Autonomy and the evolution of systems

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Increasing knowledge in comparative molecular biology produced a huge surprise: where the Synthetic Theory of the 20th century expected the most variation, on the level of genes and their products, there is far-reaching conservation. Many genetic components are old ("conserved") building blocks, which changed little during evolution. Often they are reused in different contexts. However, the same principle also appears on other levels: After the eukaryotic cell for example was invented, it was recruited within endless new contexts in order to build complex organisms like animals, plants and fungi.

If we take the consequences from these recent results a new picture of evolution emerges: Obviously the level, on which innovations appear, shifted during evolution: During early evolution the biochemical processes were generated. Then the eukaryotic cell emerged with innovations on the level of organelles, but with less biochemical innovations. During the generation of multicellularity the level of innovation is that of morphologies. Thus, in animals all basic phyla were invented with new body plans, using the quite uniform type of cell with its also uniform biochemical equipment. Then organs were generated and later organs were only modified and specialized. I propose that a consequent systems view is more appropriate to understand these evolutionary changes than older atomistic views. The main changes occur on different system levels and not only on the genetic level. Epigenetic processes, as they are under discussion in recent years, seem to mediate between the levels. A model will be presented that is able to cover these phenomena and that is suited to be used as an intellectual backbone for future understanding of evolutionary processes.

In this context it is also interesting to have a new look at patterns and processes in evolutionary transitions and at trends in evolution. Concerning these topics largely differing views exist. Many evolutionists are not interested in large scale patterns. For them evolution is a random process, which cannot generate something like patterns or trends. At best they are a by-product of a mainly diversifying evolution and need no further consideration.

In contrast there are scientists who consider patterns and trends as important phenomena. Especially paleontologists recognized trends in comparing sequences of findings from different geological layers. Occasionally there also have been considerations about some general characteristics, some universal features, which might have been generated during the major transitions. At least macroevolution does not look like just a random process. There must be some way to describe what really changed between such early forms of life like bacteria and later forms such as mammals and birds.

In some conceptual research work it has been shown that increases in autonomy and independence from the environment might be most relevant. This work describes that organisms gained in stability, self-regulation and self-assertion especially during the major transitions in evolution, that the direct influences of the environment were gradually reduced and a stabilization of self-referential, intrinsic functions within the systems was generated. In higher animals this includes the potential for more flexible and self-determined behaviors. These changes in autonomy have been reached by changes on different system levels, using building blocks that have been successful in evolution before.

The summary of my hypothesis is: By means of the construction of system levels a variety of functions for autonomy evolved and increased the capacities of self-determination and relative environmental independence of the individual organisms. This is a model that can be tested empirically and is suited to generate many new interesting questions about the organism-environment relations as well as the relations between different system levels and their changes throughout the history of life. It integrates modern empirical knowledge on evolution, physiology, paleontology and so on. Thus it is not in opposition to modern fields of research.