Propagative and Repulsive constraints in molecular and cellular biology

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Abstract

Theory of organisms (Miquel, Sonnenschein, Soto)
There is an open debate in philosophy of biology today, regarding the characterization of a living organism as an individual. In the neo-varelian approach, a biological individual is not simply defined by its genetic identity, or by its physiological integration. Organisms are autonomous agents constituted by a distinctive regime of causation realized by organisational closure. Closure is defined as a given set of constraints in which each constraint contributes to the maintenance of the others at different time scales. Thus, biological systems will not simply capture, but also produce their own constituents within their environmental niche. Furthermore, they will not only have a physical open structure, but they will also perform biological functions. Organisational closure is not self-maintenance, or self-organisation. A bacterium is not a flame, or a crystal or a simple dissipative structure.

Yet in *Investigations,* Stuart Kauffman proposes a very different definition of autonomy. Autonomous agents are related to specific open biological cycles, through which they are able to construct constraints to propagate organization. We will show two examples of *virtuous* and *vicious* cycles in molecular biology. The first one concerns "evolvability", and the way by which a bacterium under stress conditions is able to reprogram its genome. The second one concerns the degradation of connective tissues in the process of aging.
Thus, our paper challenges the classical neo-varelian approach opposing open thermodynamic flows and closed functional structures. The problem for us is not solved by the distinction between physical flows and biological constraints, since we need to understand how biological constraints disappear or propagate during development, aging and evolution.

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