Molecular Darwinism

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From the origin of life Darwinian evolution has continuously led to new and different species that make up a highly complex biosphere. Reproduction in conjunction with variation leads to the permanent selection and emergence of new species. How Nature avoids an evolutionary stall and keeps on to innovate remains poorly understood. Many aspects of Darwinian evolution have been described by experimental as well as theoretical approaches. However, a realization of Darwinian evolution on long time scales that does not end up in the selection of a single fittest evolutionary winner is still required. We introduce an experimental system that consists of linear DNA molecules of the same length that are able to reproduce in a template-directed way. Longer molecules appear by spontaneous ligation. A DNA species is formed by DNA strands of a certain length that feed on shorter strands and that eventually outcompete other existing DNA molecules. An evolutionary stall is avoided if these new species in turn serve as a niche that can be exhausted by succeeding mutants. Like this, our molecular evolutionary system is principally able to progress indefinitely.