

**Alessandro Minelli**

**The evolvability of organic forms: possible, likely and unlikely change, from the perspective of evolutionary developmental biology**

According to the Darwinian paradigm, evolution is produced by natural (and sexual) selection among alternative, heritable phenotypes ultimately produced by casual mutations in natural populations. One hundred and fifty years since the publication of Darwin's *Origin of the species*, this is still the conceptual core of the current explanations of biological evolution. However, some aspects of this theory have been inadequately explored until recent, in particular, evolvability, i.e. the probability distribution of the alternative phenotypes towards which existing living organisms are likely to evolve. There are, indeed, apparently forbidden phenotypes, even in the absence of plausible arguments for their potential adaptive disadvantage, while, on the contrary, 'monstrous' phenotypes without any hope of future success are repeatedly generated, often as a consequence of point mutations. Evolutionary developmental biology, or evo-devo, addresses specifically these aspects of disagreement between the generation of forms and their eventual survival, and explains them as the result of developmental constraints on the production of the phenotypes upon which selection will eventually operate. This is of major relevance in discussing macroevolutionary patterns, e.g. Williston's 'law', according to which the evolution of organisms with serially repeated parts would necessarily proceed from ancestors with high numbers of identical parts to descendants with smaller numbers of elements of increasingly higher individuality. This principle is far from representing a true law of nature. Nevertheless, its formulation invites adopting in evolutionary biology a methodological solution that has long proved effective in physics, namely, introducing inertial principles and focussing on the forces that can deviate a biological system from its inertial behaviour. Evolvability does not affect simply the phenotypes; it affects also the rules by which evolution proceeds, hence the categories we can adopt in describing it. No level of organization, including the individual, can be regarded as universal and definitive.