Experimental “evolutional machines”: mathematical and experimental modeling of biological evolution

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Experimentalists possess model systems of two major types for study of evolution: continuous cultivation in the chemostat and long-term development in closed laboratory microecosystems with several trophic structure. If evolutionary changes or transfer from one steady state to another in the result of changing qualitative properties of the system take place in such systems, the main characteristics of these evolution steps can be measured. By now this has not been realized from the point of view of methodology, though a lot of data on the work of both types of “evolutionary machines” has been collected. In our experiments with long-term continuous cultivation we used the bacterial strains, containing in plasmids the cloned genes of bioluminescence and green fluorescent protein, which expression level can be easily changed and controlled. In spite of the apparent kinetic diversity of evolutionary transfers in two types of systems, the general mechanisms characterizing the increase of used energy flow by populations of primer producent can be revealed at their study. According to the energy approach, at spontaneous transfer from one steady state to another (e.g. in the process of microevolution, competition or selection), heat dissipation characterizing the rate of entropy growth should increase rather then decrease or maintain steady as usually believed. The results of our observations of experimental evolution require further development of thermodynamic theory of open and closed biological systems and further study of general mechanisms of biological evolution.