

# *How Life Got This Way: Secondary Text*

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Reserving about 1,000 words for a foreword.

## EXTERNAL TEXT

### *I. Blurb*

*To fully understand today's world, we must rewind the past at several different speeds.*

Rewind decades for perspective on today's climate change debate. Rewind a million years and see climate changes that shaped the human body and brain. All time scales are equally important! But just as there are different scales of space beyond our reckoning without microscopes or telescopes, it is difficult to conceive of all time scales at once. Most history books follow a timeline on one scale and leave the rest unseen.

*How Life Got This Way* tours the entire journey by transforming our sense of time. Each chapter describes a power of ten years. Time is modeled three-dimensionally, as hourglasses, for easier visualizations. Follow along as history zooms in progressively from the age of the universe to our own lifetime. We'll see today's world continuously take shape before our eyes.

Professional educator Scot Fagerland has meticulously vetted and summarized current scientific research in this plain English history of everything. He narrates the sequence of events conversationally but philosophically. Fagerland's insights such as the "secret trillionaire fallacy" and the "3D racial spectrum" offer new perspectives on the evolution of human beings, institutions, and belief systems.

### *II. About this Website Format*

Hi, my name is Scot, and I researched and wrote this book. I will likely post it to Amazon in 2022. This online manuscript is free for an indefinite time while there is no published form. You can download each chapter on PDF or read it here. I hope it will be useful for test readers, agents, and editors. You can download each chapter on PDF or read it here.

Citing sources is one of my main concerns. However, I don't like reading a book when citations keep getting in the way. My solution is to make them discreetly. When you see a faint superscript number, [1. Like this, usually with a link to an [outside reference](#) .] clicking it will take

you to an “endnote” at the bottom of the page, with a reference to my source. When you see a big bold number, [footnote]Like this[/footnote] hover over it to make a “footnote” appear, an interesting side comment. Hovering over a lightly highlighted word will open up a glossary entry. To search for any word throughout the site, return to this "Welcome" page and enter it in the search bar at lower left.

If you enjoy what you see here, I would be grateful if you contacted me and referred your friends. You may leave comments on any page / post. Note the like / share buttons at the bottom of each page. There are also social network buttons at the bottom of this page to follow or stay in touch with me. Please consider joining the [AWESOME thought Facebook group](#).

Enough about me! Scroll back up to the menu bar to get started. I’d recommend reading the [Front Matter](#) page first. This website is mobile-friendly, but for the best presentation of all the images, I would recommend viewing it on a tablet or full-sized monitor.

## **FRONT MATTER**

### ***I. Dedication***

*I optimistically dedicate this, my first book, to those who read it.*

*If you enjoy this book while I’m alive,*

*please drop me a line and / or kindly write an Amazon review.*

*If you have found it after my lifetime, thank you for letting my thoughts live on in your mind.*

*Mission accomplished.*

### ***II. Preface: Is This The Book You’re Looking For?***

I have read an editor’s advice against writing a preface, because most people don’t read prefaces and don’t know what they’re for! For those of you who fall into that category, the preface answers the question, “Is this the book you’re looking for?” I appreciate informative prefaces; they help me decide which books to buy. I find it important to pay it forward and tell this book’s story here.

## A. Why I Wrote the Book

I guess I'm what you'd call a "student of life." Some people choose to love life by relaxing, partying, raising children, or making money. I love life by learning about it. Like many of you, I am curious about the world I was born into. To fully understand the present, we must approach it from the past. Yet that past quickly becomes distorted and forgotten. Isn't it odd that we live in the last frame of an astronomically long movie, having lost most of the film?

I grew up reading "popular science" books and some of their history counterparts. \* I began to recognize patterns. Some books were historic. They covered the collective memory of the last 100 generations or less. Early civilizations faded in vaguely from a great unknown. At the other extreme were books of prehistory. They explained the exotic origins of life and the universe but then fizzled out, sometimes without mentioning humans at all. The most common approach these days is the "history of discovery" format. Such a book focuses on a handful of scientists, dramatizing their debates and drawing out their discoveries like a mystery story. Casual readers love those books, but they are an awfully roundabout way of explaining the past. Only a few books, and dozens of disjointed magazine articles, detail the evolution of humans from the animal kingdom. As the past gets deeper and our ancestors look less like us, interest in this subject seems to diminish.

In 2008, I was on a quest to find one book that ties it all together. I was looking for a book that started from the big bang and then simply explained all the most important events that ever occurred, right up to the present. At the time, I could find no such book. I wondered if it was even theoretically possible.

## B. The "Logarithmic History" Format

The problem is one of disparate time scales. Consider the difference between catching up with your spouse at the end of a day and catching up with an old friend at a high school reunion. The conversation with your spouse will focus on minutiae, details that are trivial in the grand scheme of things but are on your mind because they are so recent. When you catch up with your

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\* Some of my favorites were John Gribbin's *In Search of the Big Bang*, James Gleick's *Chaos*, Jared Diamond's *Guns, Germs, and Steel*, and Martin Gilbert's *The First World War*.

old friend, you don't just concatenate 3,650 dinner conversations. You summarize. You explain the larger-scale circumstances that have changed your life in the last decade. Interestingly, the two conversations can be of equal length. The same is true of books. A book about the coronavirus pandemic can be equally long as a book about the universe. An author must choose his time scale.

Or ... maybe we could represent the time scales with equally-sized *chapters* of the *same* book! If you are a former math major like me, then the word "scale" suggests "power of ten." Ten was the perfect base for the content. By devoting one chapter to each power of ten years, I could zoom in from the big bang to big data in ten chapters. And by this point in my thought process, I was thinking in the first person. Suddenly, I wanted to write the book myself.

[See this book's conception, my first notebook brainstorm, April, 2008](#)

I call this format "logarithmic history". A logarithmic scale, as you may or may not remember from high school, counts multiplications instead of additions. I have learned to avoid using the word "logarithmic" prominently in the book, as it gives most people frightening high-school-math flashbacks.

A few years later, I invented another trick for visualizing these time scales. It's impossible to imagine small and large scales simultaneously in linear timeline fashion. If you laid out a billion-year timeline across your tabletop, the last million years would be almost microscopic. It is much easier to pack large numbers into three dimensions than one. That's why we buy sugar cubes packaged in boxes 3x6x7 instead of 126 laid end-to-end. The three-dimensional version of a clock is an hourglass. Let's suppose that a one-hour hourglass is one foot tall. If we scale this hourglass to about 40 feet tall (while keeping the same small bottleneck in the middle) it will last for a decade, the smallest unit of time in this book. A ten-billion-year hourglass would stand 40,000 feet tall, deeper than the ocean. That's monumental, but it's conceivable!

### **C. My directives**

As I wrote this book (mostly through the 2010s) I found myself guided by a few directives.

*Directive 1: Identify the most important events or trends of every time scale*

*and survey the current scientific consensus for each one.*

I defined “important” as (1) being a break from the past and (2) having a lasting impact on today’s human state of affairs. For instance, this book is less about dinosaurs and Cambrian explosion seashells than most natural history books are, and more about tracing our ancestral lineage from chapter to chapter.

*Directive 2: Write like a narrative, cite like a thesis.*

I considered myself a conduit from today’s world experts directly to ordinary people like me, a “translator” from technical language to plain English. Almost every obscure or controversial fact in the book cites a peer-reviewed journal article or other primary source. As a disclaimer, “narrative” has a different meaning in science writing than fiction. It doesn’t mean that there will be characters, conflict resolution, or a sense of purpose. Nonfiction “narrative” is to be contrasted with the style of academic writing. A typical research paper has narrow focus, and it spends most of its time analyzing evidence and research methods. I took great pains to weave multiple strands of research into a big-picture tapestry with an eye on four C’s: context, chronology, causation, and conclusions.

*Directive 3: Tell the story and the story within the story*

Remember my metaphor of actors in the last frame of a movie? Halfway through the book, those actors started to wonder what the movie was about. Then they began rewriting it! Modern humans inhabit two worlds, the real and the imagined, each influencing the other. A main theme for at least half the book had to be the interplay between reality and belief. Sometimes this was more direct (creation mythology) and other times more subtle. I learned how much our thought processes are biased by language and human perception. For instance, our ideas about words like *human*, *evolve*, *species*, and *extinct* limit our ability to meet reality where it’s at. Our short lifespans and fleetingly short attention spans make it difficult for us to comprehend slow changes or complex causalities.

*Directive 4: Be AWESOME*

AWESOME is my acronym to describe the viewpoint and tone of this book:

**A**gnostic / Atheist

**W**orldly

**E**xistential

**S**cientific / Statistical

**O**bjective

**M**oderate

**E**ducated

It's all too easy to let belief take over reality. Any serious inquiry to arrive at the truth must be open-minded about evidence and not take any single culture's beliefs as a given. We have to honor the scientific process and accept the answers it gives us. My [AWESOME manifesto](#) is a work in progress. I also welcome you to join my Facebook group, [AWESOME thought](#).

**D. Thanks!**

I'm lucky that I found a few friends and relatives kind enough to act as single-chapter test readers. Their feedback truly led to revisions making the book more clear, concise, and compelling. Thanks to Robert Rafii (Chs. 10 and 3), Mike Paradis (9), Marc Fienberg (8), Anthony Zimmer (7 and 1), Andrew Spathis (5), Taletha Derrington (4), and Shad Fagerland (2). I especially appreciate Laurance Ginsberg (Ch. 6), the only stranger to participate. The grand prize goes to my poor old friend Mike Hoskins, who volunteered to read eight chapters!

Expert readers are even more scarce. I am particularly appreciative of professors Carsten Wiuf and Alan Templeton, who both wrote papers cited in the book. They were the only experts who accepted my request to check my characterization of their research. Professors Edwin Taylor and Harry Noller were kind enough to grant me permission to use images that they had created.

You can't judge a classic book by its cover, but everyone judges a new book by its cover. This book wouldn't be the same without the talents of cover artist Andy Meaden.

Scot Fagerland  
Los Angeles, CA  
2008 – 2021

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### ***III. Introduction***

#### **A. History's Ten Time Scales**

Every chapter in this book measures a power of ten years. This kind of numbering is called a logarithmic scale, and it enables us to give equal attention to all periods of the past. Without it, an all-time history gets dominated by the longest time scales to such an extreme that the smallest ones become invisible. If this book were a linear timeline of the universe, then our species would be limited to the very last two words, *Homo sapiens!*

To represent the progressive “zooming in”, the chapters are numbered in reverse according to their logarithms. The first chapter in the book covers the universe’s entire ten-billion year lifetime, and ten billion is the *tenth* power of ten, so it is numbered as “Chapter 10”. The last chapter addresses the last few decades, and a decade is just *one* iteration of ten years, so it is numbered as “Chapter 1”. “A few” decades means “about three.” That is, events of the last three decades belong in Chapter 1. Events from four – five decades ago are logarithmically closer to 100 years ago than to 10, so they are more appropriate for Chapter 2, the last few centuries. \*

This table previews some of the highlights of each chapter. The abbreviations TYA, MYA, and BYA stand for Thousand, Million, and Billion Years Ago.

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\* Optional advanced explanation: This is because 3 is close to the square root of 10, which is midway between 1 and 10 in a logarithmic sense.

<b>Chapter</b>	<b>Time Scale (Years)</b>	<b>Dates</b>	<b>Most Important Events or Trends</b>
10	Ten billion	14 – 3 BYA	Formation of universe, solar system, and Earth. Beginning of life and evolution.
9	Billion	3 BYA – 300 MYA	Sexual reproduction. Plants and oxygen. Animals, vertebrates, life on land.
8	Hundred million	300 – 30 MYA	Present-day continents. Fossil fuels. Dinosaurs and mass extinction. Mammals, primates. The neocortex of the brain.
7	Ten million	30 – 3 MYA	Apes and hominins. Global cooling and ecological diversification.
6	Million	3 MYA – 300 TYA	Ice ages. Early humans and biological human nature. The big brain bang. Fire and stone technology.
5	Hundred thousand	300 – 30 TYA	Modern humans. Abstract thought, language, culture. Natural religion and drugs.
4	Ten thousand	30 – 3 TYA	Interglacial and agriculture. Americans. First civilizations. Organized religion. Writing. Wealth and power.
3	Thousand	3 TYA to 1700	Classic civilizations. Empires and world religions. Renaissance. Capitalism. Logic and Science.
2	Hundred	1700 – 1990	Enlightenment. Industrial Revolution, computers. Globalism, socialism. World Wars. Birth control. Secularization. “Left and right” politics.
1	Ten	1990s – 2010s	Web and mobile computing. Today’s four superpowers. AIDS and genetics. Global financial crisis. Millennials.

A "Chapter 0" would cover just the last few years. Since that is less than the life cycle of a book, I will maintain Chapter 0 as a blog-only chapter, an ongoing series of essays about current events. Essays about older chapters may also be relevant as our understanding of history shifts. "Margin Notes" for each chapter will be devoted to current discoveries about past events and connections from the past to the present. Over the course of my lifetime, I hope to expand each chapter into its own book.

## B. Science and Religion

You can see that the history of everything unavoidably takes us into the epistemology of science and religion. The first half of the book is devoted to “origins” (or “genesis”, if you like): how the world and human beings came to be, according to science. In Chapter 5, we take an interesting turn when modern humans started to self-reflect on their nature and origins. Then they essentially inhabited two mutually influential worlds, the real and the imagined. Only in chapter 3 did philosophers begin to question human instincts about reality, but by that time every culture was already grounded on supernatural beliefs. In chapter 2, epistemology played a major role in permanently changing the relationship between people and their governments. Now, religion and science are playing out in the struggles of ordinary but diverse people to share the world.

Good scientists pride themselves on asking tough questions and accepting hard-won answers. They don't claim to *have* “all the answers”. \* Nature has mysteries. Some mysteries are so deep and profound that they have an eternal hold on the imagination. I single out four specific mysteries as the great questions at the frontiers of science. They are nestled inside each other. In decreasing order, they are:

1. The origin of the universe (Ch. 10)
2. The origin of life (Ch. 10)
3. The nature of consciousness (Ch. 9)
4. The origins and workings of language (Ch. 5)

These are the fundamental questions that curious people can't help being curious about. So far, these questions have not yet been fully answered in terms of known *natural* principles. That is why they are so subject to *supernatural* speculations. The frontier questions are in fact the doorways that lead out of the suite of settled science, through the hall of hypotheses, and usually right into the room of religion. Today, these questions are all wrapped up in religious traditions that billions of people look to for solace, morality, and identity. That makes the truth-and-belief discussion an emotional one, especially when it is unguided. I hope that this book can help to guide discussions by clarifying what science has to say. Despite lingering mysteries, science has answered millions of questions that had baffled the greatest minds until recently. We now possess

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\* If science already had all the answers, nobody would be “doing science” anymore!

an astonishingly sophisticated understanding of events and processes that occurred well beyond our place or time – even in circumstances close to the frontiers.

An introduction often leads into a book by summarizing the events that transpired beforehand. That's not an option for this book, which begins at the very beginning of time! If you're ready, let's just dive right in with nature's greatest mystery of them all: The day the universe began.

## BACK MATTER

### I. *Conclusions*

Every book has a special relationship with its past, present, and future. This book's past forms its very subject matter. Its present is the 2010's, when I am writing it. My world history is very different from Herodotus' or H.G. Wells', because they each had their own present frames. Now the book lives on in its future when you read it. As I wrap up the incredible journey of writing *TEOH*, I would like to conclude by reflecting on my place in this past, present, and future.

#### A. The Past

A complete picture of the past requires principles as well as happenstance. Principles are the laws of nature like physics, chemistry, and geology. They tell us the rules that the world has been constrained to follow, like the rules of a sport. People go to live sporting events because they want to see the happenstance. It's the random unfolding of a game, not the rules alone, that determines the final outcomes.

Think of all the happenstance that brought us to where we are today. A nearby supernova triggered the coalescing of our solar system. The Earth ended up in a lucky orbit, the sun's habitable zone. This book covered an endless series of happenstance. Some of the circumstances that shaped the human mind and body are long forgotten, like the evolution of eyes and arms good for swinging through fruit trees. Yet we wouldn't be the same without them.

Sometimes, we can't distinguish between principle and happenstance. In a habitable zone, is ocean chemistry *bound* to yield up DNA? Or was that a one-off on our planet alone?

I vacillated endlessly about the title of this book. "Evolution" is a hot-button word. Many people, especially the people that I really wish would read this book, will be instantly repelled by that single word in the title (evidence filtering at its purest!) But there's no way I could write a history of life without evolution, so what's the point of a "euphemistic" title? Evolution is the most fundamental and overarching principle of all. It can't predict any of the happenstance, like photosynthesis or feathers or mass extinctions, but it ties them all together into a coherent theory.

Evolution draws the connection between past and present. Those with us on Earth today are here for no other reason than that their ancestors were good at surviving and reproducing.

The evolution that we studied in school had to do with genes, but similar principles act on memes, the reproductive units of human culture. From the worship of ancestral spirits to the decision to practice birth control, memes compete for cultural survival. In the end, again, those that are with us today are here not because they are right or true or preordained, but simply because they have been good at surviving and spreading.

## **B. The Present**

As we try to understand the past, we have no choice but to look through the neurological and cultural filters that are with us today.

Two related themes that came up repeatedly in my research were gradualism and categorization. The questions that we ask about history reflect the biases of our human psychology and attention spans. We want to know, “What caused X” and “When did Y first happen?” We like pat, precise answers. We like narratives and direct cause-effect sequences that we’d be able to watch in a movie. Yet when you look closely, you find that transitions were always blurry. Archaeologists once believed that modern human behavior erupted suddenly in Europe 40,000 years ago, because that’s what the available evidence showed. Then they started to find exceptions. Some demonstrations of modernity appeared earlier, and not all were in Europe. Now we must conclude that humans developed a continuum of behavior over 150,000 years and multiple continents. Nature does not progress in fits and starts; only discoveries do.

The origin of modernity now hinges on the definition of “modern”. That’s just a word, but we *think* in words. We expect the world to fit the word. Nature does not adhere to neat categories; our minds fabricate those.

Education and public knowledge are biased toward the most recent history. Although planetariums and dinosaur exhibits are very popular, the general public knows next to nothing about the “middle” Chapter 4 – 7 time scales. Until the scientific revolution, there was simply no body of knowledge to challenge the written record of the past. As scientists now make amazing new discoveries – written not in words but in fossils, landforms, isotopes, and DNA – they are dismissed with an undue amount of scorn and skepticism. Most likely, one of the reasons that the

middle chapters are poorly represented in public discourse is that they contradict religious beliefs. Most people simply “refuse to believe” the emergence of humans from the animal kingdom.

Many people also think that without religion there is no meaning. Yet we all want to know where we came from. Ancestor worship was one of the earliest religious practices. It is only natural to trace our ancestors as the generations grow exponentially. That’s where it gets really interesting! We are related to all life on Earth, and the very atoms in our body originated in stars. These profound origins are more transcendental to me than any mythology, and their power lies in their truth.

### C. The Future

This book has expressly tried to avoid predictive or normative language. Now that we are right up to the present, I hope you’ll humor me for a few closing paragraphs of contemplating, “Where do we go from here?”

Most institutions handed down to us from the past were not designed to be perfect, fair, true, or efficient for all time. They were simply good at surviving, mostly in environments very different from today. With that realization, we can now question yesterday’s traditions in today’s context and ponder different possibilities for the future.

To illustrate with one quick example, we could ask, “Why are there so many dictators?”<sup>1</sup> Consider that governments originally evolved as belligerent monarchies to outlast one another. The European holy wars ended in stalemate, locking in “national sovereignty”, an ideal that became almost sacred and then globalized by the UN.<sup>2</sup> These are explanations, but they’re not *good reasons* to tolerate autocracy anymore. Maybe we can find innovative solutions to make all nations free.

How liberating! How terrifying! Social self-realization is already starting to blossom, and the world is changing quickly. It’s changing too rapidly for many people; we must balance the competing needs of progress and stability. That’s why liberals and conservatives need to communicate instead of trying to run each other off the road.

Beyond specific policy decisions, we must more broadly decide how to view the world and each other. Humans evolved to be politico-religious thinkers in small communities. This mindset *survives*. The problem is that it leads to an endless series of untruths, some of which become toxic.

(If you need any convincing of mass delusion, just remember that most people don't believe your religion or political party. They're all fools! 😊) We are not programmed to care about people in different "categories". We can filter evidence to justify any ideology.

Now that we live in a global information age, our politico-religious intuitions sometimes do more harm than good. Is it time to start thinking about the global greater good? How about policy based less on politics, false narratives, and emotional impulses and more on a brutally honest approach to truth?

Logic and science are the only mental tools designed to dig for truth. Unfortunately, they've been a hard sell. They are upstarts among the ancient paradigms, and they are not instinctive. Everyone who's suffered through high school math knows that our brains didn't evolve for it. Most people still turn to politics and religion for the comfortable illusions that they are enlightened about the world and they occupy a special place within it. Science instead presents indifferent laws of nature. But there is comfort in that too. The laws of nature are eternal; we can rely on them. They are universal, binding us all together. They teach us about ourselves.

I think that religious people and I share the faith that the world is 90% beautiful, 9% imperfect, and 1% terrible. We have the wherewithal to address the imperfect and the terrible, especially if we cooperate to meet nature on its own terms. In this millennium, change need not come from gods or world leaders. It may be up to ordinary people to think critically, raise their children well, and forge friendships across borders.

I'll hand it over to you now, future reader. We're counting on you!

## ***II. About The Writer***

**Scot Fagerland** is a tutorney, a rare hybrid breed of solopreneur. He is a professional tutor (sometimes to the rich or famous) in Los Angeles, CA. He tutors most academic subjects, specializing in math, science, and standardized exams for high school, college, and graduate students. This follows two decades as an adjunct instructor of mathematics at several two- and four-year colleges. He was twice nominated for General Studies Instructor of the Year at the Fashion Institute of Design and Merchandising, where he taught statistics and economics. Scot is also a small-business attorney specializing in patents. He holds a BS in Applied Mathematics from the California Institute of Technology, an MS in Engineering Science from the University of California at San Diego, and a JD from the UCLA School of Law. Since 2014, Scot has blogged about all scales of history and prehistory at [www.TheEvolutionOfHuman.com](http://www.TheEvolutionOfHuman.com). He is also an active amateur genealogist on a lifelong quest to find and visit as many of his ancestors' graves as possible.

## ***III. About The Cover***

It is much easier to visualize astronomical scales of time three-dimensionally (with an hourglass) than with clock, timeline, or calendar models. The hourglass motif is used throughout the book and prominently on the cover. Within the glass, human civilization emerges from particles and time. The cast of onlookers represents the diversity of living humans and our ancestors from multiple time scales. Did you notice the small man standing on the hourglass base? At his scale, the glass has enough sand to last a century.

The back cover shows a geometric sequence of hourglasses, each of which (ignoring perspective) measures ten times the volume of the next one. This arrangement mirrors the chapters of the book. The first glass would last a million times as long as the seventh one.

Concept by Scot Fagerland, final design by [Andy Meaden](#).

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<sup>1</sup> World Population Review, “Dictatorship Countries”, <http://worldpopulationreview.com/countries/dictatorship-countries/> (updated regularly; accessed and archived 2/14/20).

<sup>2</sup> Henry Kissinger, *World Order*, Penguin Books (Kindle eBook edition, 2014), location 204.