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Discussions

Ecosystem theory of evolution

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Theory of evolution was invoked chiefly to explain such phenomena as discreteness of species, adaptedness and the "scale of nature", i.e. progress of life. Some explanations of these phenomena have been provided in ancient times already but even now they are not fully understood. Among the forerunners and founders of the modern evolutionary theory, Linnaeus has dealt mostly with discreteness, Lamarck with progress and Darwin with adaptedness but further studies have focused primarily on adaptedness seen as a result of natural selection shaping chaotic genetical variation. Moreover, adaptedness was conceived as a goal of the evolutionary process manifested in the ability to survive and multiply.

However even such primitive organisms as blue-green algae have survived for billions of years, in fact much longer than the later appearing groups of more sophisticated organisms most of which they surpass also in their reproductive potentials. What then was the purpose for evolution going beyond the level of procaryotic unicells? Was there purpose at all? Can a deterministic model of evolution be developed or there will be unavoidable acausal components?

With advent of the general system theory we came closer to answering these questions. It occurred that dynamic systems of functionally integrated elements are purposeful, or telic. For example, biotic communities proceed through a number of intermediate stages to a climax stage which is the purpose of the successional process (or sere) while the purpose of a genetic system is an organism essentially similar to its parents. Generally, the goal of a system is the state of minimal entropy production rates while in the living system entropy production rates can be

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equated to the death rates. It is undeniable that primaeval organisms as well as the pioneer stages of biotic communities have higher death rates than the higher organisms and the later successional stages. In principle these considerations solve the problem of evolutionary progress at the same time giving us criteria for assessment of evolutionary innovations. For example, sexual reproduction is progressive as it ameliorates the effect of homozygotically deleterious mutations thus decreasing death rates which are further decreased by perceptiveness, care, learning, forecast abilities, etc. Humans accumulate more such characters than any other species, hence they are superior but their achievements can be seen as a continuation of the trend starting with blue-green algae.

In addition to physical death of individuals there is genetical death of genetic lines and, in higher organisms, cultural death of non-genetically transmitted traits, such as learned behavior. Humans succeeded in creating special superstructure -the cultural world- for conservation of the non-genetical information.

Evolution is not unidirectional, however. Its progressive course is punctuated by environmental crises caused by the concerted geological and climatic perturbation during which the above trend is reversed and the primitive "r-selected" species of the relatively high entropy production rates come to the forth. Biosphere as a whole adjusts itself to new conditions in the litho-, hydro- and atmosphere on which it is superimposed. In the process most of its constituent ecosystems undergo restructuring which affects most of their constituent populations. And while the populations change their adaptive strategies, respective genetic changes are invoked. These causal relationships can be briefly described by means of the following hypothetical models discussed in more detail elsewhere.

Leto-Niobe model is symbolic presentation of the alternative evolutionary strategies: Leto strategy of having less numerous but better equipped offsprings eventually succeeds over the more entropic Niobe strategy.

Rotation model. Changes in the rates of the Earth rotation deform geoid activating the net of global faults. Concentric spheres and lithospheric plates of different densities receive different accelerations causing both strike-slip and slip-over motions in the Earth crust and interior. Hence concerted tectonic, magmatic and magnetic events periodically affecting climate and biota.

Climax cut-off model. Under the global environmental instability described by the rotation model successional processes in various ecosystems could be truncated. If the issuing disclimax lasted for a long time, the climax species could find themselves in a disadvantage and some or many of them could perish. These are mass extinctions of the geological record which are always selective. After crises climax stages could be reestablished while the empty ecological niches of the former climax species were filled by new taxa derived from the surviving successional species. With time the new group could replace also some of the successional species.

Cyclic speciation model. Potential variability of a species is normally constrained by natural selection. Under the conditions described by the climax cut-off model selection pressure decreases due to removal of the most competitive species. In the crisis populations variability, not longer constrained, could increase and even surpass normal intergeneric distinctions. Such macropolymorphic populations could then undergo adaptive radiation giving rise to arrays of new taxa.

Gene use/disuse model. Environmental and behavioral changes affect intercellular genome environments which in turn differentially affect transcriptional activities and replication rates of certain genes. More transcriptionally active and more rapidly replicated genes could lose their repeated elements through underreplication with corresponding changes in their expression during development. Such non-random genetic changes could then be selected at the genomic and organismic levels while random mutations just produced genetic noise.

Summarily these models constitute ecosystem theory of evolution which offers rather complete causation in descending order from biosphere to ecosystems to populations to genomes. In contrast, traditional "synthetic" theory of evolution ascends from chance mutations to occasional speciation events to unrelated ecosystem changes.

Furthermore, the ecosystem theory of evolution seeks to embrace social and cultural aspects of evolution. While biosphere, in contrast to other telic systems, has not yet developed any repair mechanisms capable of ameliorating environmental hazards, modern man can in principle provide such a repair service. This will be a historically justified and noble goal of human existence.

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