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FLUKE

CHANCE, CHAOS, AND WHY *EVERYTHING* WE DO MATTERS

BRIAN KLAAS

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When we try to pick out anything by itself, we find it hitched to everything else in the Universe.

—John Muir

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CHAPTER 1

INTRODUCTION

If you could rewind your life to the very beginning and then press play, would everything turn out the same?

On October 30, 1926, Mr. and Mrs. H. L. Stimson stepped off a steam train in Kyoto, Japan, and checked into room number 56 at the nearby Miyako Hotel. Once settled, they strolled through the former imperial capital, soaking up the city's autumnal explosion of color, as the Japanese maples turned crimson and the ginkgo trees burst into a golden shade of yellow, their trunks rising above a bed of lush green moss. They visited Kyoto's pristine gardens, tucked into the mudstone hills that frame the city. They marveled at its historic temples, the rich heritage of a bygone shogunate embedded in each timber. Six days later, Mr. and Mrs. Stimson packed up, paid their bill, and left.

But this was no ordinary tourist visit. The Stimson name in the ledger at the Miyako Hotel would become a historical record, a relic marking a chain of events in which one man played God, sparing one hundred thousand lives while condemning a similar number to death elsewhere. It was, perhaps, the most consequential sightseeing trip in human history.

Nineteen years later, far from the Japanese maples, in the sagebrush-dotted hills of New Mexico, an unlikely group of physicists and generals gathered at a top-secret location code-named Site Y. It was May 10, 1945, three days after the Nazis had surrendered. The focus now shifted to the

Pacific, where a bloody war of attrition seemed to have no end in sight. However, in this remote outpost of New Mexico, the scientists and soldiers saw a potential savior: a new weapon of unimaginable destruction that they called the Gadget.

No successful test had yet been carried out to demonstrate the weapon's full potential, but everyone at Site Y sensed they were getting close. In preparation, thirteen men were asked to join the Target Committee, an elite group that would decide how to introduce the Gadget to the world. Which city should be destroyed? They agreed targeting Tokyo wasn't a good idea, as heavy bombing had already devastated the new capital. After weighing up the alternatives, they agreed on a target. The first bomb would be dropped on Kyoto.

Kyoto was home to new wartime factories, including one that could churn out four hundred aircraft engines per month. Furthermore, leveling a former capital would deal a crushing blow to Japan's morale. The Target Committee also noted a small, but perhaps crucial, point: Kyoto was an intellectual hub with an educated population, home to the prestigious Kyoto University. Those who survived would, the committee supposed, recognize that this weapon represented a new era in human history—and that the war had already been lost. The Target Committee agreed: Kyoto must be destroyed.

The committee also agreed on three backup targets: Hiroshima, Yokohama, and Kokura. The target list was sent to President Truman. All they needed to do was wait for the bomb to be ready.

The Atomic Age dawned on July 16, 1945, with a successful test explosion in the vast emptiness of rural New Mexico. The Target Committee's decisions were no longer theoretical. Military strategists consulted detailed maps of Kyoto and decided on ground zero for the explosion: the city's railway yards. The intended blast site was only half a mile away from the Miyako Hotel, where Mr. and Mrs. H. L. Stimson had stayed two decades earlier.

INTRODUCTION

On August 6, 1945, the bomb code-named Little Boy fell from the sky not on Kyoto, but on Hiroshima, dropped from the *Enola Gay*. As many as 140,000 people were killed, most of them civilians. Three days later, on August 9, *Bockscar* dropped Fat Man on Nagasaki, adding roughly 80,000 casualties to the horrifying death toll.

But why was Kyoto spared? And why was Nagasaki—a city that hadn't even been considered a top-tier bombing target—destroyed? Remarkably, the lives of roughly two hundred thousand people teetered between life and death because of a tourist couple and a cloud.

By 1945, Mr. H. (Henry) L. Stimson had become America's secretary of war, the top civilian overseeing wartime operations. As a man without a uniform, Stimson felt it was his job to develop strategic goals, not to micromanage generals on how best to achieve them. But that all changed when the Target Committee picked Kyoto for destruction.

Stimson sprang into action. In a meeting with the head of the Manhattan Project, Stimson put his foot down: "I don't want Kyoto bombed." In a discussion with the commander of the U.S. armed forces, Stimson insisted that there was "one city that they must not bomb without my permission and that was Kyoto." Yet, despite his insistence, Kyoto kept reappearing on the targeting list. It ticked all the boxes, the generals insisted. It needed to be bombed. Why, they wondered, was Stimson hell-bent on protecting a nerve center of the Japanese war machine?

The generals didn't know about the Miyako Hotel, the majestic Japanese maples, or the golden ginkgo trees.

Stimson, unwavering, went straight to the top. He met with President Truman twice in late July 1945, each time outlining his vehement opposition to destroying Kyoto. Truman finally relented. Kyoto was taken out of consideration. The final targeting list contained four cities: Hiroshima, Kokura, Niigata, and a late addition, Nagasaki. Stimson had saved what the generals called his "pet city." The first bomb was dropped on Hiroshima instead.

The second bomb was to be dropped on the city of Kokura. But as the B-29 bomber approached the city, cloud cover made it difficult to see the ground below. The clouds were unexpected. A team of army meteorologists had predicted clear skies. The pilot circled, hoping the clouds would clear. When they didn't, the crew decided to attack a secondary target rather than risking a botched drop. As they approached Nagasaki, that city was also obscured by cloud cover. With fuel running low, they made one last pass, and the clouds parted at the last possible minute. The bomb fell at 11:02 a.m. on August 9, 1945. Nagasaki's civilians were doubly unlucky: the city was a last-minute addition to the backup targeting list, and it was leveled because of a fleeting window of poor weather over another city. If the bomber had taken off a few minutes earlier or a few minutes later, countless residents of Kokura might have been incinerated instead. To this day, the Japanese refer to "Kokura's luck" whenever someone unknowingly escapes from disaster.

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Clouds spared one city, while one couple's vacation decades earlier saved another. The story of Kyoto and Kokura poses an immediate challenge to our convenient, simplified assumptions of cause and effect following a rational, ordered progression. We like to imagine that we can understand, predict, and control the world. We want a rational explanation to make sense of the chaos of life. The world isn't supposed to be a place where hundreds of thousands of people live or die from decades-old nostalgia for one couple's pleasant vacation, or because clouds flitted across the sky at just the right moment.

Children incessantly ask the most important question there is: "Why?" And from a very young age, I, like you, learned that causes and effects follow straightforward patterns—from X to Y. It's a useful, stripped-down version of reality with precisely one cause and one

effect. It helps us navigate a more complex world, distilling everything that happens into clear-cut relationships that we can understand, then tame. Touching a hot stove causes pain. Smoking causes cancer. Clouds cause rain.

But in Japan, many decades ago, clouds were the immediate cause of something other than rain: mass death in one city rather than another. More peculiar still, that mass death can only be explained through the combination of a near-infinite array of arbitrary factors that had to connect together in just the right way to lead to the mushroom clouds over Hiroshima and Nagasaki: the rise of Emperor Hirohito, Einstein being born rather than somebody else, uranium being forged by geological forces millions of years earlier, countless soldiers on foreign battlefields, brilliant scientists, the Battle of Midway, on and on, until finally the devastation hinged on one pivotal vacation and one pivotal cloud. If anything about the countless preceding factors had been slightly changed, everything could have been different.

Whenever we revisit the dog-eared pages within our personal histories, we've all experienced Kokura's luck (though, hopefully, on a less consequential scale). When we consider the what-if moments, it's obvious that arbitrary, tiny changes and seemingly random, happenstance events can divert our career paths, rearrange our relationships, and transform how we see the world. To explain how we came to be who we are, we recognize pivot points that so often were out of our control. But what we ignore are the invisible pivots, the moments that we will never realize were consequential, the near misses and near hits that are unknown to us because we have never seen, and will never see, our alternative possible lives. We can't know what matters most because we can't see how it might have been.

If hundreds of thousands of people could live or die based on one couple's vacation choice decades earlier, which seemingly trivial choices or accidents could end up drastically changing the course of your life,

even far into the future? Could being late to a meeting or missing an exit off the highway not just change your life, but alter the course of history? And if that happened, would you even realize it? Or would you remain blind to the radically different possible world you unknowingly left behind?

There's a strange disconnect in how we think about the past compared to our present. When we imagine being able to travel back in time, the warning is the same: make sure you don't touch *anything*. A microscopic change to the past could fundamentally alter the world. You could even accidentally delete yourself from the future. But when it comes to the present, we never think like that. Nobody tiptoes around with extreme care to make sure not to squish the wrong bug. Few panic about an irrevocably changed future after missing the bus. Instead, we imagine the little stuff doesn't matter much because everything just gets washed out in the end. But if every detail of the past created our present, then *every* moment of our present is creating our future, too.

In 1941, four years before the atomic bombs were dropped, the Argentine author Jorge Luis Borges wrote a short story titled "The Garden of Forking Paths." The central metaphor of the story is that humans are wandering through a garden in which the paths available to us are constantly shifting. We can survey the future and see infinite possible worlds, but in any given moment we must nonetheless decide where to take our next step. When we do, the possible paths before us change, forking endlessly, opening up new possible futures and closing others down. Every step is important.

But the most astonishing revelation is that our paths are not determined solely by us. Instead, the garden we live in has grown and been tended by everything and everyone that came before us. The paths open to us are the offshoots of past histories, paved by the past steps others have taken. More disorienting still, it is not just our steps that matter because the paths through our garden are also being constantly moved

by the decisions of living people that we will neither see nor meet. In the image Borges paints for us, the paths we decide between are relentlessly redirected, our trajectories diverted, by the peculiar details of other lives we never notice, those hidden Kyoto and Kokura moments that determine the contours of our existence.

Yet, when we try to explain the world—to explain who we are, how we got here, and why the world works the way it does—we ignore the flukes. The squished bugs, the missed buses, all of it we dismiss as meaningless. We willfully ignore a bewildering truth: but for a few small changes, our lives and our societies could be profoundly different. Instead, we return again and again to the stripped-down, storybook version of reality, as we seek new knowledge of straightforward causes and effects. X causes Y, and X is always a major factor, never a minor or random or accidental tweak. Everything can be measured, plotted onto a graph, and controlled with just the right intervention or "nudge." We are seduced by pundits and data analysts, soothsayers who are often wrong, but rarely uncertain. When given the choice between complex uncertainty and comforting—but wrong—certainty, we too often choose comfort. Perhaps the world isn't so simple. Can we ever understand a world so altered by apparent flukes?

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On June 15, 1905, Clara Magdalen Jansen killed all four of her children, Mary Claire, Frederick, John, and Theodore, in a little farmhouse in Jamestown, Wisconsin. She cleaned their bodies up, tucked them into bed, then took her own life. Her husband, Paul, came home from work to find his entire family under the covers of their little beds, dead, in what must have been one of the most horrific and traumatic experiences a human being can suffer.

There is a concept in philosophy known as *amor fati*, or love of one's

fate. We must accept that our lives are the culmination of everything that came before us. You may not know the names of all eight of your great-grandparents off the top of your head, but when you look in the mirror, you are looking at generational composites of their eyes, their noses, their lips, an altered but recognizable etching from a forgotten past. When we meet someone new, we can be certain of one fact: none of their direct ancestors died before having children. It's a cliché, but true, to say that you wouldn't exist if your parents had not met in just the same, exact way. Even if the timing had been slightly different, a different person would have been born.

But that's also true for your grandparents, and your great-grandparents, and your great-great-grandparents, stretching back millennia. Your life depends on the courting of countless people in the Middle Ages, the survival of your distant Ice Age ancestors against the stalking whims of a saber-toothed tiger, and, if you go back even further, the mating preferences of chimpanzees more than 6 million years ago. Trace the human lineage back hundreds of millions of years and all our fates hinge on a single wormlike creature that, thankfully for us, avoided being squished. If those precise chains of creatures and couples hadn't survived, lived, and loved just the way that they did, other people might exist, but *you* wouldn't. We are the surviving barbs of a chain-link past, and if that past had been even marginally different, we would not be here.

The Paul who came home to that little farmhouse in Wisconsin was my great-grandfather, Paul F. Klaas. My middle name is Paul, a family name enshrined by him. I'm not related to his first wife, Clara, because she tragically severed her branch of the family tree just over a century ago. Paul got remarried, to my great-grandmother.

When I was twenty years old, my dad sat me down, showed me a 1905 newspaper clipping with the headline "Terrible Act of Insane Woman," and revealed the most disturbing chapter in our family's modern history. He showed me a photo of that Klaas family gravestone

in Wisconsin, all the little kids on one side, Clara on the other, their deaths listed on the same date. It shocked me. But what shocked me even more was the realization that if Clara hadn't killed herself and murdered her children, I wouldn't exist. My life was only made possible by a gruesome mass murder. Those four innocent children died, and now I am alive, and you are reading my thoughts. *Amor fati* means accepting that truth, even embracing it, recognizing that we are the offshoots of a sometimes wonderful, sometimes deeply flawed past, and that the triumphs and the tragedies of the lives that came before us are the reason we're here. We owe our existences to kindness and cruelty, good and evil, love and hate. It can't be otherwise because, if it were, we would not be us.

"We are going to die, and that makes us the lucky ones," Richard Dawkins once observed. "Most people are never going to die because they are never going to be born. The potential people who could have been here in my place but who will in fact never see the light of day outnumber the sand grains of Arabia." These are the limitless possible futures, full of possible people, that Dawkins called "unborn ghosts." Their ranks are infinite; we are finite. With the tiniest adjustments, different people would be born, leading different lives, in a different world. Our existence is bewilderingly fragile, built upon the shakiest of foundations.

Why do we pretend otherwise? These basic truths about the fragility of our existence defy our most deeply held intuitions about how the world works. We instinctively believe that big events have big, straightforward causes, not small, accidental ones. As a social scientist, that's what I was taught to search for: the X that causes Y. Then, several years ago, I traveled to Zambia, in southern Africa, to study why a coup d'état attempt had failed. Was it because the political system was sufficiently stable? Or, perhaps, because of a lack of popular support for the putsch? I set off to discover the *real* reason.

The Zambian coup plot had been simple, but clever: the ringleader sent troops to kidnap the army commander. The plan was to force that general, at gunpoint, to announce the coup on the radio. With orders seemingly coming from the military brass, the plotters hoped the rest of the soldiers in the barracks would join the coup, and the government would collapse.

But when I interviewed soldiers who participated in the kidnapping attempt, everything I had been taught in tidy models of reality fell apart. As the soldiers ran into the house, the army commander leaped up from his bed, ran out the back door, and began climbing up the back of his compound's wall. One of the men I interviewed told me that he reached up to capture the general, grabbing his pant leg between his fingers. The army commander pulled himself up. The soldier tried to pull him down. As if in a slow-motion film, the fabric of the general's pant leg slipped through the soldier's fingertips, allowing the commander to clamber over the wall and escape. In a split second, the coup plot failed. If the soldier had been a millisecond quicker, his grip a tiny bit stronger, the regime would likely have collapsed. Democracy survived, quite literally, by a thread.

In his 1922 play, *Back to Methuselah*, George Bernard Shaw writes, "Some men see things as they are and ask, 'Why?' I dream things that never were and ask, 'Why not?'" How are we to make sense of a world in which our existence is predicated on a near-infinite number of past events that might have turned out differently? How are we to understand ourselves or our societies when one person's life is contingent on other people's deaths, as mine is, or where democracy survives by the thread of a pant leg? We can imagine alternate worlds as we contemplate a universe of infinite possibility. But we only have one world to observe, so we can't know what would've happened if small changes were made to the past. What if the Stimsons had missed their train to Kyoto in 1926 and had vacationed in Osaka instead? What if the bomber targeting

Kokura had taken off a few minutes later and the clouds had parted? What if my great-grandfather had come home early on that tragic day? The world would be different. But how?

I am a (disillusioned) social scientist. Disillusioned because I've long had a nagging feeling that the world doesn't work the way that we pretend it does. The more I grappled with the complexity of reality, the more I suspected that we have all been living a comforting lie, from the stories we tell about ourselves to the myths we use to explain history and social change. I began to wonder whether the history of humanity is just an endless, but futile, struggle to impose order, certainty, and rationality onto a world defined by disorder, chance, and chaos. But I also began to flirt with an alluring thought: that we could find new meaning in that chaos, learning to celebrate a messy, uncertain reality, by accepting that we, and everything around us, are all just flukes, spit out by a universe that can't be tamed.

Such intellectual heresy ran against everything I had been taught, from Sunday school to grad school. Everything happens for a reason; you just need to find out what it is. If you want to understand social change, just read more history books and social science papers. To learn the story of our species and how we came to be us, dive into some biology and familiarize yourself with Darwin. To grapple with the unknowable mysteries of life, spend time with the titans of philosophy, or if you're a believer, turn to religion. And if you want to understand the intricate mechanisms of the universe, learn physics.

But what if such enduring human mysteries are all part of the same big question?

Specifically, it's the biggest puzzle humanity must grapple with: *Why do things happen?* The more I read, year after year, the more I realized that there are no ready-made solutions to that enormous puzzle just waiting to be plucked from political science theories, philosophy tomes, economic equations, evolutionary biology studies, geology research,

anthropology articles, physics proofs, psychology experiments, or neuroscience lectures. Instead, I began to recognize that each of these disparate realms of human knowledge offers a piece that, when combined, can help us get closer to solving this bewildering puzzle. The challenge of this book is to try to join many of those pieces together, to yield a new, coherent picture that reframes our sense of who we are and how our world works.

When enough puzzle pieces snap together, a fresh image emerges. As we see it come into focus, there's hope that we can replace the comforting lies we tell ourselves with something that approaches a more accurate truth, even if it means that we must flip our entire, deeply ingrained worldview on its head. A fair warning: some of you may find that flip disorienting. But we already live in disorienting times—of conspiratorial politics and pandemics, economic shocks, climate change, and fresh society-bending magic, produced by the wizardry of artificial intelligence. In a world of rapid change, many of us feel lost in a sea of uncertainty. But when lost at sea, clinging to comforting lies will only help us sink. The best life raft may just be the truth.

We live in a more interesting and complex world than we are led to believe. If we gaze a little closer, then the storybook reality of neat, tidy connections might just give way to a reality defined much more by chance and chaos, an arbitrarily intertwined world in which every moment, no matter how small, can count.

In the coming pages, I aim to dispel some of the more damaging myths we pretend are true while exploring three facets of the human experience that can help us understand ourselves: *how our species came to be the way it is and why that matters to us; how our own entangled lives are diverted endlessly by arbitrary and accidental events beyond our control;* and *why we too often misunderstand the dynamics of modern society*. As I'll demonstrate, even the tiniest flukes can matter. As the late philosopher Hannah Arendt once put it, "The smallest act in the most

limited circumstances bears the seed of boundlessness, because one deed, and sometimes one word, suffices to change every constellation."

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Some of you may already be objecting to these bold claims and lofty quotes. If the storybook version of reality is a lie, and chance and chaos drive change more than we imagine, then why is there so much apparent order in our lives, in history, and in the universe? It's true: many facets of our lives are stable, dictated by regularities and comforting routine. Perhaps I'm overstating the case, and but for a few strange stories such as the one from Kyoto, most random encounters and happenstance events are merely inconsequential curiosities that don't matter.

For decades, the field of evolutionary biology has been divided by these two contrasting ways of viewing the world. One camp sees life as following a constrained, stable trajectory. Another isn't so sure, pointing to a perpetually branching tree of life, eternally diverted by chance and chaos. To frame this debate, biologists pose the question using opposing terms: Is the world *contingent* or *convergent*? The central question is whether evolution proceeds in predictable ways, regardless of freak events and random fluctuations, or if those contingencies can lead evolution down diverging paths. As we'll see, those terms don't just help us understand Darwinian theory and the beaks of finches in the Galápagos. They also provide a useful way of understanding why our own lives—and our societies—take unexpected turns.

Imagine our lives are like a film and you could rewind back to yesterday. Then, when you reach the start of your day, you change one small detail, such as whether you stopped to have coffee before you rushed out the door. If your day stayed mostly the same whether or not you paused to have your coffee, then that would be a convergent event. The details didn't matter much. What happened was bound to happen

regardless. The train of your life left the station a few minutes later but followed the same track. However, if you stopped to have coffee and everything about your future life unfolded differently, then that would be a contingent event because so much hinged on one small detail.

The natural world seems to seesaw between contingency and convergence. Sixty-six million years ago, an asteroid nine miles wide struck Earth with the force of 10 billion Hiroshima bombs. It crashed into gypsum-rich rock beneath the shallow sea of the Yucatán Peninsula. When the asteroid hit the gypsum, the explosion unleashed huge clouds of poisonous sulfur into the atmosphere. Vast amounts of pulverized rock were also thrown up into the atmosphere, creating intense friction that culminated in an "infrared pulse." The surface of the planet surged by 500°F, cooking dinosaurs at the same temperature as a broiled chicken.

The heat was so great after the impact that the survivors mostly fit into one of two groups: those who could burrow underground, or those that lived in the seas. When we look at animals alive today, from jungles to deserts, or, indeed, when we look in the mirror, we're seeing the offshoots of these asteroid survivors, an arbitrary branch of life largely descended from resourceful diggers.

Change one detail, and we can imagine a completely different world. If the asteroid had hit a moment earlier or later, it would have hit deep ocean instead of shallow seas, releasing far less toxic gas, and killing many fewer species. If the asteroid had been delayed by just one minute, it might have missed Earth entirely. Even more mind-boggling, Harvard astrophysicist Lisa Randall has proposed that the asteroid came from oscillations in the sun's orbit as it passes through dark matter. Those small gravitational disturbances, she argues, flung the asteroid from the distant Oort cloud toward our planet. But for one small vibration in an unfathomably distant reach of deep space, dinosaurs might have survived—and humans might never have existed. That's contingency.

Now, consider our eyes instead. We've evolved extraordinarily complex, specialized rod and cone cells in our retinas that allow us to sense light, which our brains can process and translate into vivid images of the world. Those abilities are crucial to our survival. But for most of Earth's history, animals didn't have eyes. That was, until a random mutation accidentally created a clump of light-sensitive cells. Those fortunate creatures could tell when they were in brighter or darker spaces, which helped them survive. Over time, this survival advantage was reinforced through evolution by natural selection. Eventually, we ended up with sophisticated eyes, derived from a mutation to a snippet of DNA called the PAX6 gene. At first glance, that random PAX6 mutation seems like another contingent event: our distant ancestors got lucky. Millions of years later, we can watch Netflix.

But when researchers began sequencing the genomes of creatures that are astonishingly different from us, such as squid and octopus, they discovered something remarkable. Octopus and squid eyes are extremely similar to our eyes. It turns out that octopus and squid eyes emerged independently from a separate but similar mutation of the PAX6 gene. Lightning struck twice in the same gene. Our evolutionary track and the evolutionary track of octopuses and squid diverged roughly 600 million years ago, but we ended up with more or less the same kind of eye. The implication isn't that both humans and squids both beat the odds and won the species lottery. Rather, the lesson is that nature sometimes converges toward the same effective solution when presented with the same problem—because only so many solutions will work. That's a crucial insight because it suggests that the bumps produced by small, seemingly chance events sometimes get smoothed out in the end. If octopus eyes and human eyes end up mostly doing the same thing, maybe tiny changes don't matter so much. Contingency might change how the discovery happens, but the outcome is similar. It's as though hitting the snooze button in the morning might delay your journey, but

not change your life path. You get to the same destination no matter what. That's convergence.

Convergence is the "everything happens for a reason" school of evolutionary biology. Contingency is the "stuff happens" theory.

These frameworks are useful for understanding ourselves. If our lives are driven by contingencies, then small fluctuations play a huge role in everything from our career trajectories to whom we marry and the children we have. But if convergence rules, then apparently random or chance events are more likely to be mere curiosities that don't radically change our lives. We could ignore the flukes.

For centuries, the dominant worldview in science and society has been defined by an unshakable faith in convergence. Newton's laws weren't supposed to be broken. Adam Smith wrote of an "invisible hand" that guides our behavior. Biologists initially resisted Charles Darwin's theories because they put too much emphasis on random chance and too little emphasis on elegant order. Uncertainty has long been shunned, shoved aside by rational-choice theories and clockwork models. Small variations are dismissed as "noise" that should be ignored, so we can focus on the real "signal." Even our famous quotes are infused with the neat logic of convergence. "The arc of the moral universe is long, but it bends toward justice." What it doesn't ever do, we are told, is bend at random.

Several decades ago, a heretic of evolutionary theory named Motoo Kimura challenged that conventional wisdom, insisting that small, arbitrary, and random fluctuations matter more than we think. As a child growing up in the 1920s, Kimura didn't seem destined for a life of academic study. He loathed going to school because he was taught in a system in which conformity and deference to accepted knowledge was required. Students who experimented with new ideas were disciplined. Knowledge meant order and certainty, transmitted down from authority. Kimura was naturally curious, but his school was no place for an inquisitive mind. Finally, in 1937, one teacher encouraged Kimura's

curiosity. Kimura discovered a hidden academic passion: botany. He vowed to devote his life to learning the secrets of plants.

Then, in 1939, Kimura and his entire family were sickened by food poisoning. His brother died. Kimura was stuck at home, recovering. Unable to study plants, he began to read about mathematics, inheritance, and chromosomes. His obsession with plants morphed into an obsession with understanding how change can be scripted into our genes. Kimura's career trajectory—and later the field of evolutionary biology—pivoted on a rotten meal.

As a budding evolutionary theorist, Kimura pored over the molecular building blocks of life. The closer he looked, the more he began to suspect that genetic mutations occurred without much rhyme or reason. Many were neither helpful nor harmful. Instead, he discovered that they were often random and meaningless, neutral changes. Whenever a mutation occurred, Kimura's predecessors searched for an explanation, a reason, something that made sense. Kimura just shrugged. Some things happen without reasons. Some things just are.

Kimura's discoveries reshaped the field of evolutionary biology, bringing fresh insights that have influenced several generations of scholars. But his ideas are broader than that. Kimura's thinking, as we will see, can help us better understand the complexity of our world and the flukes within it. Perhaps not everything happens for a reason. And maybe, in an intertwined world, the smallest changes can produce the biggest effects.

Kimura was also a living, breathing illustration of his own ideas, a walking advertisement for how arbitrary, interconnected changes can create contingency. In 1944, Kimura had set off for university, hoping to avoid being conscripted into Japanese military service. In August 1945, he was a student at Kyoto University. If Mr. and Mrs. H. L. Stimson had missed their train in 1926 and vacationed in Osaka instead, Motoo Kimura and his ideas would likely have been obliterated in a blinding flash of atomic light.

CHAPTER 2

CHANGING ANYTHING CHANGES EVERYTHING

The delusion of individualism in an entangled existence

Few have had quite so dramatic an escape as Motoo Kimura narrowly avoiding death by atomic bomb. But everyone can pinpoint a moment that, in hindsight, was a fluke that changed his or her life. Perhaps it was a more traditional pivot, such as a chance encounter with your future spouse, or taking a class in high school that diverted your career plans to a new passion. Or maybe it was a near miss, such as a swerve of the steering wheel that kept you alive, or having a generous offer rejected on a house or an apartment only to find something far better that you now call home. These moments stand out because they're obviously consequential. We contemplate what could have been. It's clear there was an alternative path. But for one small change, spouses never meet, passions remain undiscovered, near misses become fatal hits.

But these seem to be the outliers, the moments we marvel at precisely because they are so rare and unusual. We feel as though we construct our lives not with chance, but with the building blocks of large, hopefully wise, choices—choices that we feel we, alone, control. We may seek advice for which path to choose, but we would not seek advice for that which we can't control. (Nobody buys a self-help book for how to avoid

extinction from the next cataclysmic asteroid impact.) When we make big, life-altering decisions, it's obvious to us that we're changing our trajectories. Picking the right college. Working hard at our first job to set our career on the right track. Choosing the right person for a shared life. Focus on getting the big things right, we're told, and everything will be all right. Watch just about any inspirational TED Talk or read just about any self-help book, and you will be told that you, alone, are the solution that you seek. Those messages are popular because most of us view our lives through an individualist prism. Our life stories are not crowdsourced. Our major decisions define our path, which means *we* control our path. To understand that path, worship at the Altar of Me.

Every so often, though, we see a fleeting, perplexing glimpse of our path colliding with someone else's in a way that seems out of our control. We call those moments luck, or coincidence, or fate. But we classify them as aberrations. When the world functions "normally," life seems to have a predictable, well-ordered regularity, a regularity that we convince ourselves we can mostly direct, masters of our own destinies. Then, whenever we're confronted by strange coincidences or chance diversions that seem to challenge that confident certainty, we shrug at the brief respite from normality and move on, preparing ourselves to make the next big call that shapes our future. It's a style of thinking so ubiquitous and commonplace that it's uncontested. That's just how the world works.

There's just one problem: it's a lie. It's *the* lie that defines our times. We might call it the *delusion of individualism*. We cling to this delusion, the way a man overboard clings to floating debris. But every so often, a story comes along that makes clear how absurd it is to think of ourselves as separate or separable from everyone and everything else.

In the summer of 2022, a routine tragedy took place off the coast of Greece. A tourist named Ivan from North Macedonia was swept out to sea. His friends rushed to alert the coast guard, but the searches came

up empty. Ivan was declared lost at sea, presumed dead. Then, eighteen hours later, Ivan was found. Miraculously, he was alive. It seemed impossible. But just before he slipped below the waves to drown, Ivan had spotted a small soccer ball, floating on the surface in the distance. He swam over to it with his last ounce of strength. He clung to it through the night and was rescued. The ball saved his life.

When Ivan's tale of survival made the Greek news, a mother of two boys reacted with shock. She recognized the ball Ivan was holding. Her two boys were playing with that exact ball ten days earlier when one of them accidentally kicked it into the sea. The ball had bobbed across the waves for eighty miles, until it converged with a drowning swimmer at precisely the right moment. The boys had thought little of the lost ball. They shrugged and bought a new one. Only later did they realize that without their accidental kick, Ivan would now be dead.

The real story of our lives is often written in the margins. Small details matter, and even the apparently insignificant choices of people we will never meet can seal our own fates—though most of us will never see that quite so clearly as Ivan did. The crucial mistake is to pretend Ivan is an outlier, a break from the normal way the world works. He's not. Rather, Ivan just accidentally caught a clear glimpse of what's happening around us constantly in our entangled existence, all while we ignore it because we're blinkered by a delusional worldview that assumes we're independent units solely in charge of our own lives.

The tapestry of life is woven with a magical sort of thread, one that grows longer the more you unspool it. Every present moment is created with seemingly unrelated strands that stretch far into the distant past. Whenever you tug on one thread, you'll always meet unexpected resistance because each is connected to every other part of the tapestry. The truth is, as Martin Luther King Jr. wrote in his letter from a Birmingham jail, "We are caught in an inescapable network of mutuality, tied in a single garment of destiny."

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In 1814, a French polymath named Pierre-Simon Laplace was grappling with the enduring mysteries of such an intertwined existence. Why are we so bad at predicting our futures? Why do events so often surprise us? Is it possible to understand why the world changes, so we can better control it?

Laplace's mathematical genius stood on the shoulders of Isaac Newton, a man who must have seemed superhuman to his scientific contemporaries. Before Newton, the world was a wild enigma, impossible to decipher, closely guarding her secrets. Newton cracked the code and discovered many of those secrets, which he wrote as "laws" that explained the regular and predictable behavior of bodies in motion. Newton's laws created a profound shift, not just in our understanding of the universe, but also in our philosophical perspective toward it. In the ancient past, change and calamity were ascribed to the machinations of the gods. Ships were wrecked and towers crumbled because men had angered the immortals or failed to pay them sufficient tribute. Newton sent such interventionist deities into retirement. No longer did we need god(s) to explain every minute change in our lives or in the natural world. We just needed a supernatural power to explain where the laws that govern the universe came from in the first place. God may have created the clock, but Newton's laws kept it ticking.

That gave Laplace an idea. If we live in a clocklike universe governed by rigid laws, then understanding the mechanisms of the clock should allow us to predict the future with complete accuracy. A fuzzy world could be brought into sharp focus. We could see the future as clearly as we see the present. We just needed the right tools. After all, before the scientific revolution, accurately predicting the motion of billiard balls on a table would have seemed like wizardry. With Newton's laws, the equations of mathematics and physics gave you the power to

do magic, to see the future. Could the whole universe be transformed into something that's entirely predictable?

Laplace surmised that every event, every gust of wind, every molecule, is governed by a rigid set of scientific rules: Newton's unbending laws of nature. Therefore, if you wanted to predict whether someone playing billiards would sink a ball into the corner pocket, you'd need to understand the principles of Newtonian physics, the weight of the ball, the force and the angle used to strike the ball, but you'd also need to know the seemingly insignificant details: the temperature in the room, whether a breeze was coming in from an open door, or whether traces of chalk residue were left on the cue stick. But *if* you had all the necessary information—down to the level of the atoms in the ball and the air molecules floating around the room—Laplace figured that you'd have perfect accuracy at predicting where the billiard ball would end up. Then, he proposed a radical thought: What if humans are just like billiard balls, too, our lives knocking together, but following the same laws of nature?

Drawing on that logic, Laplace came up with an intriguing thought experiment. Imagine you had a supernatural creature—now referred to as Laplace's demon—with omniscient intelligence. It would have no power to change anything, but it could know, with absolute precision, every detail about every single atom in the universe, from the molecular building blocks for each grain of sand on Bondi Beach to the chemical composition of each bacterium in the darkest recesses of an armadillo's gut in Paraguay. If that being existed, Laplace suggested, "for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes." In other words, with perfect information, the demon would see reality across time and space like a solved jigsaw puzzle, so it would understand why everything was happening and could therefore know what would happen next. The drifting soccer ball surprised Ivan, but Laplace's demon—who could see clearly how