

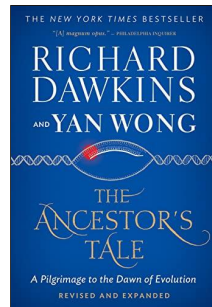


# The Providential Arrival of Our Species

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It was the great theoretical biologist, Stuart Kaufmann who, prior to Steven Jay Gould and his famous book, *Wonderful Life*, first proposed the thought-experiment of replaying the history of life “myriad times” to see what properties of life would emerge repeatedly.<sup>1</sup> Although it will always only be a thought-experiment, it is certainly meaningful to consider it carefully as it relates to the emergence of humans. In fact, there are “natural” experiments that really did take place and speak clearly to the likelihood of the arrival of humans.<sup>2</sup>



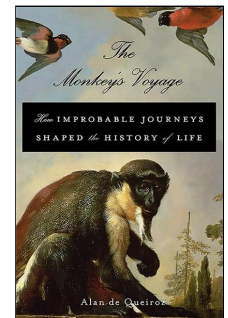
An image of monkeys riding a raft on the ocean, created in a modern and engaging style. By Midjourney.

million years old.<sup>3</sup> The fact that those early fossils bear distinctive structural features also found in African monkey fossils of about the same age implies they had a common ancestor—an early African species. (There were no monkeys in the new world prior to this.)

If they are each derived from a single African population, how did the two groups become separated? Although it is true that Africa was physically joined to South America in ancient history, the continental split and subsequent drift took place 100 million years ago—tens of millions of years before the branch point in the monkey lineage. So how did they get to the new world?

Investigators believe that there was a period of massive climate instability about 35 million years ago which included extreme precipitation events and unprecedented flooding of major rivers.

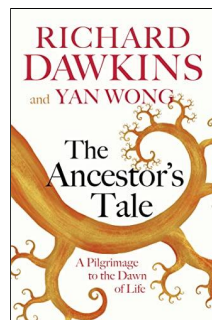
“Small islands” of vegetation and accompanying ground matter would have broken free and retained some degree of integrity as it floated down river eventually begin swept into the ocean and then drifting in currents for a couple of weeks before eventually arriving on the shore of South America. The early African monkeys were tiny (about two pounds). Once that happened, the rest is history: the next 30 to 35 million years became an interesting experiment in evolutionary biology. What took place in that lineage over that vast landscape with its millions of square miles of widely diverse habitats and roughly ten million generations? The lineage gave rise to more monkey species—lots of them—but it never gave rise to anything remotely resembling the ape or hominin lineage. In Africa, on the other hand, monkeys gave rise to a wide range of old-world monkey species (including seventy-eight alive today), all the great ape species that have ever lived, and all the dozens of hominin species—including us. In South, Central, and North America, the same lineage only gave rise to more monkeys. Apparently, even starting off with a similar “seed species” and providing it with similar environments to those which would have existed in Africa was not enough to give rise to anything that resembles the ape lineage. The whole ape lineage, including hominins, never developed in the new world despite tens of million years and vast tracks of varied habitat. Humans (or something like them) are not inevitable—at least not over 30 to 35 million years.



## What Did Not Happen

### Experiment #1: New World Monkeys

First, consider the lineages of old and new world monkeys which have been going their separate ways for about 35 to 38 million years. Today, there are 124 species of new world monkeys, each with distinctive properties such as a flat nose, nostrils that point to the side, and frequently a long prehensile tail that can be a sort of fifth limb used for swinging through the trees. Old world monkeys, on the other hand, have a narrower snout and nostrils that point down. Many have only a short tail or no tail at all. The earliest fossils of monkeys in the new world are about 30



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1. Kauffman, Stuart, 1985, “Self-organization, selective adaptation, and its limits,” in *Evolution at a Crossroads* (Depew, D J. and Web, B. H. eds.) pp 169-207 MIT Press, cited in Dawkins, 2003 *Ancestors Tale*, 2003, page 583, Houghton Mifflin.
2. Several of the “experiments” described below are derived from the 2014 book, *The Monkey's Voyage: How Improbable Journeys Shaped the History of Life*, by Alan de Queiroz.

3. Campbell et al, 2021. “An Early Oligocene age for the oldest known monkeys and rodents of South America.” *PNAS* 118:37: e2105956118.

So that is Experiment #1.

## Experiment #2. Australian Marsupials.

Consider the following second “experiment.” Just as continental drift led to the breakup of Africa and South America 100 million years ago, similarly Australia separated from South America about 60 million years ago. Early mammals were “on board” and over the coming millennia, the progeny of those mammals—a group of non-placental mammals—went on to become the mammalian lineage in Australia. So, this is another test-run of Kauffman’s thought-experiment. Remember, 60 million years is a long time! What emerged from that 60 million-year-long “test run” on this island continent? Nothing like humans, apes, monkeys or even a new placental mammal body plan ever appeared there—only more mammals with pouches as well as a small number of egg-laying species, each beautifully adapted in highly specific ways to all sorts of habitats.<sup>4</sup>

## Experiment #3: New Zealand Birds and Reptiles

Evolutionary Experiment #3 took place on the land mass we now call New Zealand. New Zealand broke away from the large supercontinent even earlier than Australia—about 80 million years ago. It carried no mammals at the time of its breakaway and no mammals ever arrived on a breakaway floating island generated by massive river-flooding. So, the only large animals that ever lived on New Zealand’s land mass were birds and reptiles. Over a period of 80 million years and a geographical area of 100,000 square miles with a vast array of different climate and ecological niches, nothing with the mammalian body plan ever arose there and certainly nothing like monkeys, apes, or humans.

## Experiment #4: The Lemurs of Madagascar

Madagascar provides more data to consider (Experiment #4). With a land area over twice that of New Zealand, it separated from Africa about 130 million years ago and from India close to 80 million years ago. Around 54 million years ago a small number of lemurs made it across the 250 miles from Africa (likely on a “floating island” event) to land in Madagascar. Lemurs are primates like us, and we would have shared a common ancestor with them about 60 million years ago. In Madagascar, lemur evolution thrived and eventually gave rise to over 100 different species of lemurs. Despite 54 million years and a very substantial tropical land area with diverse ecosystems and a primate ancestral species, this experiment also yielded no monkeys, apes, or hominins.

## Experiment #5. The Primates of Europe and Asia

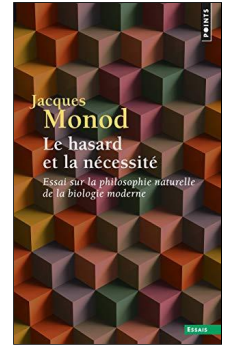
Even in Asia and Europe with their vast land area and with plenty of primates present throughout the past 60 to 65 million years nothing like the ape lineage ever got started there (Experiment #5). Africa was an “island continent” disconnected from Asia and Europe until about 24 million years ago. After the connection (likely by 16 million years ago) some monkeys and apes migrated out of Africa into the continent to their north.<sup>5</sup> Many new species of monkeys and apes

4. The platypus and spiny anteater have traits that are derived from an even more ancient form of mammal. All other Australian mammals are marsupials and have pouches, except bats. Australian bat species of course are an exception, which given their wings, proves the rule.

arose from these immigrants, and all of those existing there today can be traced back to that connection event.<sup>6</sup> But the point is that none of the primates that inhabited Europe and Asia for the 40 million or so years before the connection was established are ancestors of today’s monkeys and apes. So, despite that vast span of time and a land mass with diverse habitats covering almost fifty percent of the earth, no lineage like that in Africa emerged.

## Summary of “What Did Not Happen”

So, I think Stuart Kauffman’s notion of replaying the history of life need not be just a “thought-experiment”. Because of the geographical separation of land masses for millions and millions of years, we really do have an opportunity to get a glimpse of what would happen if we were to (in the words of Stephen Jay Gould) “play the tape again.” Humans are by no means an inevitable product of the evolutionary process. What appears in each replay is a rich assortment of other animals filling the vast array of ecological niches. But nothing even close to the trajectory that could lead to something like us with our cooperative mindset—with that “joint intentionality” I described in a previous *Peaceful Science* post<sup>7</sup>—has arisen despite tens of millions of years of independent opportunities and on land masses which stretched over 50 million square miles.



## What Did Happen

In 1970, Jacques Monod, a pioneer in molecular genetics wrote, “Pure chance, absolutely free but 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.”<sup>8</sup> Fifty years later, Sean B. Carroll, one of biology’s most respected writers today, wrote approvingly of Monod’s words and then added a bit of an update:

The domain of chance has expanded into realms [no one ever] imagined. As we have learned much more about the history and workings of the planet, we have been startled to discover how the course of life has been buffeted by a variety of cosmological and geological accidents—without which we would not be here.<sup>9</sup>

5. Since the time of the migration is so close to the actual origin of the apes, some investigators think that the fossil evidence (currently quite sparse) may eventually show that apes originated in Europe, and that it was a transitional form that migrated up and crossed the connection into Euro-Asia from Africa. (If so, there would have to have been a later back-migration from Europe into Africa.)

6. Almécija et al, 2021. “Fossil Apes and Human Evolution.” *Science* 372:587

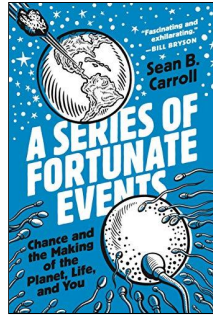
7. See my previous *Peaceful Science* article

8. Monod, Jacques, 1970, *Chance and Necessity*, cited in Carroll, Sean B. 2020, *A Series of Fortunate Events: Chance and the Making of the Planet, Life, and You*, Princeton University Press, p. 8.

9. Carroll, Sean B., 2020, *op. cit.* p. 10.

## From Space to Earth: The Improbable Rise of Mammals

He then goes on to describe the adaptive radiation of mammalian diversity that began to flourish 65 million years ago with the end of the dinosaur era. Although mammals had been present for about 100 million years prior to the extinction of dinosaurs, the explosive radiation of mammalian diversity did not occur until immediately after the event.<sup>10</sup> It is now well established that the dinosaur extinction was caused by the arrival of a six-mile-wide asteroid travelling about 50,000 miles per hour as it hit earth, creating the most powerful earthquake of all time. An event of this magnitude was almost a singularity: for *at least* the preceding 500 million years (and possibly much longer) nothing like this had happened. The crater has been found at the bottom of what is now ocean off the coast of the Yucatan Peninsula in Mexico; the iridium it carried with it in high abundance has been identified as a distinct layer in the earth's rocks at the expected time, and a layer of minerals formed only through high impact are distinctively distributed in the same layer. The impact triggered a cataclysm of volcanic eruptions, wildfires, tsunamis, acid rain, and sunlight-blocking dust. It is now clear that the dinosaur lineage, especially that of herbivorous dinosaurs was amid an ecological crisis that created much instability in the food web immediately before the asteroid's arrival.<sup>11</sup> Both events—together exceedingly improbable—provided the opening needed for the mammalian radiation that soon took over the planet. However even at that, a recent study has shown that the particular site of the catastrophic crash was fortuitous. Geologists estimate that only between one and thirteen percent of the earth's surface has rocks rich enough in hydrocarbons and sulfur to send a comparable amount of destructive material into the atmosphere. Given the speed of the earth's rotation (1000 miles per hour), they estimate that if the asteroid had arrived 30 minutes earlier it would have crashed into the Atlantic Ocean and done much less damage. If it had arrived 30 minutes later, it would have crashed in the Pacific also causing much less harm. In other words, 30 minutes either way and the dinosaurs would still be here, and we would not.<sup>12</sup>



Tropical or sub-tropical forest covered much of the earth. Indeed, Antarctica itself was a lush sub-tropical forest. All of this was due to a very high carbon dioxide level (1400 parts per million) compared to today's 415 parts per million. Then, suddenly (in geo-chronological time), the carbon dioxide level fell in half and with the global cooling that resulted, the mean surface temperature dropped more than 10F by 34 million years ago. The temperature continued to plummet until 2 million years ago. There were times (during ice ages) when the mean surface temperature was only 50 F. Although there are many factors that were influencing this shift, the main one responsible for the overall decline is understood. I mention it because if this had not happened the earth would likely have stayed very hot, bearing little resemblance to the sorts of habitats that gave rise to our lineage.

What was that major factor? The earth's surface consists of a set of about a dozen tectonic plates that slowly ride like rafts over the semi-liquid layer of magma and molten rock below. They each move very slowly—only a few centimeters per year, with one exception. Forty miles thinner than any of the other plates, the Indian plate is an anomaly. As a result, it moves more than five times faster than any of the others—about 18-20 cm per year. This might seem insignificant, but its consequences for earth's biosphere are gigantic. Sixty-five million years ago, the Indian plate was about 1500 miles southwest of where it is today, just off the eastern coast of southern Africa and a little south of Madagascar. It traveled northeast at its "rapid" speed, "crashing" into the Asian continent about 40 million years ago. The "crash" created the upthrust which we know today as the Himalayan Mountains and the Tibetan Plateau. The result of this upthrust was the exposure of a vast amount of previously submerged rock, which was now subject to the forces of erosion. This is not a geology article, so I won't go through the details, but this set in motion a series of geochemical events which "sucked up" vast amounts of carbon dioxide from the atmosphere. So, it was this event and all its subsequent consequences that drastically cut the atmospheric carbon dioxide level and resulted in the concomitant severe drop in temperature (global cooling). If the Indian plate had behaved like all the other plates gliding over the earth's surface and moved at the normal speed, it would not yet have reached Asia; the Himalayas would not yet exist; the carbon dioxide levels would still be sky high; and the earth would still be a hot house. The ecosystems on earth would have been distributed in a totally different way and many would not even exist. If this collision had not taken place, Carroll writes, "The world's climate would certainly not have changed in the way it did, and the story of life would have been much different." Carroll then goes on to describe the continued changes in climate, including especially the ice age (a once-in-300 million years event) and how the subsequent changes in climate were of fundamental significance in shaping the direction that our specific lineage took. "We were born, then," he concludes, "out of a rare ice age set in motion by a long-ago geological accident and forged by one of the most unstable and unpredictable climate cycles any mammal has encountered—a series of fortunate geological events."

## From Africa to Asia: The Improbable Collision

In Sean Carroll's book he describes a second significant event which had a massive effect in shaping the biota on earth. The development of new techniques has enabled the tracking of climate change and carbon dioxide levels in meticulous detail over this time span. For the first 15 million years after the asteroid struck, the mean temperature on earth was about 82F on average compared to 57F of today.

10. dos Reis, Mario et al, 2012. "Phylogenomic datasets provide both precision and accuracy in estimating the timescale of placental mammal phylogeny." *Proc. R. Soc. B* 279: 3491-3500.

11. Brusatte, Stephen L, 2015. "What Killed the Dinosaurs?" *Scientific American* 313:6.

12. Carroll, Sean B., 2020, *op. cit.* p. 32. Much more could be said about the reasons why dinosaurs went extinct, but not mammals. Carroll provides an excellent discussion of this on pages 26-30. Especially pertinent is his discussion of the susceptibility of large land animals to the toxic effects and climate change. Burrowing animals (like mammals) and those which spent a significant part of their lives in water (like frogs, crocodiles, turtles, and sea birds) were more likely to make it through the disaster.

## From Asia to Africa: The Improbable Rafting Journey

The origin of the anthropoid lineage (monkeys, apes, and hominins) in Africa got its start with an extremely unlikely event in its own right: the journey of a few individuals of an ancestral species from Asia to Africa across a large ancient body of water to which I referred earlier—the Tethys Sea. At the time, about 40 million years ago, the

super-continent was still breaking up and the Tethys Sea separated Asia and Africa. Fossil remains of ancient Anthropoids have been found in North Africa, but the lineage leading to these Anthropoids is thousands of miles away in Asia. The prevailing hypothesis today is that the climate instability associated with the collision of the Indian sub-continent and the formation of the Himalayan Mountains resulted in periods of very high precipitation and the massive flooding of rivers. As one reviewer writes, “These predominantly southwesterly Asian drainages were optimally oriented to discharge floating islands on a course appropriate for the Afro-Arabian continent.”<sup>13</sup> The anthropoids were small then (less than two pounds), so it is not difficult to imagine them on a huge chunk of land as it breaks away through the force of a roaring river and is carried out to sea. Since there are also a couple of Asian-derived rodent lineages that appear in the African fossil record at about the same time, it is likely that the Anthropoids were not the only small mammals to make the journey. The rafting on those floating vegetation islands is called “sweepstakes dispersal.” And this phenomenon of floating islands likely contributed to the fauna of Africa only a few times over those millions of years. One (and only one) of those floating vegetation “rafts” carried our earliest anthropoid ancestors. The descendants of those few individuals who arrived began to flourish in Africa. Indeed, they are the ancestors of all species of monkeys and apes alive today. And, of course, they are our ancestors too. Meanwhile, the anthropoid lineage of all their cousin species back in Asia, died out. What that means, based on the scientific data we have, is that if it hadn’t been for the survival of those few anthropoids on that one journey to the shores of North Africa, we, along with all monkey and ape species alive today, would never have come into existence.<sup>14</sup>

reliable source of information about the origin of our species than science. He quotes from comments made by comedian Ricky Gervais about the origin of our species:

Why are we here? Well, we just happened to be here, we couldn’t choose it. We’re not special, we’re just lucky; and this is a holiday. 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.<sup>15</sup>

Following that quote, Carroll ends his book with these words about purpose and meaning in life given that the coming into the existence of our species is merely the equivalent of holding the one-chance-in-a-million-winning-lottery-ticket. He writes: “Tell the truth, treat others kindly, create and for God’s sake laugh.” As much as I love Sean Carroll as a writer who eloquently describes the exquisite beauty of living systems—I think he has dismissed other sources that inform us about reality too quickly. This notion that natural selection—if given many, many chances at a rerun—would almost certainly not produce anything like us may well be among the most theologically significant findings<sup>16</sup> emerging from the sciences today. Theology tells us we are *not* here by accident! There are very good reasons to believe that Jesus Christ rose from the dead and if so that changes everything. With that in mind, I think we can suggest a slight change to the final words of his book: Tell the truth, treat others kindly, create, and laugh out of pure joy because you have been created to participate in the life of the One who created you. The origin of our species is grounded—not in luck—but in the providence of God.<sup>17</sup>

## Luck or Providence?

As his book draws to a close, Carroll, takes his worldview to its naturalistic conclusion, assuming, as he does, that there is no other

15. Carroll, *op. cit.*, 178.

16. Note that I said, *theologically* important. I am not equating this with a scientific conclusion about the existence of a creator, but that’s another topic for another day.

17. I discuss what I think we can (and cannot) say, scientifically and theologically, about that providence in *On The (Divine) Origin of Our Species*, which is in press at Cascade Books and due out later this year.

13. Beard, K.C., 2016. “[Out of Asia: Anthropoid origins and the colonization of Africa.](#)” *Annual Review of Anthropology*, 45, p. 207.

14. For the technical details of this story see Beard, *op. cit.*

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