Self-Organization in Biology: scope and limits

Aix-en-Provence, 24th-25th May 2011

The scientific research on the idea of self-organization in the biological domain comes from a long and rich philosophical tradition, going back at least to Kant, who claimed that biological systems should be understood as “natural purposes” (Naturzwecke), i.e. entities whose parts are reciprocally causes and effects of each other, such that the whole system can be conceived as organized by itself, self-organized.

In recent times, investigations on self-organisation in relation to biological systems were initially undertaken by Cybernetics (and specifically “second” Cybernetics) and then, starting from the 60’, by a number of theoretical and formal models in the field of Theoretical Biology. Since then, the idea of self-organization has been progressively broadened and applied to a wide range of physical and chemical phenomena (as dissipative structures in far-from-equilibrium conditions), contributing to make it a legitimate scientific concept. At present, although there is an increasing agreement in Biology on the fact that self-organization does play a central role in biological phenomena, at different levels, it is also commonly recognized that it cannot capture, alone, the complexity of biological organization.

The general aim of this workshop is to focus on the scope and limits of the idea of self-organization in biological systems, in the light of the more recent scientific advances on this issue. Self-organising and self-assembling processes pervade the biological domain (e.g., autocatalytic networks, protein folding, membrane formation, chemical signalling, various aspects of morphogenesis, patterns of collective behaviour…). Yet, living organisms appear to be *more* than self-organization, given the complexity of its constitutive, interactive, agential and historical/evolutionary dimensions, as well as the distinctive interactions they establish across levels of organization.

The workshop will be resolutely interdisciplinary, and will bring together experts with diverse backgrounds, including philosophy, biology, physics, chemistry complexity sciences and modelling.

Tuesday 24th

09h00 – 9h15: Welcome
09h15 – 9h30: *Introduction: on the explanatory role of self-organization in Biology*
– Matteo Mossio (Universidad del Pais Vasco)

Session 1 – Self-organization: from Physics (and Chemistry) to Biology
Chair: Arantza Etxeberria (Universidad del Pais Vasco)

09h30 – 10h30: *Self-Organization, Biological Function, and the Templeton Foundation*
– Evelyn Fox Keller (Massachusetts Institute of Technology)
10h30 – 11h30: *From Physics to Biology by symmetry breakings*
– Giuseppe Longo & Mael Montevil (Ecole Normale Supérieure)

11h30 – 11h45: Coffee break

11h45 – 12h45: *Recurring processes*
– John Dupré (University of Exeter)

12h45 – 14h30: Lunch

Session 2 – Self-organization and self-assembly in biological systems
Chair: Laura Nuño de la Rosa Garcia (Universidad Complutense & Université Paris 1)

14h30 – 15h30: *Different mechanisms of embryonic development, morphological evolution and the evolution of development*
– Isaac Salazar-Ciudad (Universidad Autonoma de Barcelona)
15h30 – 16h30: *Physical force, self organization, morphogenesis and cancer*
– Ana Soto & Carlos Sonnenschein (Tuft University)

16h30 – 16h45: Coffee break

16h45 – 17h45: **Round Table** (leaded by Jon Umerez, Universidad del Pais Vasco)

Wednesday 25th

Session 3 – Beyond self-organization I: the evolution of complexity
Chair: Franck Grammont (Université de Nice)

09h00 – 10h00: *The evolution of Complexity: The mechanism of Dynamical Decoupling*
– Alvaro Moreno (Universidad del Pais Vasco)
10h00 – 11h00: *From tinkering to design: lessons and open questions*
– Ricard Solé (Universidad Pompeu Fabra)

11H00 – 11h15: Coffee break

11h15 – 12h15: *On the origin of autonomy – a new look at the major transitions in evolution*
– Bernd Rosslenbroich (Universität Witten/Herdecke)

12h15 – 13h45: Lunch

Session 4 – Beyond self-organization II: constitutive and interactive autonomy
Chair: Sandro Vaienti (Université de Provence)

13h45 – 14h45: *Aging landscapes*
– Paul-Antoine Miquel (Université de Nice)
14h45 – 15h45: *Basic autonomy: from self-organization to self-construction*
– Kepa Ruiz-Mirazo (Universidad del Pais Vasco)

15h45 – 16h00: coffee break

16h00 – 17h00: *Somewhere Between Reductionist Obstinacy and Instrumentalist Coyness: Characterizing Biological Levels, Causes and Entities*
– Slobodan Perovic (University of Belgrade)
17h00 – 18h00: *Dynamical criticality in cells*
– Stuart Kauffman (University of Vermont)

18h00 – 19h00: **Round Table** (leaded by Philippe Huneman, IHPST, Université Paris 1)