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Life has Evolved to Evolve[1]

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Concomitant with the evolution of biological diversity must have been the evolution of mechanisms that facilitate evolution, due to the essentially infinite complexity of protein sequence space. We describe how evolvability can be an object of Darwinian selection, emphasizing the collective nature of the process. Rapid or dramatic environmental change leads to selection for greater evolvability. The selective pressure for large scale genetic moves, such as DNA exchange, becomes increasingly strong as the environmental conditions become more uncertain. These results demonstrate that evolvability is a selectable trait and allow for the explanation of a large body of experimental results. Many observations within evolutionary biology, heretofore considered evolutionary happenstance or accidents, are explained by selection for evolvability. As specific examaples, we discuss evolution within the immune system and evolution of drug resistant microrganisims.

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