

Preface: Limited Forms Most Beautiful

In 1859, Charles Darwin concluded his momentous book *On the Origin of Species* by musing on the grandeur of the evolutionary view of life: "from so simple a beginning endless forms most beautiful . . . have been, and are being, evolved" (Darwin 1859, 490). A century and a half after Darwin published those words, many evolutionary biologists are questioning whether the evolution of life actually does produce "endless forms." In fact, in many cases we see that evolution has produced the same form—or a very similar one—over and over again in many independent species lineages, repeatedly, on timescales of hundreds of millions of years.

The phenomenon of convergent evolution has led many of us to suggest that that famous sentence should perhaps be rewritten to read, "from so simple a beginning *limited forms* most beautiful . . . have been, and are being, evolved." The purpose of this book is to reveal to the reader how ubiquitous the phenomenon of convergent evolution is in life and that it occurs on all levels of evolution, from tiny organic molecules to entire ecosystems of species, and even in the way in which we think.

Why does evolution produce limited forms most beautiful? The phenomenon of convergent evolution leads directly to the concept of evolutionary constraint—that is, the number of evolutionary pathways available to life is in fact not endless, but is quite restricted. In the final two chapters of the book, the causes of convergent evolution and the implications of evolutionary constraint will be examined in detail. Those implications are not only of scientific but also of philosophical interest. And those implications all concern, in one way or another, an essential question: How predictable is the evolutionary process?

My fascination with convergent evolution dates back to my first visit, as a small boy, to a natural history museum and zoological garden. I was

astonished to see that the eyes of the deadly pit viper, gazing coldly at me through the glass enclosure of its pen, were identical to the eyes of my beloved black cat back at home. Both animals had eyes with very odd-looking vertical-slit pupils and irises of a beautiful gold color. How could it be that this deadly snake, a cold-blooded scaly reptile so vastly different from a warm, furry mammal, had eyes like a cat? In my later university studies I began to realize that the number of evolutionary possibilities was not endless, and that there was a very good reason why the eyes of a predatory snake and a predatory mammal are so similar. By the end of this book, I hope the reader will also share my fascination with an evolutionary process that produces limited forms most beautiful.

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