Thoughts without content are empty, intuitions without concepts are blind - determinism and contingency revisited

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Was the emergence of life a predictable outcome of chemical evolution on earth? Could evolution produce life very different from ours? These are one of the oldest questions in the field of the origin of life that not only have broad philosophical implications but also impact how we approach the problem from the methodological standpoint.

Framing the issue in terms of the dichotomy between contingency and determinism is not a fortunate because these two terms in their conventional meaning are neither mutually exclusive nor jointly exhaustive. Determinism, represented in natural sciences by Newtonian physics, relies on the assumption that every event is causally determined by a chain of previous events. In the context of the origin of life it means that once the initial conditions on the early earth have been specified further evolution follows inevitably. Considering uncertainties about conditions on the prebiotic earth, many plausible sets of initial conditions can be defined, each followed by a separate deterministic trajectory. This conventional understanding of determinism does not admit contingency. Further, it has no implications for evaluating how many sets of initial conditions lead to the emergence of life.

It appears that a better framing of the problem is as follows: given plausible sets of initial conditions on the early earth how probable and broadly spread are evolutionary trajectories that lead to life? Instead of undertaking an impossible task of specifying microscopic initial conditions for all components of the system one uses a reduced representation of this system and specify only a small set of essential macroscopic parameters, values (or ranges of values) of which can be identified, inferred or estimated from experiment, theory or historical record. The following evolutionary trajectories are still governed by laws of physics and chemistry but become probabilistic and "contingency" is admitted as variations in other variables in the system. A similar reasoning is common in other fields of science, for example in statistical mechanics. Some trajectories lead to life, perhaps in different forms, whereas others do not. Of our true interest is the ratio of these two outcomes. The issue of determinism does not directly enter the picture.

The debate about the likelihood of the emergence of life is quite old. One view holds that the origin of life is an event governed by chance, and the result of so many random events (contingencies) is unpredictable. This view was eloquently expressed by Monod. In his book "Chance or Necessity" he argued that life was a product of "nature's roulette." In an alternative view, expressed in particular by deDuve and Morowitz, the origin of life is considered a highly probable or even inevitable event (although its details need not be determined in every respect). Only in this sense the origin of life can be considered a "deterministic event".