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# A HUNTER-GATHERER'S GUIDE TO THE 21ST CENTURY

## EVOLUTION AND THE CHALLENGES OF MODERN LIFE

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# Introduction

**IN 1994, WE SPENT OUR FIRST SUMMER IN GRADUATE SCHOOL AT A TINY** field station in the Sarapiquí region of Costa Rica. Heather was studying dart-poison frogs; Bret homed in on tent-making bats. Every morning we did fieldwork in the rain forest, where it was green and lush and dark.

We remember a particular afternoon in July. A pair of macaws flew overhead, silhouetted against the sky. The river was cool and clear, and trees full of orchids crowded the bank. It was a perfect antidote to the sweat and heat of the day. On beautiful afternoons like this one, we would walk across the paved road that went all the way to the capital, onto a smaller dirt road, and cross a steel bridge that spanned the Río Sarapiquí, to take a swim at the beach below.

We paused on the bridge to admire the view: the river wending its way between walls of forest, a toucan flying between trees, the distant calls of howler monkeys. A local man whom we did not know approached and began talking to us.

"You are going to swim?" he asked, pointing at the sandy bank where we were headed.

"Yes."

"Today there was rain in the mountains," he said, pointing to the south. The river's source was in those mountains, in the cordillera. We nodded. Earlier, we had seen the thunderclouds above the mountains from the field station. "Today there was rain in the mountains," he said again.

"But no rain here," one of us said, laughing lightly, not knowing how

to make small talk in a language we weren't fluent in, while standing on a bridge, eager to swim.

"Today there was rain in the mountains," he said a third time, more emphatically. We looked at each other. Perhaps it was time to take our leave, to walk down to the river and get in the water. The sun was now directly on us. It was desperately hot.

"Okay, see you later," we said, waving, moving on. We were barely fifty feet from getting in the water.

"But the river," the man said to us, now with some urgency.

"Yes?" we asked him, confused.

"Look at the river," he said, pointing. We looked down. It looked like the river always did. Running fast and clean, smooth and . . .

"Wait," said Bret. "Is that a whirlpool? That wasn't there before." We looked at the man again, questions in our eyes. He pointed again to the south.

"Today there was a *lot* of rain in the mountains." He moved his focus back to the river. "Look at the water now."

In the moments we had been looking away, the water had come up visibly. It was moving chaotically, roiling. It had changed color, too—from dark and calm, it had become pale and filled with silt. In short order, it was filled with more than that.

The three of us stood transfixed, as the river rose spectacularly, many feet in just a few minutes. The beach disappeared under a huge volume of rushing water. Anyone on it would have been swept away. Debris, including several logs, began to hurtle past. Anything that hit that new whirlpool disappeared, then shot back up beyond the bridge.

The man turned around and began to walk off the way that he had come. He was a campesino, a farmer, but we didn't know where he was from, or how he knew that we were there, about to descend to what could easily have been our deaths.

"Wait," Bret called, then realized that we had nothing to offer him but gratitude. We literally had nothing on us but our clothes. "Thank you," we said. "Thank you so much." And Bret took off his shirt and gave it to the man.

"Really?" the man asked, as Bret held out his shirt.

"Really," Bret confirmed.

"Thank you," he said, accepting the shirt. "Good luck. And remember to think about the rain in the mountains." With that, he left.

We had been living by that river for a month, swimming in it nearly every day, sometimes alongside local people. Suddenly, we felt like strangers. We'd mistaken our few experiences swimming in the river for the wisdom of actually knowing a place. How could we have been so wrong?

At no other time in history has it been possible to think that you are a local but to be so lacking the deep knowledge of a place that keeps you safe during rare events. We moderns struggle to grasp this gap in our knowledge for many reasons. For starters, we no longer rely on tight-knit communities or a deep understanding of local terrain like humans did until recently. Given how easy it is to move from place to place with relative ease, many people tend not to stay in one locale for long at all. The facts of our individualistic lifestyles and transience tend never to strike us as odd, simply because we've neither seen nor can imagine an alternative to the world we live in right now: one where abundance and choice are ubiquitous, we rely on global systems too complex to understand, and everyone feels safe.

Until they don't.

The truth is, safety too often proves to be a facade: products on supermarket shelves turn out to be dangerous; a frightening diagnosis reveals weaknesses in a health-care system too focused on symptoms and profits; an economic downturn stresses a disintegrating social safety net; legitimate concerns about injustice become excuses for violence and anarchy while civic leaders offer pablum rather than solutions.

The problems that we face today are both more complex and simpler than experts make them seem. Depending on whom you've asked, you may have heard that we are living in the best, most prosperous time in human history. You may have also heard that we are living through the worst and most dangerous time. You may not know which side to believe. What you do know is that you can't seem to keep up.

Over the past few hundred years, developments in technology, medicine, education, and so much more have accelerated the rate at which we

are exposed to change in our environments—including our geographic, social, and interpersonal environments. Some of this change has been wildly positive, but hardly all, and other changes appear positive but have consequences so devastating that, once discovered, we struggle even to conceptualize them. All of this has encouraged the postindustrial, high-tech, progress-oriented culture we live in now. This culture, we propose, partially explains our collective troubles, from political unrest to widespread failing health and broken social systems.

The best, most all-encompassing way to describe our world is **hypernovel**. As we will show throughout the book, humans are extraordinarily well adapted to, and equipped for, change. But the rate of change itself is so rapid now that our brains, bodies, and social systems are perpetually out of sync. For millions of years we lived among friends and extended family, but today many people don't even know their neighbors' names. Some of the most fundamental truths—like the fact of two sexes—are increasingly dismissed as lies. The cognitive dissonance spawned by trying to live in a society that is changing faster than we can accommodate is turning us into people who cannot fend for ourselves.

Simply put, it's killing us.

In part, this book is about generalizing this message to all aspects of our lives: when it rains in the mountains, stay out of the river.

Many people have attempted to explain the cultural dissolution we face, but most have failed to provide a holistic explanation that not only examines our present, but also looks back into our past—our whole past—and into the future. We are evolutionary biologists who have done empirical work on sexual selection and the evolution of sociality, and theoretical work on the evolution of trade-offs, senescence, and morality. We are also married to each other, have a family together, and have often been side by side while exploring many parts of the globe. Well over a decade ago, when we were still college professors, we began formulating the idea for this book. We stood on the shoulders of giants—our mentors and senior colleagues, as well as many intellectual ancestors whom we never met—but

were also building curriculum that was unlike any that came before. We forged new paths, and posited new explanations for patterns, both old and new. We came to know our undergraduate students well, and as they engaged our curricula, they asked questions across domains: What should I be eating? Why is dating so difficult? How do we create a more just and free society? The common threads throughout these conversations—in classrooms and labs, in jungles and around campfires—were logic, evolution, and science.

Science is a method that oscillates between induction and deduction—we observe patterns, propose explanations, and test them to see how well they predict things we do not yet know. We thus generate models of the world that, when we do the scientific work correctly, achieve three things: they *predict more* than what came before, *assume less*, and come to *fit with one another*, merging into a seamless whole.

Ultimately, in this book and with these models, we seek a single, consistent explanation of the observable universe that has no gaps, takes nothing on faith, and rigorously describes every pattern at every scale. This goal almost certainly cannot be attained, but there is every indication that it can be approached. Though we may glimpse this end point from our modern perch, we are a long way from reaching the limits of what can be known.

That said, we are much closer to the goal in some areas than in others. In physics we seem tantalizingly near a "theory of everything,"[1] which really means a complete model of the least complex, most fundamental layer of explanation. As we move up in complexity, things become less and less predictable. Near the top of the stack we reach biology, where processes inside even the simplest living cells are nowhere near fully understood. Things only get more complex from there. As cells begin to function in coordinated ways, becoming organisms made up of distinct tissues, the degree of mystery compounds. The unpredictability jumps again in animals, governed by sophisticated neurological feedbacks that themselves investigate and predict the world, and once again as animals become social and begin to pool their understanding and divide their labor. Nowhere are we more regularly stumped than we are in understanding ourselves. We

*Homo sapiens* are brimming over with profound mysteries—surrounded by paradoxes born of the very things that make us distinct from the rest of the biota.

Why do we laugh, cry, or dream? Why do we mourn our dead? Why do we make up stories about people who never lived at all? Why do we sing? Fall in love? Go to war? If it's all about reproduction, why do we take so many years to get on with it? Why are we so picky about with whom we choose to do it? Why are we fascinated by the reproductive behavior of others? Why do we, sometimes, choose to impair and disrupt our own cognition? The list of human mysteries is endless.

This book will address many of those questions. It will bypass others. Our primary aim here is not to simply answer questions but to introduce you to a robust scientific framework for understanding ourselves, one we have developed over decades of study and teaching on the topic. It is not a framework you will find elsewhere; we developed it by working from first principles as much as possible.

*First principles* are those assumptions that cannot be deduced from any other assumption. They are foundational (like axioms, in math), and so thinking from first principles is a powerful mechanism for deducing truth, and a worthy goal if you are interested in fact over fiction.

Among the many benefits of first principles thinking is that it helps one avoid falling prey to the naturalistic fallacy,[2] which is the idea that "what is" in nature is "what ought to be." The framework that we present here is built to free us from these sorts of traps. It is intended to allow us humans to make sense enough of ourselves that we can, at a minimum, protect ourselves from self-inflicted harm. In this book, we will identify the most large-scale problems of our time, not through the limiting, divisive lens of politics, but through the indiscriminate lens of our evolution. One of our hopes is that we can help you to see through the noise of our modern world and become a better problem solver.

Modern *Homo sapiens* arose approximately two hundred thousand years ago, the product of 3.5 billion years of adaptive evolution. We are, in most ways, a generic species. Our morphology and physiology, though stag-

gering and marvelous when considered in isolation, are not special when compared to those of our nearest relatives. But we, uniquely, have transformed the globe and become a threat to the planet on which we still thoroughly depend.

We might have called this book *A Postindustrialist's Guide to the 21st Century*. Or An Agriculturalist's Guide. Or A Monkey's Guide, or A Mammal's Guide, or A Fish's Guide. Every one of those represents a stage of evolutionary history to which we have adapted, and from which we carry evolutionary baggage: our Environment of Evolutionary Adaptedness, or EEA, to use the term of art. In this book, we speak to our Environments of Evolutionary Adaptedness—which is to say, not just the EEA of the title, such as the African grasslands and woodlands and coasts on which our ancestors were hunter-gatherers for so long, but the many other EEAs to which we are adapted. We emerged onto land as early tetrapods; became lactating, fur-bearing mammals; developed dexterity with our hands and visual acuity as monkeys; grew and harvested our own food as agriculturalists; and live cheek to jowl with millions of anonymous others as postindustrialists.

We chose to include *hunter-gatherer* in the title of the book because our recent ancestors spent millions of years adapting to that niche. This is the reason so many people romanticize this particular phase of our evolution. But there was not just one hunter-gatherer way of life, any more than there is one mammalian way of life, or a single way to farm. And we are not adapted only to being hunter-gatherers—we also adapted, long ago, to being fish; more recently, to being primates; and most recently, to being postindustrialists. All of these are part of our evolutionary history.

This wide-ranging view is necessary if we are to understand the biggest problem of our time: Our species' pace of change now outstrips our ability to adapt. We are generating new problems at a new and accelerating rate, and it is making us sick—physically, psychologically, socially, and environmentally. If we don't figure out how to grapple with the problem of accelerating novelty, humanity will perish, a victim of its success.

This is a book not only about how our species is in danger of destroying

our world. It is also about the beauty humans have discovered and created, and how we can save it. An irrefutable evolutionary truth undergirding this book is that humans are excellent at responding to change and adapting to the unknown. We are explorers and innovators by design, and the same impulses that have created our troublesome modern condition are the only hope for saving it.

# A Hunter-Gatherer's Guide to the 21st Century

Chapter 1

# The Human Niche

It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us.

Charles Dickens, from the opening lines of *A Tale of Two Cities*, published in 1859, the same year that Charles Darwin published *On the Origin of Species*

**BERINGIA WAS A LAND OF OPPORTUNITY, A VAST AND OPEN GRASSLAND.** A landmass four times the size of California that connected Alaska to the east with Russia to the west, Beringia was not merely a temporary land bridge, a passage between Asia and the Americas. People did not scurry across, the rising waters lapping at their feet, nor was it a lifeless plain. Life was surely difficult, but for thousands of years, Beringia supported a population of people who made their home there.[1]

The people who came to Beringia were fully modern in every genetic and physical sense. They came from the west, from Asia, and for a long time there was a barrier of ice at Beringia's eastern edge. So they settled there, and many generations passed. As the world warmed, though, the ice began to melt, sea levels rose, and Beringia began to disappear, the coastline encroaching on what had been home. Where to go?


Artist's rendering of Beringia based on Bond, J. D., 2019. *Paleodrainage map of Beringia*. Yukon Geological Survey, Open File 2019-2.

Some Beringians no doubt went west, back to Asia, from where all of their ancestors had come, a land that may have lived in myth and collective memory. Perhaps in the intervening years, newer arrivals had come from there, too, and brought with them updated stories of what their home to the west was like.

As sea levels rose on the Beringians, some headed east, into a land that no humans had ever seen before. These were the first Americans. Probably the Beringians traversed that northern part of the west coast by boat.[2] The ice was still there, but there would likely have been ice-free refugia peppering the coast, places where local animals concentrated, places that may have acted as stepping-stones for those first Americans.[3]

This was, best estimates now suggest, at least fifteen thousand years ago,[4] and possibly far deeper into history even than that. Depending on what that ice sheet looked like, perhaps they couldn't make permanent landfall until they got as far south as what is now the city of Olympia, in Washington State. It was there that the glaciers ended. South of Olympia, and east, landmasses unimaginable in their scope and variety, full of verdant and beautiful landscapes and delicious and charismatic or-

ganisms, but no people, were about to be explored by humans for the first time.

It was a risky move. The whole thing was incredibly risky. None of the choices seemed good. Go back to the west, to a land already occupied by people who undoubtedly have opinions about newcomers? Head east, to a land nobody knows anything about? Or stay in place as Beringia disappears into the sea? Nobody who survived chose the third option. Go back to what your people once knew, a place vetted and abandoned by your ancestors, a place known to be full of competitors . . . or explore someplace completely new? Both are legitimate choices, both have distinct risks, distinct advantages and disadvantages. These are, likewise, the options in our modern world.

The descendants of the Beringians would come to populate the Americas in total isolation from all human populations in the Old World. They arrived before any humans on Earth had invented written language or agriculture; independent of any input from their Old World relatives, they innovated these things from scratch. Their lineage would discover hundreds of new ways of being human, and rise to an estimated population of fifty million to one hundred million before Spanish conquistadors brought the Old and New World populations into violent reconnection many thousands of years later.

We do not know for certain what the journey to the New World looked like. Perhaps the first Americans were even earlier, not making permanent homes in Beringia at all, instead circumnavigating the Pacific, clockwise, in boats.[5] What we do know is that the New World presented challenges that the first Americans had never seen before. And this story of Beringia, even if true only at the metaphorical level, is instructive of what it is to be human. It is an apt if incomplete metaphor for the situation that humanity is in today. We too find ourselves in a failing land. We too must seek new opportunities to save ourselves. And we too do not yet know what exploration will yield.

Early Americans found themselves in an immense landscape of unknown hazards and opportunities. With ancestral knowledge that was ever less relevant as a guide, the challenges of navigating this new world would

have been immense. And yet they succeeded spectacularly. The question that we ask, and which is most pertinent to our modern situation, is *How?* The answer will be found, in large measure, in understanding what it is to be human.

Several generations in, sitting around the fire at night, a bit hungry because berry season was past its peak and the deer had grown scarce, one of these early Americans, call him Bem, might have observed that bears seem to sustain themselves on the fish, so why can't we?[6] Bem didn't know much about fish, though, not like Soo, who had spent many days at river's edge, watching fish, and had insight about how the fish behaved. Soo's insight about fish was, heretofore, not one she had shared, nor one that had seemed to her likely to have any value to her people. Soo, in turn, may not have had latent engineering skills, as Gol did, and Gol may have lacked Lok's talent in experimenting with making rope. When so many people with distinct talents and insights come together around a camp fire to discuss a shared problem, the spark of innovation can spread quickly.

Most of the best ideas that our species has generated, the most important and powerful ideas, have been the result of a group of people who had different but consilient talents and vision, non-overlapping blind spots, and a political structure that allowed for novelty. Gathered around the fire at the threshold of two continents new to humanity, many insightful observers and engineers, crafters of tools and synthesizers of information, came together and learned, or relearned, how to fish salmon from rivers, what bulbs were safe to eat and how to identify them, and how to transform trees into shelter. Those populations had keepers of the flame, too: holders of tradition, individuals who would tell the story later, perhaps when a move was necessitated by the failure of a local salmon run and all of the original innovators were gone.

What all were Bem or Soo or Gol or Lok doing, exactly? They were innovating, as part of and on behalf of their people. They were testing hypotheses, creating narrative, building material and culinary traditions. They were being human.

## The Human Paradox

Twenty-first-century people face opportunities and dilemmas similar to those of the original people of the New World. Innovations in technology and science have allowed us to enter new, previously unimagined realms. But unlike the Beringians, we do not have an ancestral land to even consider returning to, because our actions affect the entire planet. We have hunted and gathered, cultivated and machined our way around the globe, transforming the earth in our wake, bending landscapes to our will and pushing many to the brink of collapse.

Some look back at our species' successes, such as the success of the Beringians, and imagine that we can master nature, that we are in control of it. But we are not, and we never will be.[7] The consequences of this bad assumption account for many of our problems today. The only way to course correct is to understand the true nature of what we are, what we might be, and how we might apply this wisdom to our benefit.

Our species is brainy and bipedal, social and talkative. We make tools, cultivate land, produce myth and magic. We have reinvented ourselves over time and across space, over and over again, learning to dominate one habitat after another. Species are defined by many things—their form and function, their genes and development, their relationship to other species. Perhaps most important, though, species are defined by their niche: the particular way they interact with and find a way to make a living in their environment.

Given our breadth of experience and geography, what exactly is the human niche?

As our species has evolved, we seem to have escaped a fundamental law of nature: the jack-of-all-trades is the master of none. To be dominant in any one niche, a species must typically specialize, sacrificing breadth and generality. It is this need to specialize that hobbles the jack-of-all-trades, a principle so universal that it has been invoked for more than four centuries in print (one of the earliest instances being a 1592 jab at actor-turned-playwright William Shakespeare).[8] "The jack-of-all-trades is the master of none" is applied broadly, from engineering to sports to ecological

science. Species are, in this way at least, like tools: the more jobs they do, the more crudely they do them.

Yet somehow here we are, jacks of nearly every trade imaginable, and simultaneously the masters of nearly every habitat on Earth. Our niche is nearly unbounded, and when we do find boundaries, we nearly immediately begin to test them. It's as if we don't believe there will ever be a final frontier.

*Homo sapiens* is not merely exceptional. We are exceptionally exceptional.[9] Unrivaled in our adaptability, ingenuity, and exploitative capacity, we have come to specialize in everything over the course of hundreds of thousands of years. We enjoy the competitive advantage of being specialists, without paying the usual costs of a lack of breadth.

This is the paradox of the human niche.[10]

A paradox in science is like an *X* on a treasure map: It tells us where to dig. Our unrivaled breadth of specialization is a paradox that marks the location of a spectacular trove, not so much of riches, but of tools. By unraveling the human paradox, we can unlock a conceptual framework that allows us to understand ourselves, and to navigate our lives with intention and skill. This book unpacks the human paradox, and describes the tools we discover there; it is also an exercise in their application.

## Campfire

In our discussion of the first Americans, we have already seen one tool in this treasure trove, though it might not seem to be a tool at all. It is a campfire.

Humans have been using fire for eons. We have used it to make light and create warmth, to increase the nutritional value of food, and to keep predators at bay. We have used fire to hollow logs to make canoes, to transform landscapes to new purposes, to soften and harden metal. We have also used fire for something even more important: The campfire is a forge for ideas. A place to discuss berries, rivers, and fish. A place to share our experiences, to talk, to laugh, to cry, to deliberate over our challenges and share our successes. From this forge emerge the kinds of ideas that render humans a true superspecies, one that surfs the rules of the universe, kicking up paradoxes in its wake.

The exchange of ideas that has occurred around the hearth for millennia is more than simple communication. It is the convergence point of individuals with different experience, talent, and insight. The linking of minds is at the root of humanity's success. It doesn't matter how smart an individual is, and it doesn't matter how much they know. In nearly every case, when minds come together, the whole is greater than the sum of its parts. For the problems that humanity faces—from which bulbs are safe to eat and how to catch rabbits, to how to equalize opportunity while creating a world that is safe from existential threats—we need more than individuals processing in isolation. If we are to survive the future, we need multitudes of people plugging in and parallel processing. Joining minds in this way exponentially increases the ability of humans to solve problems.

Just as humanity broke down boundaries between niches that no other organism has broken down, so too have we broken down boundaries between individuals that nothing else has broken down so thoroughly. With regard to niches, we are a generalist species that contains individuals who are often specialists. A single ancient American may have been terrific at wayfinding, but terrible at keeping the flame. A single modern human may be terrific at rock climbing but terrible at organizing their files, or excellent with numbers but unskilled in the baking of bread. As a species, though, we are supremely good at all of these things. It is the connections between us that allow us to transcend our individual limitations, often focusing on our trade while being sustained by the specialized labor of others.

At the boundaries between individuals, we consciously innovate and share ideas, and then reify the best and most relevant of those ideas for the current moment in the form of culture. For millennia, this magic has occurred around the common campfire.

Consciousness and culture—themes that we return to in depth in the penultimate chapter of this book—are in tension with each other, and humans need both.

Conscious thoughts are those that can be communicated to others. We define *consciousness,* therefore, as "that fraction of cognition that is packaged for exchange." This is no trick. We have not chosen a definition to make

an intractable question simple. We have chosen the definition at the epicenter of what people mean when describing a thought as "conscious."

One truth that emerges from understanding consciousness in this way is that it makes little sense to assume that individual consciousness evolved first, or that it is the most fundamental form of consciousness. Rather, our individual consciousness likely evolved in parallel with collective consciousness, and would become fully realized only later in our evolution. Understanding what is in the mind of another—known as theory of mind—is staggeringly useful. We see the rudiments of this capacity in many other species, and we see it extensively elaborated in a highly cooperative few, such as elephants, toothed whales (such as dolphins), crows, and many nonhuman primates. We humans are by far the most aware of one another's thoughts of any species that has ever existed, because we alone can, if we so choose, hand over the cognitive goods explicitly and with spectacular precision. We can accurately pass a complex abstraction from one mind to another by simply vibrating the air between us. It is everyday magic that usually passes without our notice.

For theory of mind to function, one needs to run an emulation of the other person within one's own head. For *me* to benefit from a comparison between what *I* think on the one hand and what I understand *you* to think on the other, I am all but required to have subjective experience of both *you* and *me*—to bring the two into a single currency. Shared consciousness is an emergent, intangible space between people, where concepts are lodged and co-cultivated. Each participant has a distinct perspective on the space, much as each witness to a physical event will have a somewhat different vantage point, but the space is a property of the collective.

Imagine two populations composed of equally smart individuals. In the first population, individuals cannot just propose ideas, but also must respond to and modify the ideas of others, and then strategize and plan how to act on them, with each individual contributing in his or her own area of specialty. The second is made up of individuals who, while full of good ideas themselves, have no ability to conceptualize what others are thinking. When these two populations are in competition with each other, there is simply no contest.

Even a rudimentary collective consciousness—what might be shared between wolves in a pack, for example, as they are hunting cooperatively—provides a staggering advantage. In lions, too, the pride is far greater than the sum of its individuals. Collective consciousness, an evolutionary innovation unlike any other, creates cognitive emergence.

## Culture versus Consciousness

Consciousness is valuable for problem-solving, but it isn't so good for execution. The gymnast, the virtuoso, and the warrior all succeed by taking what they have discovered consciously and learning to apply it without explicit deliberation.[11] Transformative insights and ideas move out of the conscious layer and into the parts of us that know how to get things done. When one is *in the zone,* the conscious mind is present, but as a spectator who steers clear so as not to disrupt the flow. Behaviors become habitual and intuitive. In an individual, we might call this skill or craft. In a family or a tribe, such habits become traditions, passed efficiently from one generation to the next. Scale this up further, and we have culture.

*Homo sapiens* therefore oscillate between two dominant modes. When we face problems for which our prior understanding is inadequate, we become conscious. *How do we feed ourselves in this new land?* We plug our minds into a shared problem-solving space and share what we know. Then we parallel process—proposing hypotheses, providing observations, offering challenges—until we arrive at a new answer, one that an individual would rarely reach alone. If the result works well when tested in the world, it gets refined and then driven into a more automatic, less deliberative layer. This is culture. The application of culture to the circumstances for which it is adapted is the population-level equivalent of an individual being in the zone.

This model implies a few important things. When times are good, people should be reluctant to challenge ancestral wisdom—their culture. In other words, they should be comparatively conservative. When things aren't going well, people should be prone to endure the risks that come with change. They should be comparatively progressive—liberal, if you will.

This of course has a lot to say about the modern world, because for various reasons, there is little agreement at present on how well things are going. Moments before the Titanic hit the iceberg, the ship was a marvelous testament to human achievement. Moments after, it was a monument to the hazard of hubris. Too often, it is only in retrospect that the rearranging of deck chairs appears absurd. More often than not, there is no iceberg, no clear demarcation of before and after, of the moment when consciousness should become more salient than culture.

**Humans break**

1. niche boundaries by being both generalists and specialists.
2. interpersonal boundaries by oscillating between culture and consciousness.

The financial collapse of 2008, Deepwater Horizon oil spill, and the Fukushima Daiichi nuclear disaster are all symptoms of a civilization-level disorder, one that has no name. Let's call it the **Sucker's Folly**: the tendency of concentrated short-term benefit not only to obscure risk and long-term cost, but also to drive acceptance even when the net analysis is negative.[12] These events are evidence that we are resting on our cultural laurels and speeding toward disaster, lulled into a false sense of security—and away from collective consciousness—by the opulence of our surroundings. The sooner we recognize this, the greater the chance to divert the ship to a safe course, a puzzle we will return to in the last chapter of this book.

The answer to our earlier question, then—*What is the human niche?*—is this: Humans don't have a niche, not in the standard sense of that term. We have escaped the paradigm by mastering a different game. We have discovered how to swap out our software and replace it as the need arises by oscillating between culture and consciousness. *The human niche is niche switching.*

Humanity is the master of every trade. If we were machines, we would be ones that are compatible with many software packages. The Inuit hunter

knows the Arctic, but has few of the skills needed to function in the Kalahari or the Amazon. Humans can be good at almost anything, given the proper tools and software, and human populations can be good at many things by virtue of a division of labor, but each individual person will either have to limit themself or accept the costs that come with being a generalist.

As our world becomes increasingly complex, though, the need for generalists grows. We need people who know things across domains, and who can make connections between them: not just biologists and physicists, but biophysicists; people who have switched gears and found that the tools they brought from their prior vocation serve them well in a new one. We must find ways to encourage the development of generalists. In this book, we argue that a key way to do this is to encourage a careful, nuanced understanding of what evolution is, what it has made us, and how we can resist its goals. To that end, let us first, in the remainder of this chapter, provide a few updates to evolutionary theory. The alterations that we are suggesting open a path to understanding evolution more deeply, and also to understanding ourselves, our cultures, and our species.

## Adaptation and Lineage

Adaptive evolution improves the "fit" of creatures to their environment. This is well established. In a rush to make evolutionary biology an empirical science, though, biologists prioritized defining *fitness* such that it could be easily measured. We biologists settled on a definition that is almost synonymous with *reproduction*. As is the case with many assumptions that ultimately fail, the belief that *fitness* and *reproductive success* were near synonyms was wildly successful at first, enough so that generations of biologists made great headway by simply treating them as one. All else being equal, a creature that is a better fit for the environment tends to produce more offspring, and when that is the case, biologists have excellent conceptual tools for unpacking the evolutionary process that leads to it. What happens when all else isn't equal, however, and the creature with more offspring has cut corners in the pursuit of short-term fecundity? Under these conditions the ability of biologists to understand the story is

compromised. If the harm done to fitness shows up quickly—if an individual animal produces many offspring, all of which perish in the winter—we will likely come to understand that it failed in an evolutionary sense. If, however, the descendants prosper for a fairly long time, but die off in the next drought, or the next Ice Age, there is a good chance biologists will botch our analysis of "success."

Fitness is indeed often about reproduction, but it is *always* about persistence. A successful population can ebb and flow through time. What a successful population can't do is go extinct. Extinction is failure. Persistence is success—and the reproduction of individuals is only one factor in the persistence equation.

But what does it mean to persist? Is it species persistence we are after? Do we count each population within the species separately? Is it an individual's descendants we should be counting? Logically, it must be all of those things, and more.

Adaptive evolution occurs as individuals compete for resources. Each individual is the beginning of a line of descent, and the period over which its descendants persist is a good proxy for its fitness. If Bem's descendants perish as the glaciers return, but Soo's descendants find their way through to the next interglacial, the latter were fitter—whether we were able to measure the difference or not.

But those two individuals were not only the starting points for lines of descent going forward. Each was also a member of many simultaneous, overlapping lines of descent stretching backward to a large collection of ancestors about whom we could say the same thing. So if fitness is about persistence, then the apropos question is, The persistence of what?

This is where we must break our sense of obligation to measure things. Adaptive evolution—the process that increases the "fit" of creatures to environment—is about all levels of descent at once. Adaptive evolution is therefore fractal, and the term that encapsulates it is *lineage*.

An individual and all of its descendants comprise a lineage. A species is a lineage descended from that species' most recent common ancestor—as too are larger clades, such as mammals, vertebrates, animals—lineages descended from those clades' most recent common ancestors.[13] Our job as

meaning. The term is now almost exclusively used to refer to mechanisms that directly—molecularly—regulate the expression of the genome—expressing some traits while suppressing others, creating the patterns of gene expression that give the body a coherent form and function. These regulatory mechanisms, which scientists are just beginning to understand, are the key to understanding multicellular life. Without these mechanisms, all cells with a given genome would be alike, and any large collection of cells could exist only as a colony of undifferentiated cells. It is only through the tight, epigenetic regulation of gene expression that we can have an animal or a plant composed of well-coordinated, distinct, multicellular tissues.

While the meaning of the term *epigenetic* has gone through a radical transformation, from describing inherited behavior to describing only molecular switches, a strong argument can be made that the category of epigenetic phenomena actually includes both types of regulators: molecular switches are the narrow meaning of the term—epigenetic *sensu stricto* ("in the strict sense"), while the molecular switches *plus* inherited behaviors are epigenetic *sensu lato* ("in the broad sense").

Both are epigenetic, and the implication is that a single evolutionary rule governs both molecular and cultural regulators of gene expression.

Let's take a Tibetan herdsman, as an example. He has an inherited culture that constrains his behavior. His cells take different forms and do different things based on inherited patterns of gene expression. It would make no sense to imagine that the genes in his genome and the molecular regulators that adjust their expression are rivals. If the herdsman is healthy, his cells serve his evolutionary interests as a creature—the regulation of his genes evolved to enhance his fitness. His eyes, composed of many kinds of cells distributed in particular ways, see danger and opportunity. The hazards he sees are threats to his evolutionary fitness, and the opportunities constitute ways in which he might enhance it. In other words, the genes and their regulators agree on the job to be done and show no sign of tension over it. What is the job of those genes and their regulators? It is obviously evolutionary—to lodge copies of the herdsman's genes deeply into the future. No reasonable person would argue otherwise.

But many otherwise reasonable people will fail to see this relationship

when it comes to the herdsman's culture. He may adhere to gender roles that stretch back thousands of years in his lineage, but it is commonly asserted in scientific circles that these cultural patterns are not likely to be evolutionary, that they are "just cultural"—as if that were a competing category.

The problem stems from the initial, 1976 presentation of memetic evolution by Richard Dawkins in *The Selfish Gene*. As Dawkins describes memes—laying the foundation for the rigorous Darwinian study of cultural adaptation—he makes a fateful error. He describes human culture as a new primeval soup,[16] in which cultural traits spread themselves much like genes do, rather than as a tool of the genome that evolved to enhance the genome's fitness.

This misunderstanding has never been properly resolved, and the nature versus nurture confusion it engenders continues to block analytical and societal progress. Asking if a particular trait is due to nature or nurture implies a false dichotomy between nature, genes, and evolution on the one side and between nurture and environment on the other. In fact, all of it is evolutionary.

The key to seeing why culture must serve genes as a fitness-enhancing tool, exactly as molecular regulators do, is found in the logic of trade-offs, a concept to which we will return throughout the book.

From the genome's perspective, culture is anything but free. In fact, nothing is more costly. The brain that picks up culture is big and energetically expensive to run; the process by which culture is transmitted is prone to error; and the content of human culture frequently blocks off fitness-enhancing opportunities—thou shalt not kill, steal, covet, lay with, etcetera. Anthropomorphizing the genome for a moment: If culture did not pay the genome back for its astronomical expense, the genome would have reason to be livid. Culture appears to waste time, energy, and resources that would otherwise be at the genome's disposal. One might get the impression that culture is effectively parasitizing the genome.

But the genome is in the driver's seat. A capacity for culture is nearly universal in birds and mammals; it has been elaborated, enhanced, and extended by genomic evolution over time; and it is at its most extreme in

the world's most broadly distributed and ecologically dominant species: humans. These facts tell us that whatever culture does, it is not coming at a cost to genetic fitness. Rather, it enhances fitness in dramatic ways. If culture was not paying its way, the genes whose expression it is modifying would either go extinct or evolve to be as immune to culture as an oak tree.

In our teaching of evolution to students, we have codified our understanding of the relationship between genetic and epigenetic phenomena in what we call the Omega principle. It has two elements:[17]

**Omega Principle**

1. Epigenetic regulators, such as culture, are superior to genes in that they are more flexible and can adapt more rapidly.
2. Epigenetic regulators, such as culture, evolve to serve the genome.

We have chosen to use the signifier Ω (omega) to call to mind π (pi), and thus indicate the obligate nature of the relationship. Adaptive elements of culture are no more independent of genes than the diameter of a circle is independent of that circle's circumference.

From the Omega principle we derive a powerful concept: any expensive and long-lasting cultural trait (such as traditions passed down within a lineage for thousands of years) should be presumed to be adaptive.

Throughout this book, we will discuss such traits—from harvest feasts to the building of pyramids—through this evolutionary lens. We will use first principles to extrapolate what makes humans so special, and why the novelty of the modern era has made us mentally, physically, and socially unhealthy. In order to discover those principles, we must look for clues. In the next chapter, we will explore our deep history, touring the many forms we have taken, some of the many systems and abilities our ancestors innovated, and the human universals that unite us all.

Chapter 2

# A Brief History of the Human Lineage

**THERE ARE SEVERAL HUMAN UNIVERSALS.[1]**

All humans have language. We can tell *self* from *other,* and can distinguish self as subject ("I cooked for her") from self as object ("she cooked for me"). We use facial expressions that are both general and nuanced, which include happiness, sadness, anger, fear, surprise, disgust, and contempt. We don't just use tools; we use tools to make more tools.

We live in or under shelter. We live in groups, usually with family, and adults are expected to help socialize children. Children observe elders, and copy them. We also learn by trial and error.

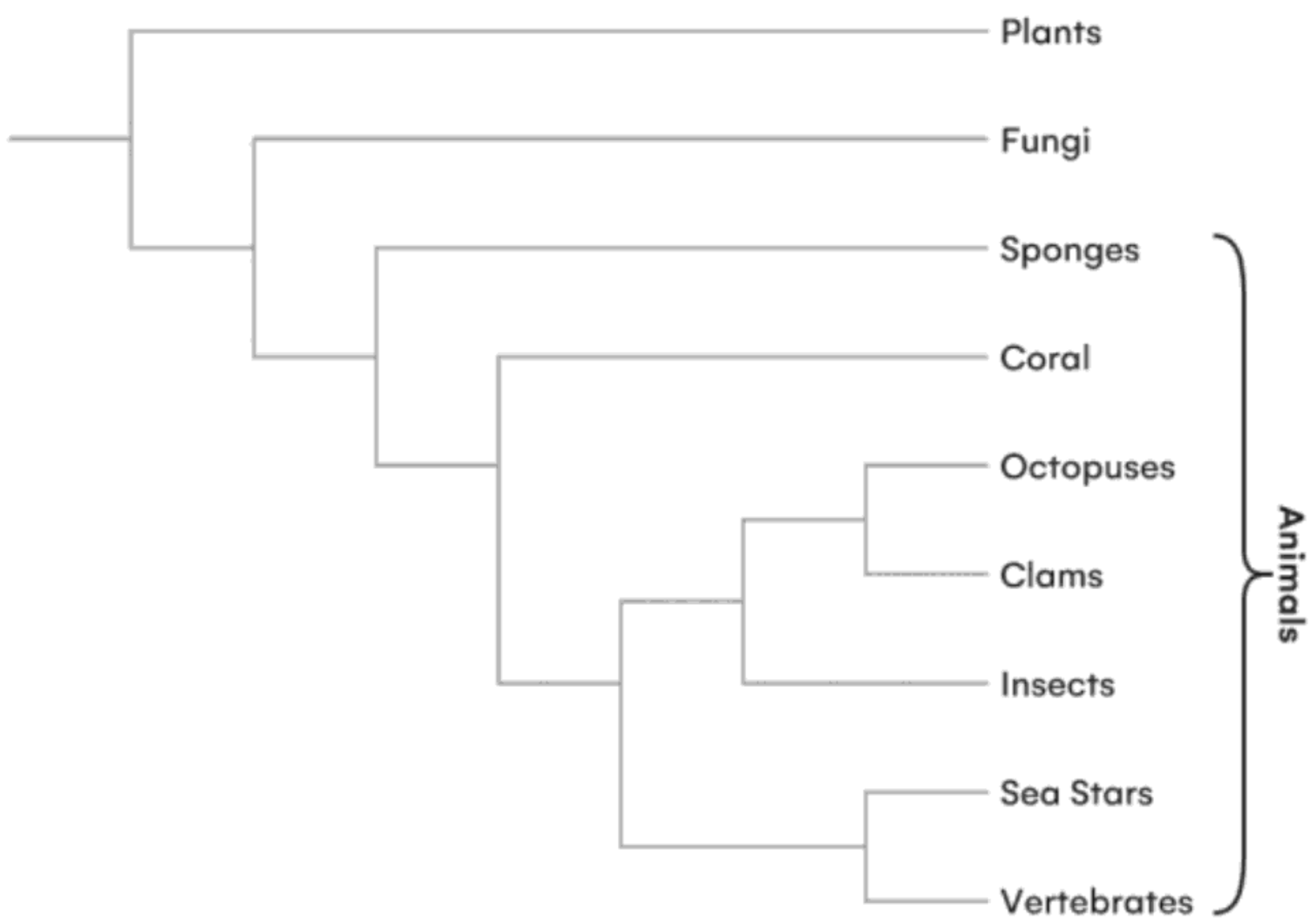
We have status, governed by rules stemming from kinship, age, sex, and beyond. We have rules of succession and markers of hierarchy. We engage in division of labor. Reciprocity is important, both in the positive sense—barn raising for neighbors, exchanging gifts—and in the negative—retaliation for perceived wrongs. We trade.

We predict and plan for the future, or at least we try to. We have law, and we have leaders, although both may be situational or ephemeral. We have rituals, and religious practice, and standards of sexual modesty. We admire hospitality and generosity. We have an aesthetic, which we apply to our bodies, our hair, and our environment. We know how to dance. We make music. We play.

It took so long for us to become who we are today. If you look deeply into the history of life on our planet, you can see how these universals emerged over hundreds of millions of years, and once you understand this, you will see why change, especially rapid change, isn't always such a good thing.

right, and the midline is a point of inflection, the views from either side a near mirror image of the other. Insects have a left and right, as do we vertebrates, although we are more closely related to sea stars than we are to insects. This reveals that even a patently useful trait like bilateral symmetry is not universally so—adult sea stars apparently gave up having a left and right in favor of radial symmetry.[8]

**A Phylogenetic Tree**




This evolutionary tree reflects our current understanding of the relationships between several extant taxa.[9] Many taxa are excluded, but the nature of evolutionary trees is that you can exclude taxa without rendering a tree untrue; it's just less complete.

This tree does *not* suggest that vertebrates are "more highly evolved" than anything else on the tree. This tree *does* suggest, among other things, that:

- Vertebrates and sea stars are more closely related to one another than either are to anything else on the tree.
- Clams and octopuses are each other's closest relatives on this tree; insects are closely related to them. Animals and fungi are more closely related to each other than either is to plants.

Five hundred million years ago we began to organize our internal activities—we evolved a single centralized heart, and brain, where before there were multiple centers for pumping and pressurizing blood, and multiple centers for neural processing. With a single brain to organize inputs, we also developed ever more ways to sense our world.

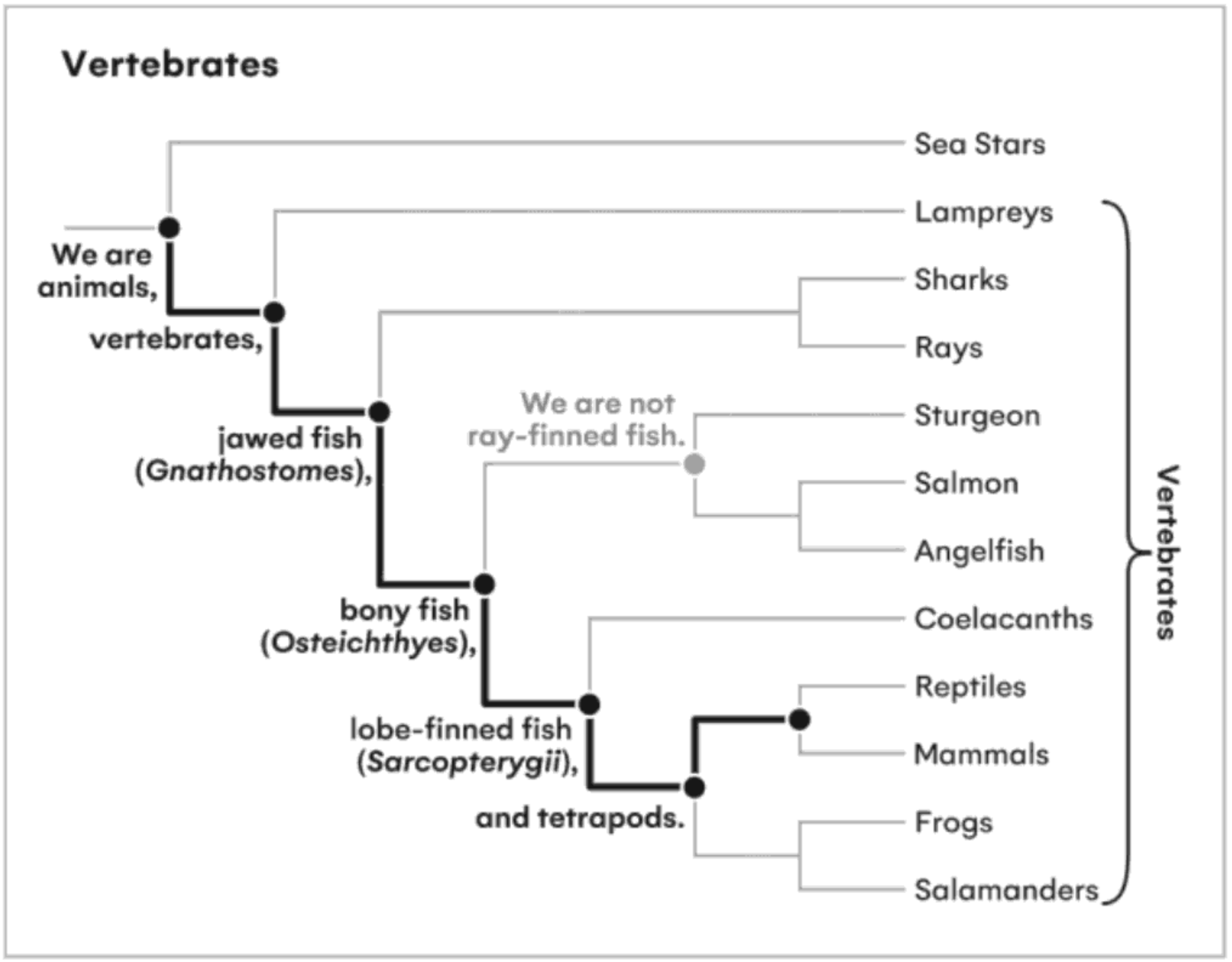
Soon enough, on a geological time scale, we had become craniates, the brainy ones, with our precious brains carefully protected within skulls. Bone hadn't evolved yet, nor jaws, so we were still limited in what we could accomplish. Yet organisms by that description persist today—lampreys, still alive, still doing fine, thank you very much—are modern representatives of those early craniates. With no jaws and no bone, their little brains work hard to find hosts to latch on to and parasitize.

Teeth and jaws evolved, and both proved useful. As did myelin, which coats the outside of neurons and allows the transmission of neurological signals to increase in speed: with myelin, our ability to move, feel, and think got faster.

By 440 million years ago, many fish were armored with sheets of bone on the outside of their bodies, but nobody yet on Earth had an internal bony skeleton. Some of the modern descendants of those fish, which have jaws and teeth but no bone, appear to be the sharks, skates, and rays.[10] Sharks, the animals of many people's nightmares, do what they do without a bone in their body. There are so many ways to be strong, to be clever, to be successful.

When bone, a molecular relative of teeth, showed up as internal skeletal material, rather than as armor, replacing the cartilage that came before it, we became Osteichthyes—bony fishes. We are also, still and forever, eukaryotes, animals, vertebrates, craniates. Group membership never disappears, but an organism will try to pass as something it's not, if enough of its traits transform. We are nucleate, heterotrophic, vertebral, brainy, bony fish. We are fish.[11]

Three hundred eighty million years ago, give or take, some of us fish made a go of it in shallow water, near land. We were tetrapods. Some of our fins




began to seem more like limbs than fins, their bony, muscular extensions became our hands and feet, our fingers and toes. Moving all the way onto land, though, is hard. Terrestrial life takes work, and while land is a vast and promising frontier for those who can do it, the compromises are significant. Everything from holding yourself up, and not being crushed by gravity, to the different ways that light, sound, and odors travel in air compared to water, needed to be dealt with in this new world. Nearly every system needed to be retooled. For a long while, we retained our close relationship with water, lounging in it to keep our skin, our major respiratory organ, functional, and returning to it to breed. Many individuals made mistakes, costly mistakes, deadly mistakes. It all could have turned out so very differently. Our ancestors' errors proved to be survivable or—sometimes—not errors at all, in retrospect. It almost seems preordained, that it would be us discovering our own history, and writing about it, rather than an "evolution played out differently" version of dolphins, or elephants, or parrots

discovering and reflecting on their history . . . or farther afield yet, bees, or octopuses, or chanterelle mushrooms.

These early tetrapods, amphibians all, stayed close to water, except when they didn't. Those individuals that ventured far from water took significant risks in doing so, and most of them surely died. All of them were explorers in their way; most of them, like many explorers, took a risk that did not pay off. But those that did not perish found landscapes uninhabited by other vertebrates, and abundant food. So our amphibian ancestors spread across the land, a hot, humid landscape in which the world's first forests were forming, and in many dank corners, giant millipedes and scorpions scuttled and roamed.

Three hundred million years ago, the Earth's continents were all lumped together into the single landmass known as Pangaea, fit together like puzzle pieces. Pangaea was a lush, warm world of abundant plants and giant insects. Even the poles of the planet were free of ice then. Into this world emerged a new egg. The old egg was simple and fragile—it is the egg still used by salmon and salamanders, frogs and flounder. This new egg though, the amniotic egg, had so many protective and nourishing layers that individuals could move their lives farther from fresh water. Finally, we were free of needing such large amounts of water. We were early reptiles; we were amniotes. We are also, still and forever, fish.

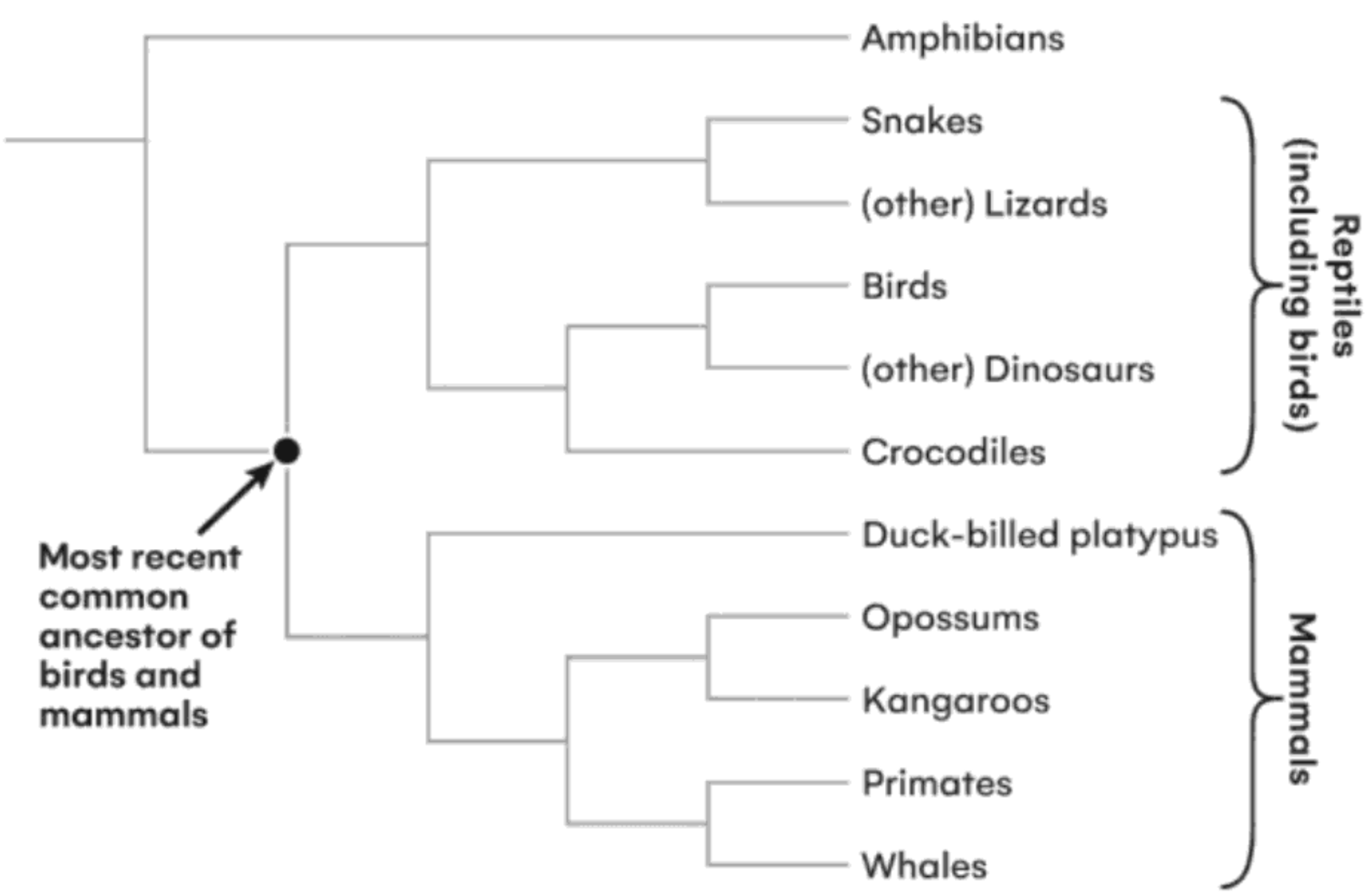
Three hundred million years ago, we were on land, with lungs and a fancy new egg. We amniotes evolved from Reptiliomorphs—broadly speaking, reptiles—so all of us amniotes are reptiles, too. Reptiles split and branched, as clades do. Early on in our lives as amniotes, a branching occurred, between the lineage that would further diversify as reptiles, and the one that would become mammals.

Some reptiles lost their teeth and grew shells, and we call them turtles. Some reptiles developed forked tongues and paired penises, and we call most of them lizards. Later, some lizards lost their legs, and some of those legless lizards are what we now call snakes. Even without legs, though, snakes are still tetrapods, because their history doesn't change just because their form has. Some reptiles became dinosaurs, and some dinosaurs became birds. (So, yes: Dinosaurs are not extinct. Birds are dinosaurs. And birds are also fish.)

Birds and mammals have a most recent common ancestor at the base of the reptile tree, and this ancestor of ours was low-slung and slow, cold-blooded and asocial, and didn't have much going on cognitively. Both the lineage that would become birds, and that which would become mammals, independently and without input from the other, evolved into beings that run hot, stand up tall, move fast, and have big, hyperconnected brains. It's a more expensive path through the world, being warm-blooded and big-brained, and birds and mammals have addressed the expense, and its problems, in different ways, but for each of these two groups, it has worked out well for us.

Both birds and mammals have more cultural learning and social com-

**Tetrapods**




Relationships between tetrapods are depicted here. Among the reptiles, three relationships are worth special note:

1. Snakes are the largest clade of legless lizards.
2. Birds are the only clade of dinosaurs that did not go extinct sixty-five million years ago.
3. Turtles and tortoises ("Testudines") are unambiguously reptiles, but who their closest relatives are remains in question, so they are excluded from this tree.

our computing power went up, too. Early mammal adaptations allowed for greater efficiency in circulation, respiration, locomotion, and hearing. Early in our mammal history we also became more efficient at chomping on things and in getting rid of waste in the form of urine.[15]

We humans are the beneficiaries of those evolutionary innovations of so many tens of millions of years ago, as are our cats and dogs and horses, as are the squirrels and wombats and wolverines.

There were steps necessary to our becoming what we are, but how many of those would have been necessary for similarly conscious organisms in a rerun of history? What if we could start back at the beginning and try this historical experiment that is *life on Earth* one more time?

In a rerun of history, the chances that the most conscious organisms on the planet would have a four-chambered heart, five digits, and eyes that are built backward are low. But in a rerun of history, in which conscious beings once again emerge, selection would certainly have figured out some way to do an end run around its own inadequacies, creating brains—no matter the specifics—that can look into the future, even when selection itself cannot.

Sixty-five million years ago, the Chicxulub meteor hit the Earth near the Yucatán peninsula. Its impact kicked up so much dust that the sun was blocked for years. Photosynthesis ground to a halt. On the other side of the planet, perhaps accelerated by Chicxulub, one of the largest volcanic features on the planet was forming, the Indian Deccan Traps, belching out large amounts of climate-changing gases.[16] Mass extinctions followed, including that of all the (non-avian) dinosaurs, which had been doing pretty well for themselves for many tens of millions of years.

There is still disagreement about how long it took mammals to begin to diversify, to turn into the great chaotic mess of nearly five thousand mammal species extant on the planet today—half of which are rodents, another quarter of which are bats, and the remaining quarter of which include forms as varied as dolphins and kangaroos, elephant seals and antelope, rhinoceroses and lemurs.

Sometime back when dinosaurs still reigned, primates emerged from the mammalian ranks.[17] Against the odds, our primate ancestors managed