

ON LIFE'S NATURE AND THE INTRINSIC LIMITS OF SYNTHETIC BIOLOGY

Question of reference: (1) -- **What are the possibilities and the limits of the synthetic study of the origins of life?**

Kepa Ruiz-Mirazo

D. Logic and Philosophy of Science --- Biophysics Unit

University of the Basque Country (UPV/EHU), Basque Country, Spain.

Abstract

The inherent limitations of synthetic biology approaches will be discussed, not only from the 'bottom-up' point of view of origins-of-life-research but, rather, from a more general standpoint, based on a particular conception/definition of the living.

Extended summary

In this contribution some potential limitations to achieve the complete synthesis of living systems will be examined, in particular if the task is approached from a top-down, externally biased, or human-goal-oriented perspective, typical of engineering practices. Almost by definition, synthetic biology pushes the boundaries of life as we know it on planet Earth and, therefore, is bound to generate very important insights for biology and the general problem of the origins of a living domain -- among other potential fields of application. Nevertheless, as we will explain, regardless of the tradition in which current synthetic investigations are rooted (genetic engineering, origins of life, artificial life) or their specific focus and methodology of work (O'Malley et al. 2008), the experimental designs, models or interventions carried out in this field always involve a tension with the characteristic individual organization of life (its self-producing dynamics, implemented in genetically instructed and compartmentalized metabolisms), as well as with its remarkable (Darwinian, open-ended) evolutionary capabilities at the collective/ecological level. Taking as a standpoint a concrete proposal for a universal definition of life, based on the concepts of 'autonomy' and 'open-ended evolution' (Ruiz-Mirazo et al. 2004), and a scheme of prebiotic transitions articulated around them, we will analyze whether --how deeply and in how many ways-- do such concepts entail an authentic challenge for synthetic biology. Actually, we will claim that the inherent difficulties to tackle these two properties constitute much 'harder truths' for synthetic biology than the ones commonly acknowledged (Kwok 2010). According to this view, more carefully expressed and justified in (Ruiz-Mirazo & Moreno 2013), the synthetic strategies that have greater possibilities of being successful in the future imply a *negotiation* with life, not its direct subordination to our goals. That is to say, in order to reconstruct, tame and expand the living domain, we still have to learn much better 'how to play its game'. This is why I consider that synthetic approaches should be mainly directed towards the development of basic biological knowledge and a deeper understanding of what life is and how it came about.

References

Kwok, R. (2010): Five hard truths for synthetic biology. *Nature* 463: 288-290.

O'Malley, M. *et al.* (2008): Knowledge-making distinctions in synthetic biology. *BioEssays* 30: 57-65.

Ruiz-Mirazo, K. & Moreno, A. (2013): Synthetic Biology: challenging life in order to grasp, use or extend it. *Forthcoming in Biological Theory (Springer)*.

Ruiz-Mirazo, K., Peretó, J. & Moreno, A. (2004): A universal definition of life: autonomy and open-ended evolution. *Origins of Life and Evolution of the Biosphere* 34: 323-346.