universe and not merely considering it as one of the possible state of aggregation of matter, the result of a cosmic combinatorial game.

**Life and the management of chance:** A probabilistic component (in the sense of genetic random mutations that are irrespective of organism needs) enters in the Darwinian evolution pictures as a key ingredient since it is connected to the ability of life to generate genetic variability on which selection will operate through a non-random process [1]. With abuse of language we can say that the success of life in resisting on this planet for billions of years is also relate to its ability of internalize, manage and even turn to its advantage unavoidable random factors. But there is no predetermined path. For example it has been recognized that the existence of an “arrow of complexity” in biological evolution has to be understood in a “passive” sense: Darwinian evolution is not an a priori pressure to complexity but it will push in that direction to as long as it provides selective advantages [2]. Complexity here looks like a global by-product of the evolutionary mechanism. So, if in Biology the role of “chance” has been normalized, in the Origin of Life field (OoL) the situation is subtle and puzzling.

**Prebiotic evolution and the denial of chance:** In the OoL literature there is a recent strong tendency to emphasize the assumption of the *inevitability* of life [3]. According to this narrative, universal laws of physics and chemistry impose stringent constraints in the pathway that goes from simple elements to more and more complex molecular structure and chemical networks up up to the common ancestor and further. Here the role of *chance* is conceived at best in terms of *contingency about initial conditions* (prebiotic concentration, composition of the atmosphere, thermal conditions, etc.) or at worst as synonymous with “something without a cause” and so discharged as unscientific.

**Chance, driven out through the door, will come back through the window:** Determinism about the laws versus contingency creates a distinguishing sense of discomfort in the OoL field. The irony of fate is that despite the “biochemical predestination” or “cosmic imperative of life” dogma, here uncertainty reign supreme. The clarification of the historical path that goes from the end of the late bombardment to first prokaryotes (around 300 million years) passing through a plethora of paradoxes and enigmas (about chirality, self-replication, cellularity, genetic code and so forth) is plagued by poor knowledge about the actual conditions of the primitive environment and lack of paleontological and molecular relics [4]. Many possible evolutionary paths are again at the mercy of the game of contingencies. Experiments and computer simulation outputs run the risk of being regarded highly speculative.

**Are OoL findings condemned to be always ambiguous and controversial?:** Maybe tomorrow a exceptional discovery will change OoL filed in the same way that the “cosmic microwave background” revolutionized the knowledge about the origins of the universe. To date, the scenario depicted above pushes some authors to argue that OoL research needs to focus on the *a-historic* aspect, i.e. to unfold an organizing underlying principle, a *driving force* that cut across the realms of Physics, Chemistry and Biology, a rail that guides *in a continuum* from the inanimate matter to the complexity of life [5]. The stronger this driving force is, the weaker will be the role played by chance. Some candidates have been advocated (like extending Darwinian arguments to the molecular level or invoking maximum entropy production principles) but no consensus has been reached so far [6]. It is likely that a combination of different thrusts worked in concert but here again the demon of chance peeps out. The amount of chance that the scientific speculations about the origins is willing to accept is to some extent arbitrary and it will be a perennial source of debate.

**References:** [1] Wagner A. (2012) *Philosophy of Science*, 79, 95–119. [2] Miconi T. (2008) *Artificial Life*, 14: 325–344. [3] Berry S. (1997) *J. of Chemical Education*, Vol. 74 No. 8. [4] Peretó J. (2012) *Chem. Soc. Rev.*, 41, 5394–5403. [5] Pross A. and Pascal R. (2013) *Open Biol.*, 20133:120190. [6] Perry R. S. and Kolb V. M. (2004) *Int. J. of Astrobiology*, 3(1): 45–53.