

Villa Monastero, Varenna (Italy),

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Evolvability: the evolution of evolution

Organisers: Marco Bersanelli, Elio Sindoni, Ard Louis, Charles Harper, Simon Conway Morris

Daniel Dennett famously referred to evolution as a universal “acid”, from which no process was immune. The fact of organic evolution should not blind us, however, to deeper, and perhaps less explored, facets. Darwinian orthodoxy, for instance, not only presupposes random mechanisms, such as mutation, but also random out-comes. So far as the latter is concerned, however, the evidence from evolutionary convergence very much suggests that the end-points are much more constrained than sometimes imagined. So too the Darwinian paradigm is less well equipped to account for the emergence of complex systems. There is indeed a growing suspicion that the evolution itself “learns” how to evolve more effectively. This is enshrined in the concept of evolvability, whereby the existing framework allows organic systems to gear-up, perhaps at an increasing pace.

Evolvability, therefore, re-opens the question as to how organic systems not only work, but display an astonishing robustness to environmental insult. While mechanistic analogies are very widely used in described organic form and function, the reality is that the integration, scaling and self-repair mechanisms are far beyond what our existing technologies can achieve. It would not be surprising, therefore, if biological systems have shown both trends towards optimization, and also the ability to develop procedures that facilitate not only the evolutionary mechanisms themselves, but such features as homeostasis and developmental control. This general field of evolvability is at present relatively ill-defined and open-ended. It is also very wide ranging and cuts across existing boundaries and disciplines. Nevertheless it is very much “in the air” and we feel the time is very opportune to bring together a cross-disciplinary group to explore some of the implications. Amongst the principal themes we suggest the following to be of particular interest:

- How well do we understand gene networks?
- What is the role of stress in evolution?
- What is the significance of developmental plasticity?
- What is the role of co-option?

- To what extent are organisms and their molecular architecture modular?
- What is the significance of genomic stream-lining?
- At what levels does evolvability operate?
- What may evolvability tell us about attempts at directed and engineered evolution?
- To what extent are the processes involved subject to convergent evolution?
- Are concepts of optimization relevant to these concepts?

These areas are of considerable interest not only to biologists (and indeed many other scientists), but also the wider public who follow with keen interest the debates on evolution. In addition, therefore, to inviting a distinguished panel of scientists we also believe it opportune to have as observers a number of scientific journalists and those in related media activity. Given the location it seems sensible to invite some Italian journalists, but the highly successful Journalists Fellowship Programme based in Cambridge would also provide many potential names.

Up to now, the following speakers have accepted our invitation:

Chris Adami, Caltech
 Uri Alon, Weizmann Institute
 Frances Arnold, Caltech,
 Lynn Helena Caporale,
 Michael Deem, Rice U
 Nigel Goldenfeld, UIUC
 Marc Kirschner, Harvard
 Richard Lenski, Michigan State U
 Lakshminarayanan Mahadevan, Harvard
 Amos Maritan, U Padova
 Martin Nowak, Harvard
 Wilson Poon, U of Edinburgh
 Rob Reenan, Brown,
 James Shapiro, U of Chicago
 Sarah Teichmann
 Andreas Wagner, U of New Mexico,
 Günter Wagner, Yale
 William Wimsatt, U. of Chicago

still to be confirmed --

Mary Jane West Eberhard
 Rudy Raff