

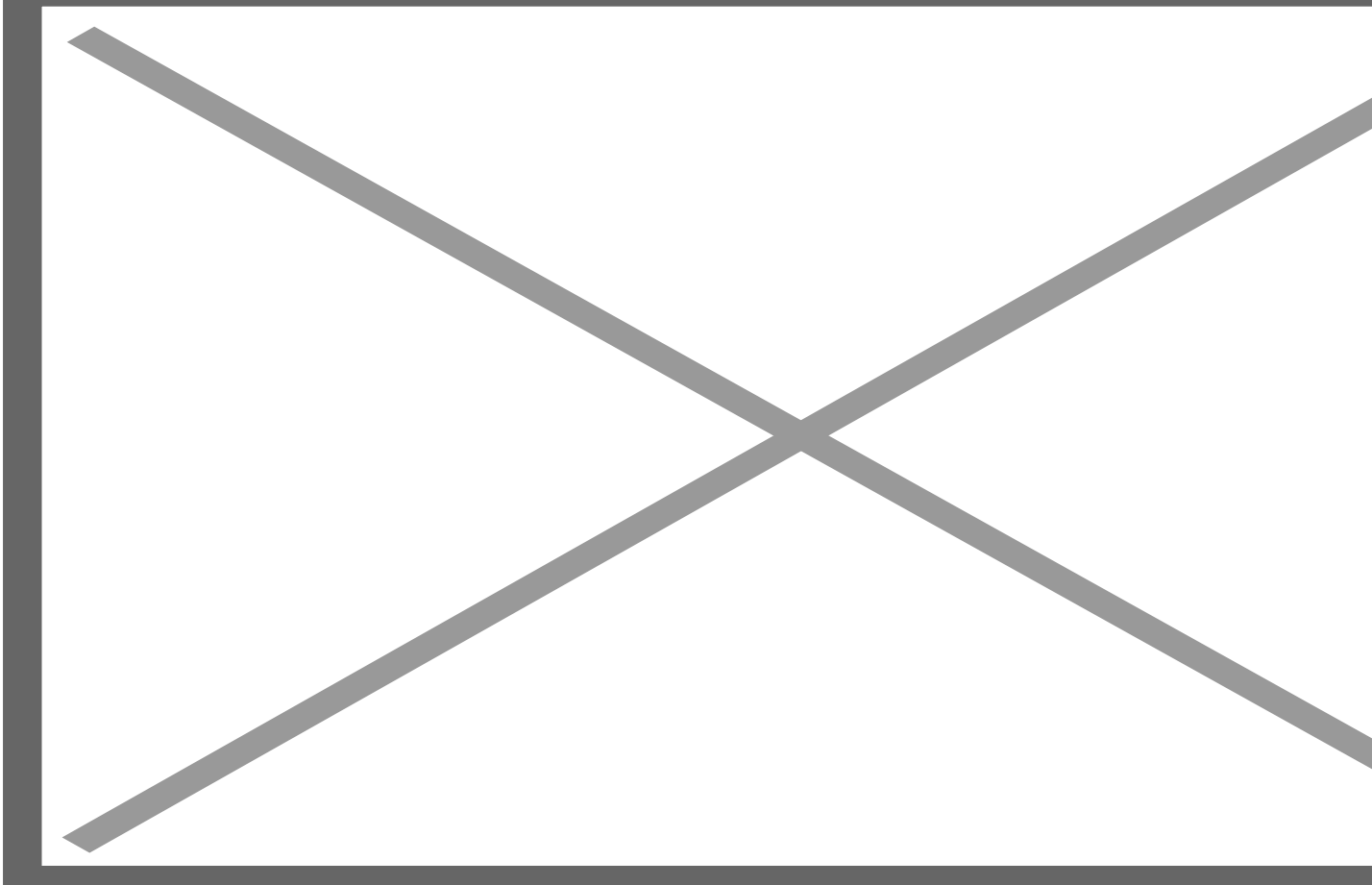
‘We humans might never have evolved’: Chance is the central narrative of human evolution

Prince Hamlet spent a lot of time pondering the nature of chance and probability in William Shakespeare’s tragedy. In the famous “To be or not to be” speech, he notes that we helplessly face “the slings and arrows of outrageous fortune” — though a little earlier in the play he declares that “there’s a special providence in the fall of a sparrow,” suggesting that everything happens because God wills it to be so.

We can hardly fault the prince for holding two seemingly contradictory views about the nature of chance; after all, it is a puzzle that has vexed humankind through the ages. Why are we here? Or to give the question a slightly more modern spin, what sequence of events brought us here, and can we imagine a world in which we didn’t arrive on the scene at all?

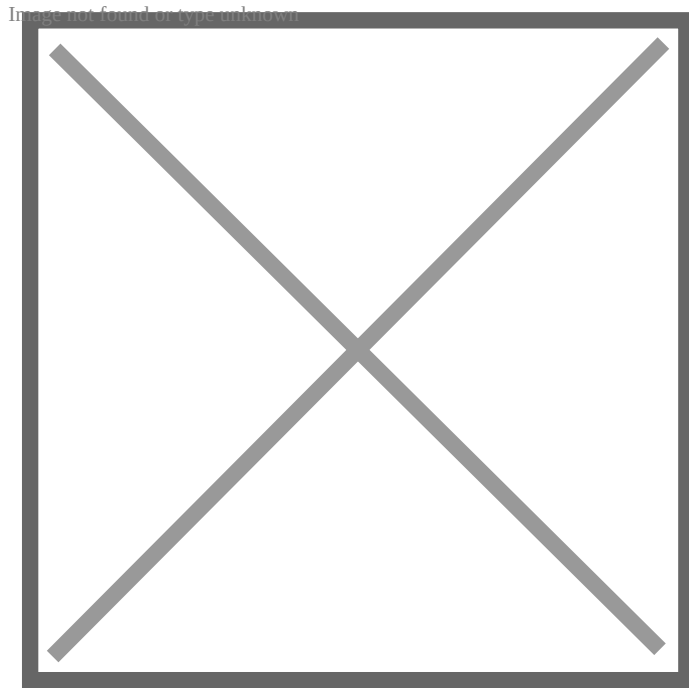
It is to biologist Sean B. Carroll’s credit that he’s found a way of taking a puzzle that could easily fill volumes (and probably *has* filled volumes), and presenting it to us in a slim, non-technical, and fun little book, [“A Series of Fortunate Events: Chance and the Making of the Planet, Life, and You.”](#)

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Credit: Sean B. Carroll

Carroll (not to be confused with physicist and writer Sean M. Carroll) gets the ball rolling with an introduction to the key concepts in probability and game theory, but quickly moves on to the issue at the heart of the book: the role of chance in evolution. Here we meet a key historical figure, the 20th-century French biochemist Jacques Monod, who won a Nobel Prize for his work on genetics. Monod understood that genetic mutations play a critical role in evolution, and he was struck by the random nature of those mutations.



Jacques Monod. Credit: Corbis

Carroll quotes Monod: “Pure chance, absolutely free and blind, at the very root of the stupendous edifice of evolution: This central concept of modern biology is no longer one among other possible or even conceivable hypotheses. It is today the *sole* conceivable hypothesis, the only one that squares with observed and tested fact.”

“There is no scientific concept, in any of the sciences,” Monod concludes, “more destructive of anthropocentrism than this one.”

From there, it’s a short step to the realization that we humans might never have evolved in the first place. As Monod put it, “Man was the product of an incalculable number of fortuitous events.” For those who still believed that God was in charge, micromanaging the events of the universe, this came as a heavy blow. Carroll quotes an American theologian, R.C. Sproul, who wrote that “The mere existence of chance is enough to rip God from his cosmic throne.” If we accept that chance plays any role at all, “it leaves God not only out of date, but out of a job.”

But genetic mutations are just one kind of random happening; there are plenty of others that nature sends our way. Take asteroids: Usually they circle the sun harmlessly between the orbits of Mars and Jupiter — but occasionally one of them slams into Earth. That's what happened at the end of the Cretaceous period, killing off the dinosaurs and paving the way for the rise of small furry mammals — some of whom were our great-great-great (add some more greats) grandparents.

The asteroid story has been told many times, but Carroll adds another, less-often-discussed angle: The asteroid happened to strike the Earth at just the “right” spot: an area on Mexico's Yucatan peninsula rich in hydrocarbons and sulfur, so that the impact ejected enormous amounts of soot and sunlight-deflecting aerosols into the atmosphere. Carroll does the math: Given the Earth's rotation speed, he notes that had the object struck 30 minutes earlier or 30 minutes later it would have hit the Atlantic or the Pacific Ocean; still a colossal blast, but not the sort that would have necessarily given the mammals an edge over the dinosaurs. (What-ifs of this sort are entertaining but perhaps a bit arbitrary; for example, why focus on the Earth's rotation rather than its orbital motion — or the myriad of other factors that had to be “just so” for the impact to happen where and when it did?)

The slings and arrows continued post-asteroid; organisms continued to evolve, their destinies shaped by genes, environment, and natural selection. Carroll explains in some detail how Darwin's theory took shape, and how it challenged the prevailing worldview in which different species were assumed to be created individually by God. In this new picture, there is no guiding hand; events simply unfold according to the laws of nature. Carroll sums it up: “Look around you at all the beauty, complexity, and variety of life. We live in a world of mistakes, governed by chance.”

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But if chance rules the day, how do complex organisms arise at all? This is the tricky part, and we now understand much better than Darwin how genetic mutation and natural selection work together in a kind of stepwise, cumulative process — what Carroll calls “the staircase of evolution.” (Carroll is hardly the first to describe these processes; Richard Dawkins, for example, devotes much of his 1996 book, “Climbing Mount Improbable,” to the question of how evolution yields complexity.)

There is a fair bit of microbiology here — Carroll is interested in the nuts and bolts of mutation — but the historical details are what stuck with me. Like the Russian biologist Ilia Ivanov, who, in a project funded by the Soviet Communist Party, tried to create a human-chimpanzee hybrid (a “humanzee”). (The Communists were eager to show that religion was obsolete, and that the universe is merely matter interacting with matter, all the way down.) The Pasteur Institute in Paris backed the project, too. Ivanov eventually managed to inseminate three chimps with human sperm, but they did not become pregnant.

So humans and chimpanzees aren't quite as close as Ivanov imagined, but they are still very close — close enough that viruses that infect one species often jump to the other. Take HIV, the virus that causes AIDS. Carroll explains how a single mutation in the simian immunodeficiency virus (SIV) allowed it to

make the jump from chimps into humans — ultimately killing more than 32 million people. Chance events brought us here, but chance events can also kill us. A chapter on cancer follows, with a detailed exploration of how cancer's effects involve a mix of genetic and environmental factors — and, once again, luck.

If the book has a central message, it is that we should thank our lucky stars that we are here at all. But instead of veering into philosophy, Carroll chooses levity; his final section is a cleverly staged imaginary conversation between Monod, Albert Camus, Kurt Vonnegut, and no less than six comedians — with himself as moderator. And while he gives himself the last word, I'll end with what Ricky Gervais says just beforehand, on the question of why we are here: "We're not special, we're just lucky," he says "We didn't exist for 14 and a half billion years. Then we got 80 or 90 years if we're lucky, and then we'll never exist again. So we should make the most of it."

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[Find "A Series of Fortunate Events: Chance and the Making of the Planet, Life, and You" here.](#)
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