The Theory of Recursive Abiotic Evolution

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Living things may be considered to be a self-sustaining non-trivial phase transition in state space due to the special nature of their complexity and abilities to replicate and develop in time. However the threshold of complexity is so high[1] it is hard to conceive of a mechanism by which the inorganic to organic or 'living' phase transition[2] occurred on earth ca. 4 billion years ago. Despite this, it is becoming clear that more progress might be made if we consider mechanisms through which life was established, rather than exploring pre-biotic chemistry.[3]

In this regard we hypothesise that cycles of growth and decay, bond making and bond breaking, hot and cold, high and low pH / salt, dissolution and precipitation, are vital in establishing an evolutionary dynamic in absence of the complex machinery responsible for sustaining biological systems. We suggest that these cycles allow the growth, selection, and propagation of a population of non-living entities with complex characteristics that are able to harness resources from the surroundings. The systems that transition to life over time are those populations that can increase, adapt, and persist in a range of environments. This requires not only time, but the development of minimal functions that allow the entities to develop robustness, and therefore can survive in the widest range of environments.

In this contribution we describe a theory that captures the above processes and places tangible limits on the experimental set up to establish a new life form, as well as the describe nature of the constituients in terms of chemical diversity, environment, concentrations and the time required. The overall aim will be to test this theory and use it to emerge a new population that becomes so complex and functional, it is able to interact with itself establishing an evolutionary dynamic. It is thought that such dynamics will lead to the self-sustained evolution programmed by the heterogeneity in the surroundings. Our ultimate aim is to produce complex propagating 'inanimate' things (according to their conventional biochemical contents) that are 'animated' and therefore above the 'living' complexity threshold[1].

References:

1. S. Marshall, L. Cronin, in preparation.
2. C. Scharf, L. Cronin, *Proc. Nat. Acad. Sci, USA*, **2016**, 113, 8127-8132.
3. L. Cronin, S. Walker, *Science*, **2016**, 352, 1174-1175