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Double-tap or move your cursor over the table and click to zoom.

TABLE 1 • THE CENTRAL TRIAD: THREE TYPES OF EXPOSURE

	FRAGILE	*ROBUST*	*ANTIFRAGILE*
Mythology—Greek	Sword of Damocles, Rock of Tantalus	Phoenix	Hydra
Mythology—New York and Brooklyn	Dr. John	Nero Tulip	Fat Tony, Yevgenia Krasnova*
Black Swan	Exposed to negative Black Swans		Exposed to positive Black Swans
Businesses	New York: Banking system		Silicon Valley: "Fail fast," "Be foolish"
Biological & economic systems	Efficiency, optimized	Redundancy	Degeneracy (functional redundancy)
Errors	Hates mistakes	Mistakes are just information	Loves mistakes (since they are small)
Errors	Irreversible, large (but rare) errors, blowups		Produces reversible, small errors
Science/technology	Directed research	Opportunistic research	Stochastic tinkering (antifragile tinkering or bricolage)
Dichotomy event-exposure	Studying events, measuring their risks, statistical properties of events	Studying exposure to events, statistical properties of exposures	Modifying exposure to events
Science	Theory	Phenomenology	Heuristics, practical tricks
Human body	Mollification, atrophy, "aging," sarcopenia	Mithridatization, recovery	Hormesis, hypertrophy

Ways of thinking	Modernity	Medieval Europe	Ancient Mediterranean
Human relationships	Friendship	Kinship	Attraction
Ancient culture (Nietzsche)	Apollonian	Dionysian	Balanced mixture of Apollonian and Dionysian
Ethics	The weak	The magnificent	The strong
Ethics	System without skin in the game	System with skin in the game	System with soul in the game
Regulation	Rules	Principles	Virtue
Systems	Concentrated sources of randomness		Distributed sources of randomness
Mathematics (functional)	Nonlinear-concave, or concave-convex	Linear, or convex-concave	Nonlinear-convex
Mathematics (probability)	Left-skewed (or negative skewed)	Low volatility	Right-skewed (or positive skewed)
Option Trading	Short volatility, gamma, vega	Flat volatility	Long volatility, "gamma," "vega"
Knowledge	Explicit	Tacit	Tacit with convexity
Epistemology	True-False		Sucker-Nonsucker
Life and thinking	Tourist, personal and intellectual		Flâneur with a large private library
Financial dependence	Corporate employment, Tantalized class	Dentist, dermatologist, niche worker, minimum-wage earner	Taxi driver, artisan, prostitute, f*** you money
Learning	Classroom	Real life, pathemata mathemata	Real life and library
Political systems	Nation-state; centralized		Collection of city-states; decentralized

Social system	Ideology		Mythology
	Post-agricultural modern settlements		Nomadic and hunter-gatherer tribes
Knowledge	Academia	Expertise	Erudition
Science	Theory	Phenomenology	Evidence-based phenomenology
Psychological well-being	Post-traumatic stress		Post-traumatic growth
Decision making	Model-based probabilistic decision making	Heuristic-based decision making	Convex heuristics
Thinkers	Plato, Aristotle, Averroes	Early Stoics, Menodotus of Nicomedia, Popper, Burke, Wittgenstein, John Gray	Roman Stoics, Nietzsche, Nietzsche perhaps Hegel (sublation), Jaspers
Economic life	Econophasters cults	Anthropologists	Religion
Economic life (effect on economic life)	Bureaucrats		Entrepreneurs
Reputation (profession)	Academic, corporate executive, pope, bishop, politician	Postal employee, truck driver, train conductor	Artist, writer
Reputation (class)	Middle class	Minimum-wage persons	Bohemian, aristocracy, old money
Medicine	*Via positiva* Additive treatment (give medication)		*Via negativa* Subtractive treatment (remove items from consumption, say cigarettes, carbs, etc.)
Philosophy/ science	Rationalism	Empiricism	Skeptical, subtractive empiricism

	Separable		Holistic
Economic life		Owner operated	
Finance	Short option		Long option
Knowledge	Positive science	Negative science	Art
Stress	Chronic stressors		Acute stressors, with recovery
Decision making	Acts of commission		Acts of omission ("missed opportunity")
Literature	E-reader	Book	Oral tradition
Business	Industry	Small business	Artisan
Food	Food companies		Restaurants
Finance	Debt	Equity	Venture capital
Finance	Public debt	Private debt with no bailout	Convertible
General	Large	Small but specialized	Small but not specialized
General	Monomodal		Barbell
Risk taking	Markowitz	Kelly criterion	Kelly criterion using finite bets
Legal system	Statutory law, legal code		Common law, equity
Regulation	Code of regulations		Heuristic regulations
Finance	Banks, hedge funds managed by econophasters	Hedge funds (some)	Hedge funds (some)
Business	Agency problem		Principal operated
Noise-signal	Signal only		Stochastic resonance, simulated annealing
Model error	Concave to errors		Convex to errors
Education	Soccer mom	Street life	Barbell: parental library, street fights

Physical training	Organized sports, gym machines		Street fights
Urbanism	Robert Moses, Le Corbusier		Jane Jacobs

* Dr. John, Nero Tulip, Fat Tony, and Yevgenia Krasnova are characters in *The Black Swan*. Nero Tulip is also a character in *Fooled by Randomness*.

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Double-tap or move your cursor over the table and click to zoom.

TABLE 2 • THE MECHANICAL AND THE ORGANIC (BIOLOGICAL OR NONBIOLOGICAL)

THE MECHANICAL, NONCOMPLEX	*THE ORGANIC, COMPLEX*
Needs continuous repair and maintenance	Self-healing
Hates randomness	Loves randomness (small variations)
No need for recovery	Needs recovery between stressors
No or little interdependence	High degree of interdependence
Stressors cause material fatigue	Absence of stressors cause atrophy
Age with use (wear and tear)	Age with disuse*
Undercompensates from shocks	Overcompensates from shocks
Time brings only senescence	Time brings aging and senescence

* Frano Barović reading this chapter wrote to me: "Machines: use it and lose it; organisms: use it or lose it." Also note that everything alive needs stressors, but not all machines need to be left alone—a point we will visit in our discussion of annealing.

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TABLE 3 • FRAGILIZING INTERVENTIONISM AND ITS EFFECTS ACROSS DISCIPLINES

FIELD	*EXAMPLE OF INTERVENTIONISM*	*IATROGENICS/ COSTS*
Medicine, Health	Overtreatment	Fragility
	Steady feeding, thermal stability, etc.—denying the human body randomness	Medical error
	Pharmaceutical addition, not subtraction	Sicker (but longer-living) humans, richer pharma, antibiotic-resistant bacteria
Ecology	Micromanaging forest fires	Worsening total risks—larger "big ones"
Politics	Central planning	Informational opacity
	U.S. supporting rotten regimes "for the sake of stability"	Chaos after a revolution
Economics	"No More Boom and Bust" (Greenspan (US), Labor (UK)), Great Moderation (Bernanke)	Fragility
	State interventionism	Deeper crises when they happen
	Optimization	Support for established, state-friendly corporations; stifling of entrepreneurs
	Illusion of pricing rare events, value-at-risk methodologies, illusion of economies of scale, ignorance of second-order effects	Vulnerability, pseudo-efficiency
		Big-time blowups
Business	Positive advice (charlatans), focus on return not risk (what to avoid)	Richer charlatans, bankrupt businesses
Urbanism	City planning	Urban blight, inner cities, depressions, crime
Forecasting	Forecasting in Black Swan Domain (Fourth Quadrant) in spite of the horrible track record	Hidden risks (people take more risks when supplied with a forecast)
Literature	Copy editors trying to change your text	Blander, more *New York Times*–style commoditized writing

Parenting	Soccer mom (or pop): removing every random element from children's lives	Touristification of children's minds
Education	The entire concept is grounded in interventionism	Ludification—transformation of children's brains
Technology	Neomania	Fragility, alienation, nerdification
Media	High-frequency sterile information	Disruption of the noise/signal filtering mechanism Interventionism

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Double-tap or move your cursor over the table and click to zoom.

TABLE 4 • THE DIFFERENCE BETWEEN THE TELEOLOGICAL AND OPTIONALITY

NARRATIVE KNOWLEDGE	*ANTIFRAGILE: OPTIONALITY-DRIVEN TINKERING, TRIAL AND ERROR*
Hates uncertainty (fragile to change, or turkey-style misunderstanding of the past)	Domesticates uncertainty (antifragile to the unknown)
Looks at the past, subject to overfitting to past	Looks at the future
Epimetheus	Prometheus
Teleological action	Opportunistic action
Tourist-style	Flâneur-style
Fragile, naive rationality	Robust rationality
Psychologically comfortable	Psychologically uncomfortable, but sense of thrill and adventure
Concave (visible known gains, unknown errors)	Convex (small known errors, large possible gains)
Subject to turkey problems (mistaking evidence of absence for absence of evidence)	Can benefit from suckers and turkey problems
Subject to epiphenomena and the green lumber fallacy	Escapes the green lumber fallacy
Academia's sole mechanism outside laboratory and physical science	Practice's main mechanism
Narrative is epistemological	Narrative is instrumental
Trapped into a story	No meaningful dependence on a story—the narrative can be just for motivation
Narrow domain, closed space of action	Broad domain, open space of action
Needs to understand logic of things	Little understanding is necessary, just rationality in comparing two outcomes (exercising the better option)
Doesn't benefit from the philosopher's stone (a.k.a. convexity bias; see Chapter 19)	Relies on the philosopher's stone

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TABLE 5 • THE LECTURING-BIRDS-HOW-TO-FLY EFFECT ACROSS DOMAINS: EXAMPLE OF MISATTRIBUTION OF RESULTS IN TEXTBOOKS

FIELD	*ORIGINATION AND DEVELOPMENT AS MARKETED BY BIRDS LECTURERS*	*REAL ORIGINATION AND DEVELOPMENT*
Jet Engine	Physicists (busted by Scranton)	Tinkering engineers with no understanding of "why it works"
Architecture	Euclidian geometry, mathematics (busted by Beaujouan)	Heuristics and secret recipes (guilds)
Cybernetics	Norbert Wiener (busted by Mindell)	Programmers "wiki-style"
Derivatives formulas	Black, Scholes, and Fragilista Merton (busted by Haug and Taleb)	Traders and practitioners, Regnauld, Bachelier, Thorp
Medicine	Biological understanding (busted by a long series of doctors)	Luck, trial and error, side effects of other medicines, or sometimes poisoning (mustard gas)
Industrial Revolution	Growth in knowledge, Scientific Revolution (busted by Kealey)	Adventurers, hobbyists
Technology	Formal science	Technology, businesses

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Double-tap or move your cursor over the table and click to zoom.

TABLE 6 • DOMAINS AND COMPARISON OF LIFE EXPECTANCY WHEN WE COMPARE THE "OLD" TO THE "YOUNG"

COMPARATIVE LIFE EXPECTANCY	*DOMAIN*	*PROBABILITY DISTRIBUTION*
The young is expected to live longer than the old.	Perishable: life of humans and other animals	Gaussian (or close, from same type of family)
Both the young and the old have equivalent life expectancy.	Non-perishable informational: lifetime of species	Exponential
LINDY EFFECT. The old is expected to stay longer than the young in proportion to their age.	Non-perishable informational: life of intellectual production, lifetime of genera	Power law

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Double-tap or move your cursor over the table and click to zoom.

TABLE 7 • ETHICS AND THE FOUNDATIONAL ASYMMETRY

NO SKIN IN THE GAME	*SKIN IN THE GAME*	*SKIN IN THE GAME FOR THE SAKE OF OTHERS, OR SOUL IN THE GAME*
(Keeps upside, transfers downside to others, owns a hidden option at someone else's expense)	*(Keeps his own downside, takes his own risk)*	*(Takes the downside on behalf of others, or universal values)*
Bureaucrats	Citizens	Saints, knights, warriors, soldiers
Cheap talk ("tawk" in Fat Tony's lingo)	Actions, no tawk	Expensive talk
Consultants, sophists	Merchants, businessmen	Prophets, philosophers (in the pre-modern sense)
Businesses	Artisans	Artists, some artisans
Corporate executives (with suit)	Entrepreneurs	Entrepreneurs/Innovators
Theoreticians, data miners, observational studies	Laboratory and field experimenters	Maverick scientists
Centralized government	Government of city-states	Municipal government
Editors	Writers	Great writers
Journalists who "analyze" and predict	Speculators	Journalists who take risks and *expose* frauds (powerful regimes, corporations)
Politicians	Activists	Rebels, dissidents, revolutionaries
Bankers	Traders	(They would not engage in vulgar commerce)
Fragilista Prof. Dr. Joseph Stiglitz	Fat Tony	Nero Tulip
Risk vendors		Taxpayers (not quite voluntarily soul in the game, but they are victims)

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Double-tap or move your cursor over the table and click to zoom.

TABLE 8 • COMPARING PROFESSIONS AND ACTIVITIES

INVITED TO BE OPPORTUNIST (FITS ETHICS TO PROFESSION)	*PROTECTED FROM PLAYING THE PSEUDOETHICS GAME*
Gold-digger	Prostitute
Networker	Social person
Compromises	Doesn't compromise
Someone "here to help"	Erudite, dilettante, amateur
Merchant, professional (Classical period)	Landowner (Classical period)
Employee	Artisan
Academic at a research university, researcher depending on "grants"	Lens maker, philosophy teacher in a college or Lycée high school, independent scholar

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TABLE 9 • THE FOUR DIFFERENT CLASSES OF PAYOFFS

Left Tail of the Distribution	*Right Tail of the Distribution*	*Condition*
Thin	Thick	Antifragile
Thick	Thick	Fragile (Type 1) [Very Rare]
Thick	Thin	Fragile (Type 2)
Thin	Thin	Robust

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TABLE 10

	THIN-TAILED DISTRIBUTION FOR X	*FAT-TAILED DISTRIBUTION FOR X*
$f(x)$ "mitigating" by clipping extreme outcomes, i.e., convex-concave	Very robust outcome	Quite robust outcome
$f(x)$ concave-convex, exacerbates remote outcomes	Robust outcome (sort of)	FOURTH QUADRANT Fragile (if $f(x)$ is concave) or antifragile

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Double-tap or move your cursor over the table and click to zoom.

TABLE 11 • RICARDO'S ORIGINAL EXAMPLE (COSTS OF PRODUCTION PER UNIT)

	CLOTH	*WINE*
Britain	100	110
Portugal	90	80

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Double-tap or move your cursor over the table and click to zoom.

TABLE 12

MODEL	*SOURCE OF FRAGILITY*	*REMEDY*
Portfolio theory, mean-variance, etc.	Assuming knowledge of the parameters, not integrating models across parameters, relying on (very unstable) correlations. Assumes ω_A (bias) and ω_B (fragility) = 0	1/n (spread as large a number of exposures as manageable), barbells, progressive and organic construction, etc.
Ricardian comparative advantage	Missing layer of randomness in the price of wine may imply total reversal of allocation. Assumes ω_A (bias) and ω_B (fragility) = 0	Natural systems find their own allocation through tinkering
Samuelson optimization	Concentration of sources of randomness under concavity of loss function. Assumes ω_A (bias) and ω_B (fragility) = 0	Distributed randomness
Arrow-Debreu lattice state-space	Ludic fallacy: assumes exhaustive knowledge of outcomes and knowledge of probabilities. Assumes ω_A (bias), ω_B (fragility), and ω_C (antifragility) = 0	Use of metaprobabilities changes entire model implications
Dividend cash flow models	Missing stochasticity causing convexity effects. Mostly considers ω_C (antifragility) =0	Heuristics

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TABLE 13 • KNOW HOW VS KNOW WHAT AND THEIR SIBLINGS

TYPE 1	*TYPE 2*
Know *what*	Know *how*
Explicit	Implicit, Tacit
Demonstrative knowledge	Nondemonstrative knowledge
Episteme	Techne
Epistemic base	Experiential knowledge
Propositional knowledge	**Heuristic**
Literal	Figurative
Targeted activity	Bricolage
Rationalism	**Empiricism**
Scholarship	Practice
Mathematics	Engineering
Inductive knowledge, using Aristotle's teleological principles	Epilogism (Menodotus of Nicomedia and the school of empirical medicine)
Causative historiography	*Historia a sensate cognitio*
Diagnostic	*Autopsia*
Letter of the law	Spirit of the law
Ideas	Customs
Ludic probability, statistics textbooks	Ecological uncertainty, not tractable in textbook
Logos	Mythos
Kerygma (the explainable and teachable part of religion)	Dogma (in the religious sense, the unexplainable)
Exoteric theology (Averroes and Spinoza)	Esoteric theology (Averroes and Spinoza)

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THE BLACK SWAN

The Impact of the Highly Improbable

NASSIM NICHOLAS TALEB

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CONTENTS

NOTE TO THE SECOND EDITION

In order to preserve the integrity of the original text, I have limited the updating of the current edition to a small number of footnotes. I added a long Postscript essay, going deeper into philosophical and empirical discussions of the subject and addressing some misunderstandings of the concept of the Black Swan that cropped up after the initial publication of the book.

PROLOGUE

ON THE PLUMAGE OF BIRDS

Before the discovery of Australia, people in the Old World were convinced that *all* swans were white, an unassailable belief as it seemed completely confirmed by empirical evidence. The sighting of the first black swan might have been an interesting surprise for a few ornithologists (and others extremely concerned with the coloring of birds), but that is not where the significance of the story lies. It illustrates a severe limitation to our learning from observations or experience and the fragility of our knowledge. One single observation can invalidate a general statement derived from millennia of confirmatory sightings of millions of white swans. All you need is one single (and, I am told, quite ugly) black bird.*

I push one step beyond this philosophical-logical question into an empirical reality, and one that has obsessed me since childhood.† What we call here a Black Swan (and capitalize it) is an event with the following three attributes.

First, it is an *outlier*, as it lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility. Second, it carries an extreme impact (unlike the bird). Third, in spite of its outlier status, human nature makes us concoct explanations for its occurrence *after* the fact, making it explainable and predictable.

I stop and summarize the triplet: rarity, extreme impact, and retrospective (though not prospective) predictability.* A small number of Black Swans explain almost everything in our world, from the success of ideas and religions, to the dynamics of historical events, to elements of our own personal lives. Ever since we left the Pleistocene, some ten millennia ago, the effect of these Black Swans has been increasing. It started accelerating during the industrial revolution, as the world started getting more complicated, while ordinary events, the ones we study and discuss and try to predict from reading the newspapers, have become increasingly inconsequential.

Just imagine how little your understanding of the world on the eve of the events of 1914 would have helped you guess what was to happen next. (Don’t

cheat by using the explanations drilled into your cranium by your dull high school teacher.) How about the rise of Hitler and the subsequent war? How about the precipitous demise of the Soviet bloc? How about the consequences of the rise of Islamic fundamentalism? How about the effect of the spread of the Internet? How about the market crash of 1987 (and the more unexpected recovery)? Fads, epidemics, fashion, ideas, the emergence of art genres and schools. All follow these Black Swan dynamics. Literally, just about everything of significance around you might qualify.

This combination of low predictability and large impact makes the Black Swan a great puzzle; but that is not yet the core concern of this book. Add to this phenomenon the fact that we tend to act as if it does not exist! I don't mean just you, your cousin Joey, and me, but almost all "social scientists" who, for over a century, have operated under the false belief that their tools could measure uncertainty. For the applications of the sciences of uncertainty to real-world problems has had ridiculous effects; I have been privileged to see it in finance and economics. Go ask your portfolio manager for his definition of "risk," and odds are that he will supply you with a *measure* that *excludes* the possibility of the Black Swan—hence one that has no better predictive value for assessing the total risks than astrology (we will see how they dress up the intellectual fraud with mathematics). This problem is endemic in social matters.

The central idea of this book concerns our blindness with respect to randomness, particularly the large deviations: Why do we, scientists or nonscientists, hotshots or regular Joes, tend to see the pennies instead of the dollars? Why do we keep focusing on the minutiae, not the possible significant large events, in spite of the obvious evidence of their huge influence? And, if you follow my argument, why does reading the newspaper actually *decrease* your knowledge of the world?

It is easy to see that life is the cumulative effect of a handful of significant shocks. It is not so hard to identify the role of Black Swans, from your armchair (or bar stool). Go through the following exercise. Look into your own existence. Count the significant events, the technological changes, and the inventions that have taken place in our environment since you were born and compare them to what was expected before their advent. How many of them came on a schedule? Look into your own personal life, to your choice of profession, say, or meeting your mate, your exile from your country of origin,

the betrayals you faced, your sudden enrichment or impoverishment. How often did these things occur according to plan?

What You Do Not Know

Black Swan logic makes *what you don't know* far more relevant than what you do know.* Consider that many Black Swans can be caused and exacerbated *by their being unexpected*.

Think of the terrorist attack of September 11, 2001: had the risk been reasonably *conceivable* on September 10, it would not have happened. If such a possibility were deemed worthy of attention, fighter planes would have circled the sky above the twin towers, airplanes would have had locked bulletproof doors, and the attack would not have taken place, period. Something else might have taken place. What? I don't know.

Isn't it strange to see an event happening precisely because it was not supposed to happen? What kind of defense do we have against that? Whatever you come to know (that New York is an easy terrorist target, for instance) may become inconsequential if your enemy knows that you know it. It may be odd that, in such a strategic game, what you know can be truly inconsequential.*

This extends to all businesses. Think about the "secret recipe" to making a killing in the restaurant business. If it were known and obvious, then someone next door would have already come up with the idea and it would have become generic. The next killing in the restaurant industry needs to be an idea that is not easily conceived of by the current population of restaurateurs. It has to be at some distance from expectations. The more unexpected the success of such a venture, the smaller the number of competitors, and the more successful the entrepreneur who implements the idea. The same applies to the shoe and the book businesses—or any kind of entrepreneurship. The same applies to scientific theories—nobody has interest in listening to trivialities. The payoff of a human venture is, in general, inversely proportional to what it is expected to be.

Consider the Indian Ocean tsunami of December 2004. Had it been expected, it would not have caused the damage it did—the areas affected would have been less populated, an early warning system would have been put in place. What you know cannot really hurt you.

Experts and "Empty Suits"

The inability to predict outliers implies the inability to predict the course of history, given the share of these events in the dynamics of events.

But we act as though we are able to predict historical events, or, even worse, as if we are able to change the course of history. We produce thirty-year projections of social security deficits and oil prices without realizing that we cannot even predict these for next summer—our cumulative prediction errors for political and economic events are so monstrous that every time I look at the empirical record I have to pinch myself to verify that I am not dreaming. What is surprising is not the magnitude of our forecast errors, but our absence of awareness of it. This is all the more worrisome when we engage in deadly conflicts: wars are fundamentally unpredictable (and we do not know it). Owing to this misunderstanding of the causal chains between policy and actions, we can easily trigger Black Swans thanks to aggressive ignorance—like a child playing with a chemistry kit.

Our inability to predict in environments subjected to the Black Swan, coupled with a general lack of the awareness of this state of affairs, means that certain professionals, while believing they are experts, are in fact not. Based on their empirical record, they do not know more about their subject matter than the general population, but they are much better at narrating—or, worse, at smoking you with complicated mathematical models. They are also more likely to wear a tie.

Black Swans being unpredictable, we need to adjust to their existence (rather than naïvely try to predict them). There are so many things we can do if we focus on antiknowledge, or what we do not know. Among many other benefits, you can set yourself up to collect serendipitous Black Swans (of the positive kind) by maximizing your exposure to them. Indeed, in some domains—such as scientific discovery and venture capital investments—there is a disproportionate payoff from the unknown, since you typically have little to lose and plenty to gain from a rare event. We will see that, contrary to social-science wisdom, almost no discovery, no technologies of note, came from design and planning—they were just Black Swans. The strategy for the discoverers and entrepreneurs is to rely less on top-down planning and focus on maximum tinkering and recognizing opportunities when they present themselves. So I disagree with the followers of Marx and those of Adam Smith: the reason free markets work is because they allow people to be lucky,

thanks to aggressive trial and error, not by giving rewards or "incentives" for skill. The strategy is, then, to tinker as much as possible and try to collect as many Black Swan opportunities as you can.

Learning to Learn

Another related human impediment comes from excessive focus on what we do know: we tend to learn the precise, not the general.

What did people learn from the 9/11 episode? Did they learn that some events, owing to their dynamics, stand largely outside the realm of the predictable? No. Did they learn the built-in defect of conventional wisdom? No. What did they figure out? They learned precise rules for avoiding Islamic prototerrorists and tall buildings. Many keep reminding me that it is important for us to be practical and take tangible steps rather than to "theorize" about knowledge. The story of the Maginot Line shows how we are conditioned to be specific. The French, after the Great War, built a wall along the previous German invasion route to prevent reinvasion—Hitler just (almost) effortlessly went around it. The French had been excellent students of history; they just learned with too much precision. They were too practical and exceedingly focused for their own safety.

We do not spontaneously learn that *we don't learn that we don't learn*. The problem lies in the structure of our minds: we don't learn rules, just facts, and only facts. Metarules (such as the rule that we have a tendency to not learn rules) we don't seem to be good at getting. We scorn the abstract; we scorn it with passion.

Why? It is necessary here, as it is my agenda in the rest of this book, both to stand conventional wisdom on its head and to show how inapplicable it is to our modern, complex, and increasingly *recursive* environment.*

But there is a deeper question: What are our minds made for? It looks as if we have the wrong user's manual. Our minds do not seem made to think and introspect; if they were, things would be easier for us today, but then we would not be here today and I would not have been here to talk about it—my counterfactual, introspective, and hard-thinking ancestor would have been eaten by a lion while his nonthinking but faster-reacting cousin would have run for cover. Consider that thinking is time-consuming and generally a great waste of energy, that our predecessors spent more than a hundred million

years as nonthinking mammals and that in the blip in our history during which we have used our brain we have used it on subjects too peripheral to matter. Evidence shows that we do much less thinking than we believe we do—except, of course, when we think about it.

A NEW KIND OF INGRATITUDE

It is quite saddening to think of those people who have been mistreated by history. There were the *poètes maudits*, like Edgar Allan Poe or Arthur Rimbaud, scorned by society and later worshipped and force-fed to schoolchildren. (There are even schools named after high school dropouts.) Alas, this recognition came a little too late for the poet to get a serotonin kick out of it, or to prop up his romantic life on earth. But there are even more mistreated heroes—the very sad category of those who we do not know were heroes, who saved our lives, who helped us avoid disasters. They left no traces and did not even know that they were making a contribution. We remember the martyrs who died for a cause that we knew about, never those no less effective in their contribution but whose cause we were never aware of—precisely because they were successful. Our ingratitude toward the *poètes maudits* fades completely in front of this other type of thanklessness. This is a far more vicious kind of ingratitude: the feeling of uselessness on the part of the silent hero. I will illustrate with the following thought experiment.

Assume that a legislator with courage, influence, intellect, vision, and perseverance manages to enact a law that goes into universal effect and employment on September 10, 2001; it imposes the continuously locked bulletproof doors in every cockpit (at high costs to the struggling airlines)—just in case terrorists decide to use planes to attack the World Trade Center in New York City. I know this is lunacy, but it is just a thought experiment (I am aware that there may be no such thing as a legislator with intellect, courage, vision, and perseverance; this is the point of the thought experiment). The legislation is not a popular measure among the airline personnel, as it complicates their lives. But it would certainly have prevented 9/11.

The person who imposed locks on cockpit doors gets no statues in public squares, not so much as a quick mention of his contribution in his obituary. “Joe Smith, who helped avoid the disaster of 9/11, died of complications of liver disease.” Seeing how superfluous his measure was, and how it squandered resources, the public, with great help from airline pilots, might well boot him out of office. *Vox clamantis in deserto*. He will retire depressed, with a great sense of failure. He will die with the impression of having done nothing useful. I wish I could go attend his funeral, but, reader, I can’t find him. And yet, recognition can be quite a pump. Believe me, even those who

genuinely claim that they do not believe in recognition, and that they separate labor from the fruits of labor, actually get a serotonin kick from it. See how the silent hero is rewarded: even his own hormonal system will conspire to offer no reward.

Now consider again the events of 9/11. In their aftermath, who got the recognition? Those you saw in the media, on television performing heroic acts, and those whom you saw trying to give you the impression that they were performing heroic acts. The latter category includes someone like the New York Stock Exchange chairman Richard Grasso, who "saved the stock exchange" and received a huge bonus for his contribution (the equivalent of several *thousand* average salaries). All he had to do was be there to ring the opening bell on television—the television that, we will see, is the carrier of unfairness and a major cause of Black Swan blindness.

Who gets rewarded, the central banker who avoids a recession or the one who comes to "correct" his predecessors' faults and happens to be there during some economic recovery? Who is more valuable, the politician who avoids a war or the one who starts a new one (and is lucky enough to win)?

It is the same logic reversal we saw earlier with the value of what we don't know; everybody knows that you need more prevention than treatment, but few reward acts of prevention. We glorify those who left their names in history books at the expense of those contributors about whom our books are silent. We humans are not just a superficial race (this may be curable to some extent); we are a very unfair one.

LIFE IS VERY UNUSUAL

This is a book about uncertainty; to this author, the rare event *equals* uncertainty. This may seem like a strong statement—that we need to principally study the rare and extreme events in order to figure out common ones—but I will make myself clear as follows. There are two possible ways to approach phenomena. The first is to rule out the extraordinary and focus on the "normal." The examiner leaves aside "outliers" and studies ordinary cases. The second approach is to consider that in order to understand a phenomenon, one needs first to consider the extremes—particularly if, like the Black Swan, they carry an extraordinary cumulative effect.

I don't particularly care about the usual. If you want to get an idea of a friend's temperament, ethics, and personal elegance, you need to look at him under the tests of severe circumstances, not under the regular rosy glow of daily life. Can you assess the danger a criminal poses by examining only what he does on an *ordinary* day? Can we understand health without considering wild diseases and epidemics? Indeed the normal is often irrelevant.

Almost everything in social life is produced by rare but consequential shocks and jumps; all the while almost everything studied about social life focuses on the "normal," particularly with "bell curve" methods of inference that tell you close to nothing. Why? Because the bell curve ignores large deviations, cannot handle them, yet makes us confident that we have tamed uncertainty. Its nickname in this book is GIF, Great Intellectual Fraud.

PLATO AND THE NERD

At the start of the Jewish revolt in the first century of our era, much of the Jews' anger was caused by the Romans' insistence on putting a statue of Caligula in their temple in Jerusalem in exchange for placing a statue of the Jewish god Yahweh in Roman temples. The Romans did not realize that what the Jews (and the subsequent Levantine monotheists) meant by *god* was abstract, all embracing, and had nothing to do with the anthropomorphic, too human representation that Romans had in mind when they said *deus*. Critically, the Jewish god did not lend himself to symbolic representation. Likewise, what many people commoditize and label as "unknown," "improbable," or "uncertain" is not the same thing to me; it is not a concrete and precise category of knowledge, a *nerdified* field, but its opposite; it is the lack (and limitations) of knowledge. It is the exact contrary of knowledge; one should learn to avoid using terms made for knowledge to describe its opposite.

What I call *Platonicity*, after the ideas (and personality) of the philosopher Plato, is our tendency to mistake the map for the territory, to focus on pure and well-defined "forms," whether objects, like triangles, or social notions, like utopias (societies built according to some blueprint of what "makes sense"), even nationalities. When these ideas and crisp constructs inhabit our minds, we privilege them over other less elegant objects, those with messier and less tractable structures (an idea that I will elaborate progressively throughout this book).

Platonicity is what makes us think that we understand more than we actually do. But this does not happen everywhere. I am not saying that Platonic forms don't exist. Models and constructions, these intellectual maps of reality, are not always wrong; they are wrong only in some specific applications. The difficulty is that a) you do not know beforehand (only after the fact) *where* the map will be wrong, and b) the mistakes can lead to severe consequences. These models are like potentially helpful medicines that carry random but very severe side effects.

The *Platonic fold* is the explosive boundary where the Platonic mind-set enters in contact with messy reality, where the gap between what you know and what you think you know becomes dangerously wide. It is here that the Black Swan is produced.

TOO DULL TO WRITE ABOUT

It was said that the artistic filmmaker Luchino Visconti made sure that when actors pointed at a closed box meant to contain jewels, there were real jewels inside. It could be an effective way to make actors live their part. I think that Visconti's gesture may also come out of a plain sense of aesthetics and a desire for authenticity—somehow it may not feel right to fool the viewer.

This is an essay expressing a primary idea; it is neither the recycling nor repackaging of other people's thoughts. An essay is an impulsive meditation, not science reporting. I apologize if I skip a few obvious topics in this book out of the conviction that what is too dull for me to write about might be too dull for the reader to read. (Also, to avoid dullness may help to filter out the nonessential.)

Talk is cheap. Someone who took too many philosophy classes in college (or perhaps not enough) might object that the sighting of a Black Swan does not invalidate the theory that *all swans are white* since such a black bird is not technically a swan since whiteness to him may be the essential property of a swan. Indeed those who read too much Wittgenstein (and writings about comments about Wittgenstein) may be under the impression that language problems are important. They may certainly be important to attain prominence in philosophy departments, but they are something we, practitioners and decision makers in the real world, *leave for the weekend*. As I explain in the chapter called "The Uncertainty of the Phony," for all of their intellectual appeal, these niceties have no serious implications Monday to Friday as opposed to more substantial (but neglected) matters. People in the classroom, not having faced many true situations of decision making under uncertainty, do not realize what is important and what is not—even those who are scholars of uncertainty (or *particularly* those who are scholars of uncertainty). What I call the practice of uncertainty can be piracy, commodity speculation, professional gambling, working in some branches of the Mafia, or just plain serial entrepreneurship. Thus I rail against "sterile skepticism," the kind we can do nothing about, and against the exceedingly theoretical language problems that have made much of modern philosophy largely irrelevant to what is derisively called the "general public." (In the past, for better or worse, those rare philosophers and thinkers who were not self-standing depended on a patron's support. Today academics in abstract disciplines depend on one

another's opinion, without external checks, with the severe occasional pathological result of turning their pursuits into insular prowess-showing contests. Whatever the shortcomings of the old system, at least it enforced *some* standard of relevance.)

The philosopher Edna Ullmann-Margalit detected an inconsistency in this book and asked me to justify the use of the precise metaphor of a Black Swan to describe the unknown, the abstract, and imprecise uncertain—white ravens, pink elephants, or evaporating denizens of a remote planet orbiting Tau Ceti. Indeed, she caught me red handed. There is a contradiction; this book is a story, and I prefer to use stories and vignettes to illustrate our gullibility about stories and our preference for the dangerous compression of narratives.*

You need a story to displace a story. Metaphors and stories are far more potent (alas) than ideas; they are also easier to remember and more fun to read. If I have to go after what I call the narrative disciplines, my best tool is a narrative.

Ideas come and go, stories stay.

THE BOTTOM LINE

The beast in this book is not just the bell curve and the self-deceiving statistician, nor the Platonified scholar who needs theories to fool himself with. It is the drive to "focus" on what makes sense to us. Living on our planet, today, requires a lot more imagination than we are made to have. We lack imagination and repress it in others.

Note that I am not relying in this book on the beastly method of collecting selective "corroborating evidence." For reasons I explain in Chapter 5, I call this overload of examples naïve empiricism—successions of anecdotes selected to fit a story do not constitute evidence. Anyone looking for confirmation will find enough of it to deceive himself—and no doubt his peers.* The Black Swan idea is based on the structure of randomness in empirical reality.

To summarize: in this (personal) essay, I stick my neck out and make a claim, against many of our habits of thought, that our world is dominated by the extreme, the unknown, and the very improbable (improbable according our current knowledge)—and all the while we spend our time engaged in small talk, focusing on the known, and the repeated. This implies the need to use the extreme event as a starting point and not treat it as an exception to be pushed under the rug. I also make the bolder (and more annoying) claim that in spite of our progress and the growth in knowledge, or perhaps *because* of such progress and growth, the future will be increasingly less predictable, while both human nature and social "science" seem to conspire to hide the idea from us.

Chapters Map

The sequence of this book follows a simple logic; it flows from what can be labeled purely literary (in subject and treatment) to what can be deemed entirely scientific (in subject, though not in treatment). Psychology will be mostly present in Part One and in the early part of Part Two; business and natural science will be dealt with mostly in the second half of Part Two and in Part Three. Part One, "Umberto Eco's Antilibrary," is mostly about how we perceive historical and current events and what distortions are present in such perception. Part Two, "We Just Can't Predict," is about our errors in dealing

with the future and the unadvertised limitations of some "sciences"—and what to do about these limitations. Part Three, "Those Gray Swans of Extremistan," goes deeper into the topic of extreme events, explains how the bell curve (that great intellectual fraud) is generated, and reviews the ideas in the natural and social sciences loosely lumped under the label "complexity." Part Four, "The End," will be very short.

I derived an unexpected amount of enjoyment writing this book—in fact, it just wrote itself—and I hope that the reader will experience the same. I confess that I got hooked on this withdrawal into pure ideas after the constraints of an active and transactional life. After this book is published, my aim is to spend time away from the clutter of public activities in order to think about my philosophical-scientific idea in total tranquillity.

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* The spread of camera cell phones has afforded me a large collection of pictures of black swans sent by traveling readers. Last Christmas I also got a case of Black Swan Wine (not my favorite), a videotape (I don't watch videos), and two books. I prefer the pictures.

† I used the logical metaphor of the black swan (not capitalized) for Black Swan Events (capitalized), but this problem should not be confused with the logical problem raised by many philosophers. This is not so much about exceptions as it is about the oversize role of extreme events in many domains in life. Furthermore, the logical problem is about the possibility of the exception (black swan); mine is about the *role* of the exceptional event (Black Swan) leading to the degradation of predictability and the need to be robust to negative Black Swans and exposed to positive ones.

* The highly expected *not happening* is also a Black Swan. Note that, by symmetry, the occurrence of a highly improbable event is the equivalent of the nonoccurrence of a highly probable one.

* The Black Swan is the result of collective and individual epistemic limitations (or distortions), mostly confidence in knowledge; it is not an objective phenomenon. The most severe mistake made in the interpretation of my Black Swan is to try to define an "objective Black Swan" that would be invariant in the eyes of all observers. The events of September 11, 2001, were a Black Swan for the victims, but certainly not to the perpetrators. The Postscript provides an additional discussion of the point.

* The Idea of Robustness: Why do we formulate theories leading to projections and forecasts without focusing on the robustness of these theories and the consequences of the errors? It is much easier to deal with the Black Swan problem if we focus on robustness to errors rather than improving predictions.

* *Recursive* here means that the world in which we live has an increasing number of feedback loops, causing events to be the cause of more events (say, people buy a book *because* other people bought it), thus generating snowballs and arbitrary and unpredictable planet-wide winner-take-all effects. We live in an environment where information flows too rapidly, accelerating such epidemics. Likewise, events can happen *because* they are not supposed to happen. (Our intuitions are made for an environment with simpler causes and effects and slowly moving information.) This type of randomness did not prevail during the Pleistocene, as socioeconomic life was far simpler then.

* The metaphor of the black swan is not at all a modern one—contrary to its usual attribution to Popper,

Mill, Hume, and others. I selected it because it corresponds to the ancient idea of a “rare bird.” The Latin poet Juvenal refers to a “bird as rare as the black swan”—*rara avis in terris nigroque simillima cygno*.

* It is also naïve empiricism to provide, in support of some argument, series of eloquent confirmatory quotes by dead authorities. By searching, you can always find someone who made a well-sounding statement that confirms your point of view—and, on every topic, it is possible to find another dead thinker who said the exact opposite. Almost all of my non–Yogi Berra quotes are from people I disagree with.

The writer Umberto Eco belongs to that small class of scholars who are encyclopedic, insightful, and nondull. He is the owner of a large personal library (containing thirty thousand books), and separates visitors into two categories: those who react with "Wow! Signore *professore dottore* Eco, what a library you have! How many of these books have you read?" and the others—a very small minority—who get the point that a private library is not an ego-boosting appendage but a research tool. Read books are far less valuable than unread ones. The library should contain as much of *what you do not know* as your financial means, mortgage rates, and the currently tight real-estate market allow you to put there. You will accumulate more knowledge and more books as you grow older, and the growing number of unread books on the shelves will look at you menacingly. Indeed, the more you know, the larger the rows of unread books. Let us call this collection of unread books an *antilibrary*.

We tend to treat our knowledge as personal property to be protected and defended. It is an ornament that allows us to rise in the pecking order. So this tendency to offend Eco's library sensibility by focusing on the known is a human bias that extends to our mental operations. People don't walk around with anti-résumés telling you what they have not studied or experienced (it's the job of their competitors to do that), but it would be nice if they did. Just as we need to stand library logic on its head, we will work on standing knowledge itself on its head. Note that the Black Swan comes from our misunderstanding of the likelihood of surprises, those unread books, because we take what we know a little too seriously.

Let us call an antischolar—someone who focuses on the unread books, and makes an attempt not to treat his knowledge as a treasure, or even a possession,

or even a self-esteem enhancement device—a skeptical empiricist.

The chapters in this section address the question of how we humans deal with knowledge—and our preference for the anecdotal over the empirical. Chapter 1 presents the Black Swan as grounded in the story of my own obsession. I will make a central distinction between the two varieties of randomness in Chapter 3. After that, Chapter 4 briefly returns to the Black Swan problem in its original form: how we tend to generalize from what we see. Then I present the three facets of the same Black Swan problem: a) *The error of confirmation*, or how we are likely to undeservedly scorn the virgin part of the library (the tendency to look at what confirms our knowledge, not our ignorance), in Chapter 5; b) *the narrative fallacy*, or how we fool ourselves with stories and anecdotes (Chapter 6); c) how emotions get in the way of our inference (Chapter 7); and d) *the problem of silent evidence*, or the tricks history uses to hide Black Swans from us (Chapter 8). Chapter 9 discusses the lethal fallacy of building knowledge from the world of games.

Chapter One

THE APPRENTICESHIP OF AN EMPIRICAL SKEPTIC

Anatomy of a Black Swan—The triplet of opacity—Reading books backward—The rearview mirror—Everything becomes explainable—Always talk to the driver (with caution)—History doesn't crawl; it jumps—"It was so unexpected"—Sleeping for twelve hours

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This is not an autobiography, so I will skip the scenes of war. Actually, even if it were an autobiography, I would still skip the scenes of war. I cannot compete with action movies or memoirs of adventurers more accomplished than myself, so I will stick to my specialties of chance and uncertainty.

ANATOMY OF A BLACK SWAN

For more than a millennium the eastern Mediterranean seaboard called Syria Libanensis, or Mount Lebanon, had been able to accommodate at least a dozen different sects, ethnicities, and beliefs—it worked like magic. The place resembled major cities of the eastern Mediterranean (called the Levant) more than it did the other parts in the interior of the Near East (it was easier to move by ship than by land through the mountainous terrain). The Levantine cities were mercantile in nature; people dealt with one another according to a clear protocol, preserving a peace conducive to commerce, and they socialized quite a bit across communities. This millennium of peace was interrupted only by small occasional friction *within* Moslem and Christian communities, rarely between Christians and Moslems. While the cities were mercantile and mostly Hellenistic, the mountains had been settled by all manner of religious minorities who claimed to have fled both the Byzantine and Moslem orthodoxies. A mountainous terrain is an ideal refuge from the mainstream, except that your enemy is the other refugee competing for the same type of rugged real estate. The mosaic of cultures and religions there was deemed an example of coexistence: Christians of all varieties (Maronites, Armenians, Greco-Syrian Byzantine Orthodox, even Byzantine Catholic, in addition to the few Roman Catholics left over from the Crusades); Moslems (Shiite and Sunni); Druzes; and a few Jews. It was taken for granted that people learned to be tolerant there; I recall how we were taught in school how far more civilized and wiser we were than those in the Balkan communities, where not only did the locals refrain from bathing but also fell prey to fractious fighting. Things appeared to be in a state of stable equilibrium, evolving out of a historical tendency for betterment and tolerance. The terms *balance* and *equilibrium* were often used.

Both sides of my family came from the Greco-Syrian community, the last Byzantine outpost in northern Syria, which included what is now called Lebanon. Note that the Byzantines called themselves “Romans”—*Roumi* (plural *Roum)* in the local languages. We originate from the olive-growing area at the base of Mount Lebanon—we chased the Maronite Christians into the mountains in the famous battle of Amioun, my ancestral village. Since the Arab invasion in the seventh century, we had been living in mercantile peace with the Moslems, with only some occasional harassment by the Lebanese Maronite Christians from the mountains. By some (literally) Byzantine arrangement between the

Arab rulers and the Byzantine emperors, we managed to pay taxes to both sides and get protection from both. We thus managed to live in peace for more than a millennium almost devoid of bloodshed: our last true problem was the later troublemaking crusaders, not the Moslem Arabs. The Arabs, who seemed interested only in warfare (and poetry) and, later, the Ottoman Turks, who seemed only concerned with warfare (and pleasure), left to us the uninteresting pursuit of commerce and the less dangerous one of scholarship (like the translation of Aramaic and Greek texts).

By any standard the country called Lebanon, to which we found ourselves suddenly incorporated after the fall of the Ottoman Empire, in the early twentieth century, appeared to be a stable paradise; it was also cut in a way to be predominantly Christian. People were suddenly brainwashed to believe in the nation-state as an entity.* The Christians convinced themselves that they were at the origin and center of what is loosely called Western culture yet with a window on the East. In a classical case of static thinking, nobody took into account the differentials in birthrate between communities and it was assumed that a slight Christian majority would remain permanent. Levantines had been granted Roman citizenship, which allowed Saint Paul, a Syrian, to travel freely through the ancient world. People felt connected to everything they felt was worth connecting to; the place was exceedingly open to the world, with a vastly sophisticated lifestyle, a prosperous economy, and temperate weather just like California, with snow-covered mountains jutting above the Mediterranean. It attracted a collection of spies (both Soviet and Western), prostitutes (blondes), writers, poets, drug dealers, adventurers, compulsive gamblers, tennis players, après-skiers, and merchants—all professions that complement one another. Many people acted as if they were in an old James Bond movie, or the days when playboys smoked, drank, and, instead of going to the gym, cultivated relationships with good tailors.

The main attribute of paradise was there: cabdrivers were said to be polite (though, from what I remember, they were not polite to me). True, with hindsight, the place may appear more Elysian in the memory of people than it actually was.

I was too young to taste the pleasures of the place, as I became a rebellious idealist and, very early on, developed an ascetic taste, averse to the ostentatious signaling of wealth, allergic to Levantine culture’s overt pursuit of luxury and its obsession with things monetary.

As a teenager, I could not wait to go settle in a metropolis with fewer James Bond types around. Yet I recall something that felt special in the intellectual air. I attended the French lycée that had one of the highest success rates for the French *baccalauréat* (the high school degree), even in the subject of the French language. French was spoken there with some purity: as in prerevolutionary Russia, the Levantine Christian and Jewish patrician class (from Istanbul to Alexandria) spoke and wrote formal French as a language of distinction. The most privileged were sent to school in France, as both my grandfathers were—my paternal namesake in 1912 and my mother's father in 1929. Two thousand years earlier, by the same instinct of linguistic distinction, the snobbish Levantine patricians wrote in Greek, not the vernacular Aramaic. (The New Testament was written in the bad local patrician Greek of our capital, Antioch, prompting Nietzsche to shout that "God spoke bad Greek.") And, after Hellenism declined, they took up Arabic. So in addition to being called a "paradise," the place was also said to be a miraculous crossroads of what are superficially tagged "Eastern" and "Western" cultures.

On Walking Walks

My ethos was shaped when, at fifteen, I was put in jail for (allegedly) attacking a policeman with a slab of concrete during a student riot—an incident with strange ramifications since my grandfather was then the minister of the interior, and the person who signed the order to crush our revolt. One of the rioters was shot dead when a policeman who had been hit on the head with a stone panicked and randomly opened fire on us. I recall being at the center of the riot, and feeling a huge satisfaction upon my capture while my friends were scared of both prison and their parents. We frightened the government so much that we were granted amnesty.

There were some obvious benefits in showing one's ability to act on one's opinions, and not compromising an inch to avoid "offending" or bothering others. I was in a state of rage and didn't care what my parents (and grandfather) thought of me. This made them quite scared of *me*, so I could not afford to back down, or even blink. Had I concealed my participation in the riot (as many friends did) and been discovered, instead of being openly defiant, I am certain that I would have been treated as a black sheep. It is one thing to be cosmetically defiant of authority by wearing unconventional clothes—what social scientists and economists call "cheap signaling"—and another to prove willingness to

translate belief into action.

My paternal uncle was not too bothered by my political ideas (these come and go); he was outraged that I used them as an excuse to dress sloppily. To him, inelegance on the part of a close family member was the mortal offense.

Public knowledge of my capture had another major benefit: it allowed me to avoid the usual outward signs of teenage rebellion. I discovered that it is much more effective to act like a nice guy and be "reasonable" if you prove willing to go beyond just verbiage. You can afford to be compassionate, lax, and courteous if, once in a while, when it is least expected of you, but completely justified, you sue someone, or savage an enemy, just to show that you can walk the walk.

"Paradise" Evaporated

The Lebanese "paradise" suddenly evaporated, after a few bullets and mortar shells. A few months after my jail episode, after close to thirteen centuries of remarkable ethnic coexistence, a Black Swan, coming out of nowhere, transformed the place from heaven to hell. A fierce civil war began between Christians and Moslems, including the Palestinian refugees who took the Moslem side. It was brutal, since the combat zones were in the center of the town and most of the fighting took place in residential areas (my high school was only a few hundred feet from the war zone). The conflict lasted more than a decade and a half. I will not get too descriptive. It may be that the invention of gunfire and powerful weapons turned what, in the age of the sword, would have been just tense conditions into a spiral of uncontrollable tit-for-tat warfare.

Aside from the physical destruction (which turned out to be easy to reverse with a few motivated contractors, bribed politicians, and naïve bondholders), the war removed much of the crust of sophistication that had made the Levantine cities a continuous center of great intellectual refinement for three thousand years. Christians had been leaving the area since Ottoman times—those who moved to the West took Western first names and melded in. Their exodus accelerated. The number of cultured people dropped below some critical level. Suddenly the place became a vacuum. Brain drain is hard to reverse, and some of the old refinement may be lost forever.

The Starred Night

The next time you experience a blackout, take some solace by looking at the sky. You will not recognize it. Beirut had frequent power shutdowns during the war. Before people bought their own generators, one side of the sky was clear at night, owing to the absence of light pollution. That was the side of town farthest from the combat zone. People deprived of television drove to watch the erupting lights of nighttime battles. They appeared to prefer the risk of being blown up by mortar shells to the boredom of a dull evening.

So you could see the stars with great clarity. I had been told in high school that the planets are in something called *equilibrium*, so we did not have to worry about the stars hitting us unexpectedly. To me, that eerily resembled the stories we were also told about the "unique historical stability" of Lebanon. The very idea of assumed equilibrium bothered me. I looked at the constellations in the sky and did not know what to believe.

HISTORY AND THE TRIPLET OF OPACITY

History is opaque. You see what comes out, not the script that produces events, the generator of history. There is a fundamental incompleteness in your grasp of such events, since you do not see what's inside the box, how the mechanisms work. What I call the generator of historical events is different from the events themselves, much as the minds of the gods cannot be read just by witnessing their deeds. You are very likely to be fooled about their intentions.

This disconnect is similar to the difference between the food you see on the table at the restaurant and the process you can observe in the kitchen. (The last time I brunched at a certain Chinese restaurant on Canal Street in downtown Manhattan, I saw a rat coming out of the kitchen.)

The human mind suffers from three ailments as it comes into contact with history, what I call the *triplet of opacity*. They are:

a. the illusion of understanding, or how everyone thinks he knows what is going on in a world that is more complicated (or random) than they realize;
b. the retrospective distortion, or how we can assess matters only after the fact, as if they were in a rearview mirror (history seems clearer and more organized in history books than in empirical reality); and
c. the overvaluation of factual information and the handicap of authoritative and learned people, particularly when they create categories—when they "Platonify."

Nobody Knows What's Going On

The first leg of the triplet is the pathology of thinking that the world in which we live is more understandable, more explainable, and therefore more predictable than it actually is.

I was constantly told by adults that the war, which ended up lasting close to seventeen years, was going to end in "only a matter of days." They seemed quite confident in their forecasts of duration, as can be evidenced by the number of people who sat waiting in hotel rooms and other temporary quarters in Cyprus, Greece, France, and elsewhere for the war to finish. One uncle kept telling me how, some thirty years earlier, when the rich Palestinians fled to Lebanon, they considered it a *very temporary* solution (most of those still alive are still there,

six decades later). Yet when I asked him if it was going to be the same with our conflict, he replied, “No, of course not. This place is different; it has always been different.” Somehow what he detected in others did not seem to apply to him.

This duration blindness in the middle-aged exile is quite a widespread disease. Later, when I decided to avoid the exile’s obsession with his roots (exiles’ roots penetrate their personalities a bit too deeply), I studied exile literature precisely to avoid the traps of a consuming and obsessive nostalgia. These exiles seemed to have become prisoners of their memory of idyllic origin—they sat together with other prisoners of the past and spoke about the old country, and ate their traditional food while some of their folk music played in the background. They continuously ran counterfactuals in their minds, generating alternative scenarios that could have happened and prevented these historical ruptures, such as “if the Shah had not named this incompetent man as prime minister, we would still be there.” It was as if the historical rupture had a specific cause, and that the catastrophe could have been averted by removing *that* specific cause. So I pumped every displaced person I could find for information on their behavior during exile. Almost all act in the same way.

One hears endless stories of Cuban refugees with suitcases still half packed who came to Miami in the 1960s for “a matter of a few days” after the installation of the Castro regime. And of Iranian refugees in Paris and London who fled the Islamic Republic in 1978 thinking that their absence would be a brief vacation. A few are still waiting, more than a quarter century later, for the return. Many Russians who left in 1917, such as the writer Vladimir Nabokov, settled in Berlin, perhaps to be close enough for a quick return. Nabokov himself lived all his life in temporary housing, in both indigence and luxury, ending his days at the Montreux Palace hotel on Lake Geneva.

There was, of course, some wishful thinking in all of these forecasting errors, the blindness of hope, but there was a knowledge problem as well. The dynamics of the Lebanese conflict had been patently unpredictable, yet people’s reasoning as they examined the events showed a constant: almost all those who cared seemed convinced that they understood what was going on. Every single day brought occurrences that lay completely outside their forecast, but they could not figure out that they had not forecast them. Much of what took place would have been deemed completely crazy with respect to the past. Yet it did not seem that crazy *after* the events. This retrospective plausibility causes a discounting of the rarity and conceivability of the event. I later saw the exact same illusion of

understanding in business success and the financial markets.

History Does Not Crawl, It Jumps

Later, upon replaying the wartime events in my memory as I formulated my ideas on the perception of random events, I developed the governing impression that our minds are wonderful explanation machines, capable of making sense out of almost anything, capable of mounting explanations for all manner of phenomena, and generally incapable of accepting the idea of unpredictability. These events were unexplainable, but intelligent people thought they were capable of providing convincing explanations for them—after the fact. Furthermore, the more intelligent the person, the better sounding the explanation. What's more worrisome is that all these beliefs and accounts appeared to be logically coherent and devoid of inconsistencies.

So I left the place called Lebanon as a teenager, but, since a large number of my relatives and friends remained there, I kept coming back to visit, especially during the hostilities. The war was not continuous: there were periods of fighting interrupted by "permanent" solutions. I felt closer to my roots during times of trouble and experienced the urge to come back and show support to those left behind who were often demoralized by the departures—and envious of the fair-weather friends who could seek economic and personal safety only to return for vacations during these occasional lulls in the conflict. I was unable to work or read when I was outside Lebanon while people were dying, but, paradoxically, I was less concerned by the events and able to pursue my intellectual interests guilt-free when I was *inside* Lebanon. Interestingly, people partied quite heavily during the war and developed an even bigger taste for luxuries, making the visits quite attractive in spite of the fighting.

There were a few difficult questions. How could one have predicted that people who seemed a model of tolerance could become the purest of barbarians overnight? Why was the change so abrupt? I initially thought that perhaps the Lebanese war was truly not possible to predict, unlike other conflicts, and that the Levantines were too complicated a race to figure out. Later I slowly realized, as I started to consider all the big events in history, that their irregularity was not a local property.

The Levant has been something of a mass producer of consequential events nobody saw coming. Who predicted the rise of Christianity as a dominant

religion in the Mediterranean basin, and later in the Western world? The Roman chroniclers of that period did not even take note of the new religion—historians of Christianity are baffled by the absence of contemporary mentions. Apparently, few of the big guns took the ideas of a seemingly heretical Jew seriously enough to think that he would leave traces for posterity. We only have a single contemporary reference to Jesus of Nazareth—in *The Jewish Wars* of Josephus—which itself may have been added later by a devout copyist. How about the competing religion that emerged seven centuries later; who forecast that a collection of horsemen would spread their empire and Islamic law from the Indian subcontinent to Spain in just a few years? Even more than the rise of Christianity, it was the spread of Islam (the third edition, so to speak) that carried full unpredictability; many historians looking at the record have been taken aback by the swiftness of the change. Georges Duby, for one, expressed his amazement about how quickly close to ten centuries of Levantine Hellenism were blotted out "with a strike of a sword." A later holder of the same history chair at the Collège de France, Paul Veyne, aptly talked about religions spreading "like bestsellers"—a comparison that indicates unpredictability. These kinds of discontinuities in the chronology of events did not make the historian's profession too easy: the studious examination of the past in the greatest of detail does not teach you much about the mind of History; it only gives you the illusion of understanding it.

History and societies do not crawl. They make jumps. They go from fracture to fracture, with a few vibrations in between. Yet we (and historians) like to believe in the predictable, small incremental progression.

It struck me, a belief that has never left me since, that we are just a great machine for looking backward, and that humans are great at self-delusion. Every year that goes by increases my belief in this distortion.

Dear Diary: On History Running Backward

Events present themselves to us in a distorted way. Consider the nature of information: of the millions, maybe even trillions, of small facts that prevail before an event occurs, only a few will turn out to be relevant later to your understanding of what happened. Because your memory is limited and filtered, you will be inclined to remember those data that subsequently match the facts, unless you are like the eponymous Funes in the short story by Jorge Luis Borges,

“Funes, the Memorious,” who forgets nothing and seems condemned to live with the burden of the accumulation of unprocessed information. (He does not manage to live too long.)

I had my first exposure to the retrospective distortion as follows. During my childhood I had been a voracious, if unsteady, reader, but I spent the first phase of the war in a basement, diving body and soul into all manner of books. School was closed and it was raining mortar shells. It is dreadfully boring to be in basements. My initial worries were mostly about how to fight boredom and what to read next*—though being forced to read for lack of other activities is not as enjoyable as reading out of one’s own volition. I wanted to be a philosopher (I still do), so I felt that I needed to make an investment by forcibly studying others’ ideas. Circumstances motivated me to study theoretical and general accounts of wars and conflicts, trying to get into the guts of History, to get into the workings of that big machine that generates events.

Surprisingly, the book that influenced me was not written by someone in the thinking business but by a journalist: William Shirer’s *Berlin Diary: The Journal of a Foreign Correspondent, 1934–1941*. Shirer was a radio correspondent, famous for his book *The Rise and Fall of the Third Reich*. It occurred to me that the *Journal* offered an unusual perspective. I had already read (or read about) the works of Hegel, Marx, Toynbee, Aron, and Fichte on the philosophy of history and its properties and thought that I had a vague idea of the notions of dialectics, to the extent that there was something to understand in these theories. I did not grasp much, except that history had some logic and that things developed through contradiction (or opposites) in a way that elevated mankind into higher forms of society—that kind of thing. This sounded awfully similar to the theorizing around me about the war in Lebanon. To this day I surprise people who put the ludicrous question to me about what books “shaped my thinking” by telling them that this book taught me (albeit inadvertently) the most about philosophy and theoretical history—and, we will see, about science as well, since I learned the difference between forward and backward processes.

How? Simply, the diary purported to describe the events *as they were taking place*, not after. I was in a basement with history audibly unfolding above me (the sound of mortar shells kept me up all night). I was a teenager attending the funerals of classmates. I was experiencing a nontheoretical unfolding of History and I was reading about someone apparently experiencing history as it went along. I made efforts to mentally produce a movielike representation of the

future and realized it was not so obvious. I realized that if I were to start writing about the events later they would seem more … *historical*. There was a difference between the *before* and the *after*.

The journal was purportedly written without Shirer knowing what was going to happen next, when the information available to him was not corrupted by the subsequent outcomes. Some comments here and there were quite illuminating, particularly those concerning the French belief that Hitler was a transitory phenomenon, which explained their lack of preparation and subsequent rapid capitulation. At no time was the extent of the ultimate devastation deemed possible.

While we have a highly unstable memory, a diary provides indelible facts recorded more or less immediately; it thus allows the fixation of an unrevised perception and enables us to later study events in their own context. Again, it is the purported method of description of the event, not its execution, that was important. In fact, it is likely that Shirer and his editors did some cheating, since the book was published in 1941 and publishers, I am told, are in the business of delivering texts to the general public instead of providing faithful depictions of the authors' mind-sets stripped of retrospective distortions. (By "cheating," I mean removing at the time of publication elements that did not turn out to be relevant to what happened, thus enhancing those that may interest the public. Indeed the editing process can be severely distorting, particularly when the author is assigned what is called a "good editor.") Still, encountering Shirer's book provided me with an intuition about the workings of history. One would suppose that people living through the beginning of WWII had an inkling that something momentous was taking place. Not at all.*

Shirer's diary turned out to be a training program in the dynamics of uncertainty. I wanted to be a philosopher, not knowing at the time what most professional philosophers did for a living. The idea led me to adventure (rather to the adventurous practice of uncertainty) and also to mathematical and scientific pursuits instead.

Education in a Taxicab

I will introduce the third element of the triplet, the curse of learning, as follows. I closely watched my grandfather, who was minister of defense, and later minister of the interior and deputy prime minister in the early days of the war, before the

fading of his political role. In spite of his position he did not seem to know what was going to happen any more than did his driver, Mikhail. But unlike my grandfather, Mikhail used to repeat “God knows” as his main commentary on events, transferring the task of understanding higher up.

I noticed that very intelligent and informed persons were at no advantage over cabdrivers in their predictions, but there was a crucial difference. Cabdrivers did not believe that they understood as much as learned people—really, they were not the experts and they knew it. Nobody knew anything, but elite thinkers thought that they knew more than the rest because they were elite thinkers, and if you’re a member of the elite, you automatically know more than the nonelite.

It is not just knowledge but information that can be of dubious value. It came to my notice that almost everybody was acquainted with current events in their smallest details. The overlap between newspapers was so large that you would get less and less information the more you read. Yet everyone was so eager to become familiar with every fact that they read every freshly printed document and listened to every radio station as if the great answer was going to be revealed to them in the next bulletin. People became encyclopedias of who had met with whom and which politician said what to which other politician (and with what tone of voice: “Was he more friendly than usual?”). Yet to no avail.

CLUSTERS

I also noticed during the Lebanese war that journalists tended to cluster not necessarily around the same opinions but frequently around the same framework of analyses. They assign the same importance to the same sets of circumstances and cut reality into the same categories—once again the manifestation of Platonicity, the desire to cut reality into crisp shapes. What Robert Fisk calls "hotel journalism" further increased the mental contagion. While Lebanon in earlier journalism was part of the Levant, i.e., the eastern Mediterranean, it now suddenly became part of the Middle East, as if someone had managed to transport it closer to the sands of Saudi Arabia. The island of Cyprus, around sixty miles from my village in northern Lebanon, and with almost identical food, churches, and habits, suddenly became part of Europe (of course the natives on both sides became subsequently conditioned). While in the past a distinction had been drawn between Mediterranean and non-Mediterranean (i.e., between the olive oil and the butter), in the 1970s the distinction suddenly became that between Europe and non-Europe. Islam being the wedge between the two, one does not know where to place the indigenous Arabic-speaking Christians (or Jews) in that story. Categorizing is necessary for humans, but it becomes pathological when the category is seen as definitive, preventing people from considering the fuzziness of boundaries, let alone revising their categories. Contagion was the culprit. If you selected one hundred independent-minded journalists capable of seeing factors in isolation from one another, you would get one hundred different opinions. But the process of having these people report in lockstep caused the dimensionality of the opinion set to shrink considerably—they converged on opinions and used the same items as causes. For instance, to depart from Lebanon for a moment, all reporters now refer to the "roaring eighties," assuming that there was something particularly distinct about that exact decade. And during the Internet bubble of the late 1990s, journalists agreed on crazy indicators as explanatory of the quality of worthless companies that everyone wanted very badly.*

If you want to see what I mean by the arbitrariness of categories, check the situation of polarized politics. The next time a Martian visits earth, try to explain to him why those who favor allowing the elimination of a fetus in the mother's womb also oppose capital punishment. Or try to explain to him why those who accept abortion are supposed to be favorable to high taxation but against a strong

military. Why do those who prefer sexual freedom need to be against individual economic liberty?

I noticed the absurdity of clustering when I was quite young. By some farcical turn of events, in that civil war of Lebanon, Christians became pro-free market and the capitalistic system—i.e., what a journalist would call "the Right"—and the Islamists became socialists, getting support from Communist regimes *(Pravda*, the organ of the Communist regime, called them "oppression fighters," though subsequently when the Russians invaded Afghanistan, it was the Americans who sought association with bin Laden and his Moslem peers).

The best way to prove the arbitrary character of these categories, and the contagion effect they produce, is to remember how frequently these clusters reverse in history. Today's alliance between Christian fundamentalists and the Israeli lobby would certainly seem puzzling to a nineteenth-century intellectual —Christians used to be anti-Semites and Moslems were the protectors of the Jews, whom they preferred to Christians. Libertarians used to be left-wing. What is interesting to me as a probabilist is that some random event makes one group that initially supports an issue ally itself with another group that supports another issue, thus causing the two items to fuse and unify … until the surprise of the separation.

Categorizing always produces reduction in true complexity. It is a manifestation of the Black Swan generator, that unshakable Platonicity that I defined in the Prologue. Any reduction of the world around us can have explosive consequences since it rules out some sources of uncertainty; it drives us to a misunderstanding of the fabric of the world. For instance, you may think that radical Islam (and its values) are your allies against the threat of Communism, and so you may help them develop, until they send two planes into downtown Manhattan.

It was a few years after the beginning of the Lebanese war, as I was attending the Wharton School, at the age of twenty-two, that I was hit with the idea of efficient markets—an idea that holds that there is no way to derive profits from traded securities since these instruments have automatically incorporated all the available information. Public information can therefore be useless, particularly to a businessman, since prices can already "include" all such information, and news shared with millions gives you no real advantage. Odds are that one or more of the hundreds of millions of other readers of such information will already have bought the security, thus pushing up the price. I then completely

gave up reading newspapers and watching television, which freed up a considerable amount of time (say one hour or more a day, enough time to read more than a hundred additional books per year, which, after a couple of decades, starts mounting). But this argument was not quite the entire reason for my dictum in this book to avoid the newspapers, as we will see further benefits in avoiding the toxicity of information. It was initially a great excuse to avoid keeping up with the minutiae of business, a perfect alibi since I found nothing interesting about the details of the business world—inelegant, dull, pompous, greedy, unintellectual, selfish, and boring.

Where Is the Show?

Why someone with plans to become a "philosopher" or a "scientific philosopher of history" would wind up in business school, and the Wharton School no less, still escapes me. There I saw that it was not merely some inconsequential politician in a small and antique country (and his philosophical driver Mikhail) who did not know what was going on. After all, people in small countries are supposed to *not know* what is going on. What I saw was that in one of the most prestigious business schools in the world, in the most potent country in the history of the world, the executives of the most powerful corporations were coming to describe what they did for a living, and it was possible that they too did not know what was going on. As a matter of fact, in my mind it was far more than a possibility. I felt in my spine the weight of the epistemic arrogance of the human race.*

I became obsessive. At the time, I started becoming conscious of my subject —the *highly improbable consequential event*. And it was not only well-dressed, testosterone-charged corporate executives who were usually fooled by this concentrated luck, but persons of great learning. This awareness turned my Black Swan from a problem of lucky or unlucky people in business into a problem of knowledge and science. My idea is that not only are some scientific results useless in real life, because they underestimate the impact of the highly improbable (or lead us to ignore it), but that many of them may be actually creating Black Swans. These are not just taxonomic errors that can make you flunk a class in ornithology. I started to see the consequences of the idea.

8¾ LBS LATER

Four and a half years after my graduation from Wharton (and 8¾ pounds heavier), on October 19, 1987, I walked home from the offices of the investment bank Credit Suisse First Boston in Midtown Manhattan to the Upper East Side. I walked slowly, as I was in a bewildered state.

That day saw a traumatic financial event: the largest market drop in (modern) history. It was all the more traumatic in that it took place at a time when we thought we had become sufficiently sophisticated with all these intelligent-talking Platonified economists (with their phony bell curve-based equations) to prevent, or at least forecast and control, big shocks. The drop was not even the response to any discernible news. The occurrence of the event lay outside anything one could have imagined on the previous day—had I pointed out its possibility, I would have been called a lunatic. It qualified as a Black Swan, but I did not know the expression then.

I ran into a colleague of mine, Demetrius, on Park Avenue, and, as I started talking to him, an anxiety-ridden woman, losing all inhibitions, jumped into the conversation: “Hey, do the two of you know what’s going on?” People on the sidewalk looked dazed. Earlier I had seen a few adults silently sobbing in the trading room of First Boston. I had spent the day at the epicenter of the events, with shell-shocked people running around like rabbits in front of headlights. When I got home, my cousin Alexis called to tell me that his neighbor committed suicide, jumping from his upper-floor apartment. It did not even feel eerie. It felt like Lebanon, with a twist: having seen both, I was struck that financial distress could be more demoralizing than war (just consider that financial problems and the accompanying humiliations can lead to suicide, but war doesn’t appear to do so directly).

I feared a Pyrrhic victory: I had been vindicated intellectually, but I was afraid of being too right and seeing the system crumble under my feet. I did not really want to be *that* right. I will always remember the late Jimmy P. who, seeing his net worth in the process of melting down, kept half-jokingly begging the price on the screen to stop moving.

But I realized then and there that I did not give a hoot about the money. I experienced the strangest feeling I have ever had in my life, this deafening trumpet signaling to me that *I was right*, so loudly that it made my bones vibrate. I have never had it since and will never be able to explain it to those who have

never experienced it. It was a physical sensation, perhaps a mixture of joy, pride, and terror.

And I felt vindicated? How?

During the one or two years after my arrival at Wharton, I had developed a precise but strange specialty: betting on rare and unexpected events, those that were on the *Platonic fold*, and considered "inconceivable" by the Platonic "experts." Recall that the Platonic fold is where our representation of reality ceases to apply—but we do not know it.

For I was early to embrace, as a day job, the profession of "quantitative finance." I became a "quant" and trader at the same time—a quant is a brand of industrial scientist who applies mathematical models of uncertainty to financial (or socioeconomic) data and complex financial instruments. Except that I was a quant exactly in reverse: I studied the flaws and the limits of these models, looking for the *Platonic fold* where they break down. Also I engaged in speculative trading, not "just tawk," which was rare for quants since they were prevented from "taking risks," their role being confined to analysis, not decision making. I was convinced that I was totally incompetent in predicting market prices—but that others were generally incompetent also but did not know it, or did not know that they were taking massive risks. Most traders were just "picking pennies in front of a streamroller," exposing themselves to the high-impact rare event yet sleeping like babies, unaware of it. Mine was the only job you could do if you thought of yourself as risk-hating, risk-aware, and highly ignorant.

Also, the technical baggage that comes with being a quant (a mixture of applied mathematics, engineering, and statistics), in addition to the immersion in practice, turned out to be very useful for someone wanting to be a philosopher.* First, when you spend a couple of decades doing mass-scale empirical work with data and taking risks based on such studies, you can easily spot elements in the texture of the world that the Platonified "thinker" is too brainwashed, or threatened, to see. Second, it allowed me to become formal and systematic in my thinking instead of wallowing in the anecdotal. Finally, both the philosophy of history and epistemology (the philosophy of knowledge) seemed inseparable from the empirical study of times series data, which is a succession of numbers in time, a sort of historical document containing numbers instead of words. And numbers are easy to process on computers. Studying historical data makes you conscious that history runs forward, not backward, and that it is messier than

narrated accounts. Epistemology, the philosophy of history, and statistics aim at understanding truths, investigating the mechanisms that generate them, and separating regularity from the coincidental in historical matters. They all address the question of what one knows, except that they are all to be found in different buildings, so to speak.

The Four-Letter Word of Independence

That night, on October 19, 1987, I slept for twelve hours straight.

It was hard to tell my friends, all hurt in some manner by the crash, about this feeling of vindication. Bonuses at the time were a fraction of what they are today, but if my employer, First Boston, and the financial system survived until year-end, I would get the equivalent of a fellowship. This is sometimes called "f*** you money," which, in spite of its coarseness, means that it allows you to act like a Victorian gentleman, free from slavery. It is a psychological buffer: the capital is not so large as to make you spoiled-rich, but large enough to give you the freedom to choose a new occupation without excessive consideration of the financial rewards. It shields you from prostituting your mind and frees you from outside authority—any outside authority. (Independence is person-specific: I have always been taken aback at the high number of people in whom an astonishingly high income led to additional sycophancy as they became more dependent on their clients and employers and more addicted to making even more money.) While not substantial by some standards, it literally cured me of all financial ambition—it made me feel ashamed whenever I diverted time away from study for the pursuit of material wealth. Note that the designation *f*** you* corresponds to the exhilarating ability to pronounce that compact phrase *before* hanging up the phone.

These were the days when it was extremely common for traders to break phones when they lost money. Some resorted to destroying chairs, tables, or whatever would make noise. Once, in the Chicago pits, another trader tried to strangle me and it took four security guards to drag him away. He was irate because I was standing in what he deemed his "territory." Who would want to leave such an environment? Compare it to lunches in a drab university cafeteria with gentle-mannered professors discussing the latest departmental intrigue. So I stayed in the quant and trading businesses (I'm still there), but organized myself to do minimal but intense (and entertaining) work, focus only on the most

technical aspects, never attend business “meetings,” avoid the company of “achievers” and people in suits who don’t read books, and take a sabbatical year for every three on average to fill up gaps in my scientific and philosophical culture. To slowly distill my single idea, I wanted to become a flâneur, a professional meditator, sit in cafés, lounge, unglued to desks and organization structures, sleep as long as I needed, read voraciously, and not owe any explanation to anybody. I wanted to be left alone in order to build, small steps at a time, an entire system of thought based on my Black Swan idea.

Limousine Philosopher

The war in Lebanon and the crash of 1987 seemed identical phenomena. It became obvious to me that nearly everyone had a mental blindspot in acknowledging the role of such events: it was as if they were not able to see these mammoths, or that they rapidly forgot about them. The answer was looking straight at me: it was a psychological, perhaps even biological, *blindness;* the problem lay not in the nature of events, but in the way we perceived them.

I end this autobiographical prelude with the following story. I had no defined specialty (outside of my day job), and wanted none. When people at cocktail parties asked me what I did for a living, I was tempted to answer, “I am a *skeptical empiricist* and a flâneur-reader, someone committed to getting very deep into an idea,” but I made things simple by saying that I was a limousine driver.

Once, on a transatlantic flight, I found myself upgraded to first class next to an expensively dressed, high-powered lady dripping with gold and jewelry who continuously ate nuts (low-carb diet, perhaps), insisted on drinking only Evian, all the while reading the European edition of *The Wall Street Journal*. She kept trying to start a conversation in broken French, since she saw me reading a book (in French) by the sociologist-philosopher Pierre Bourdieu—which, ironically, dealt with the marks of social distinction. I informed her (in English) that I was a limousine driver, proudly insisting that I only drove “very upper-end” cars. An icy silence lasted the whole flight, and, although I could feel the tension, it allowed me to read in peace.

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* It is remarkable how fast and how effectively you can construct a nationality with a flag, a few speeches,

and a national anthem; to this day I avoid the label “Lebanese,” preferring the less restrictive “Levantine” designation.

* Benoît Mandelbrot, who had a similar experience at about the same age, though close to four decades earlier, remembers his own war episode as long stretches of painful boredom punctuated by brief moments of extreme fear.

* The historian Niall Ferguson showed that, despite all the standard accounts of the buildup to the Great War, which describe “mounting tensions” and “escalating crises,” the conflict came as a surprise. Only retrospectively was it seen as unavoidable by backward-looking historians. Ferguson used a clever empirical argument to make his point: he looked at the prices of imperial bonds, which normally include investors’ anticipation of government’s financing needs and decline in expectation of conflicts since wars cause severe deficits. But bond prices did not reflect the anticipation of war. Note that this study illustrates, in addition, how working with prices can provide a good understanding of history.

* We will see in Chapter 10 some clever quantitative tests done to prove such herding; they show that, in many subject matters, the distance between opinions is remarkably narrower than the distance between the average of opinions and truth.

* I then realized that the great strength of the free-market system is the fact that company executives don’t need to know what’s going on.

* I specialized in complicated financial instruments called “derivatives,” those that required advanced mathematics—but for which the errors for using the wrong mathematics were the greatest. The subject was new and attractive enough for me to get a doctorate in it.

  Note that I was not able to build a career just by betting on Black Swans—there were not enough tradable opportunities. I could, on the other hand, avoid being exposed to them by protecting my portfolio against large losses. So, in order to eliminate the dependence on randomness, I focused on technical inefficiencies between complicated instruments, and on exploiting these opportunities without exposure to the rare event, before they disappeared as my competitors became technologically advanced. Later on in my career I discovered the easier (and less randomness laden) business of protecting, insurance-style, large portfolios against the Black Swan.

YEVGENIA'S BLACK SWAN

Pink glasses and success—How Yevgenia stops marrying philosophers—I told you so

Five years ago, Yevgenia Nikolayevna Krasnova was an obscure and unpublished novelist, with an unusual background. She was a neuroscientist with an interest in philosophy (her first three husbands had been philosophers), and she got it into her stubborn Franco-Russian head to express her research and ideas in literary form. She dressed up her theories as stories, and mixed them with all manner of autobiographical commentary. She avoided the journalistic prevarications of contemporary narrative nonfiction ("On a clear April morning, John Smith left his house. …"). Foreign dialogue was always written in the original language, with translations appended like movie subtitles. She refused to dub into bad English conversations that took place in bad Italian.*

No publisher would have given her the time of day, except that there was, at the time, some interest in those rare scientists who could manage to express themselves in semi-understandable sentences. A few publishers agreed to speak with her; they hoped that she would grow up and write a "popular science book on consciousness." She received enough attention to get the courtesy of rejection letters and occasional insulting comments instead of the far more insulting and demeaning silence.

Publishers were confused by her manuscript. She could not even answer their first question: "Is this fiction or nonfiction?" Nor could she respond to the "Who is this book written for?" on the publishers' book proposal forms. She was told, "You need to understand who your audience is" and "amateurs write for themselves, professionals write for others." She was also told to conform to a precise genre because "bookstores do not like to be confused and need to know where to place a book on the shelves." One editor protectively added, "This, my dear friend, will only sell ten copies, including those bought by your ex-husbands and family members."

She had attended a famous writing workshop five years earlier and came out

nauseated. “Writing well” seemed to mean obeying arbitrary rules that had grown into gospel, with the confirmatory reinforcement of what we call “experience.” The writers she met were learning to retrofit what was deemed successful: they all tried to imitate stories that had appeared in past issues of *The New Yorker*—not realizing that most of what is new, by definition, cannot be modeled on past issues of *The New Yorker*. Even the idea of a “short story” was a me-too concept to Yevgenia. The workshop instructor, gentle but firm in his delivery, told her that her case was utterly hopeless.

Yegvenia ended up posting the entire manuscript of her main book, *A Story of Recursion*, on the Web. There it found a small audience, which included the shrewd owner of a small unknown publishing house, who wore pink-rimmed glasses and spoke primitive Russian (convinced that he was fluent). He offered to publish her, and agreed to her condition to keep her text completely unedited. He offered her a fraction of the standard royalty rate in return for her editorial stricture—he had so little to lose. She accepted since she had no choice.

It took five years for Yevgenia to graduate from the “egomaniac without anything to justify it, stubborn and difficult to deal with” category to “persevering, resolute, painstaking, and fiercely independent.” For her book slowly caught fire, becoming one of the great and strange successes in literary history, selling millions of copies and drawing so-called critical acclaim. The start-up house has since become a big corporation, with a (polite) receptionist to greet visitors as they enter the main office. Her book has been translated into forty languages (even French). You see her picture everywhere. She is said to be a pioneer of something called the Consilient School. Publishers now have a theory that “truck drivers who read books do not read books written for truck drivers” and hold that “readers despise writers who pander to them.” A scientific paper, it is now understood, can hide trivialities or irrelevance with equations and jargon; consilient prose, by exposing an idea in raw form, allows it to be judged by the public.

Today, Yevgenia has stopped marrying philosophers (they argue too much), and she hides from the press. In classrooms, literary scholars discuss the many clues indicating the inevitability of the new style. The distinction between fiction and nonfiction is considered too archaic to withstand the challenges of modern society. It was so evident that we needed to remedy the fragmentation between art and science. After the fact, her talent was so obvious.

Many of the editors she later met blamed her for not coming to them,

convinced that they would have immediately seen the merit in her work. In a few years, a literary scholar will write the essay “From Kundera to Krasnova,” showing how the seeds of her work can be found in Kundera—a precursor who mixed essay and metacommentary (Yevgenia never read Kundera, but did see the movie version of one of his books—there was no commentary in the movie). A prominent scholar will show how the influence of Gregory Bateson, who injected autobiographical scenes into his scholarly research papers, is visible on every page (Yevgenia has never heard of Bateson).

Yevgenia’s book is a Black Swan.

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* Her third husband was an Italian philosopher.

Chapter Three

THE SPECULATOR AND THE PROSTITUTE

On the critical difference between speculators and prostitutes—Fairness, unfairness, and Black Swans—Theory of knowledge and professional incomes—How Extremistan is not the best place to visit, except, perhaps, if you are a winner

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Yevgenia's rise from the second basement to superstar is possible in only one environment, which I call Extremistan.* I will soon introduce the central distinction between the Black Swan–generating province of Extremistan and the tame, quiet, and uneventful province of Mediocristan.

THE BEST (WORST) ADVICE

When I play back in my mind all the "advice" people have given me, I see that only a couple of ideas have stuck with me for life. The rest has been mere words, and I am glad that I did not heed most of it. Most consisted of recommendations such as "be measured and reasonable in your statements," contradicting the Black Swan idea, since empirical reality is not "measured," and its own version of "reasonableness" does not correspond to the conventional middlebrow definition. To be genuinely empirical is to reflect reality as faithfully as possible; to be honorable implies not fearing the appearance and consequences of being outlandish. The next time someone pesters you with unneeded advice, gently remind him of the fate of the monk whom Ivan the Terrible put to death for delivering uninvited (and moralizing) advice. It works as a short-term cure.

The most important piece of advice was, in retrospect, bad, but it was also, paradoxically, the most consequential, as it pushed me deeper into the dynamics of the Black Swan. It came when I was twenty-two, one February afternoon, in the corridor of a building at 3400 Walnut Street in Philadelphia, where I lived. A second-year Wharton student told me to get a profession that is "scalable," that is, one in which you are not paid by the hour and thus subject to the limitations of the amount of your labor. It was a very simple way to discriminate among professions and, from that, to generalize a separation between types of uncertainty—and it led me to the major philosophical problem, the problem of induction, which is the technical name for the Black Swan. It allowed me to turn the Black Swan from a logical impasse into an easy-to-implement solution, and, as we will see in the next chapters, to ground it in the texture of empirical reality.

How did career advice lead to such ideas about the nature of uncertainty? Some professions, such as dentists, consultants, or massage professionals, cannot be scaled: there is a cap on the number of patients or clients you can see in a given period of time. If you are a prostitute, you work by the hour and are (generally) paid by the hour. Furthermore, your presence is (I assume) necessary for the service you provide. If you open a fancy restaurant, you will at best steadily fill up the room (unless you franchise it). In these professions, no matter how highly paid, your income is subject to gravity. Your revenue depends on your continuous efforts more than on the quality of your decisions. Moreover, this kind of work is largely predictable: it will vary, but not to the point of making the income of a single day more significant than that of the rest of your

life. In other words, it will not be Black Swan driven. Yevgenia Nikolayevna would not have been able to cross the chasm between underdog and supreme hero overnight had she been a tax accountant or a hernia specialist (but she would not have been an underdog either).

Other professions allow you to add zeroes to your output (and your income), if you do well, at little or no extra effort. Now being lazy, considering laziness as an asset, and eager to free up the maximum amount of time in my day to meditate and read, I immediately (but mistakenly) drew a conclusion. I separated the "idea" person, who sells an intellectual product in the form of a transaction or a piece of work, from the "labor" person, who sells you his work.

If you are an idea person, you do not have to work hard, only think intensely. You do the same work whether you produce a hundred units or a thousand. In quant trading, the same amount of work is involved in buying a hundred shares as in buying a hundred thousand, or even a million. It is the same phone call, the same computation, the same legal document, the same expenditure of brain cells, the same effort in verifying that the transaction is right. Furthermore, you can work from your bathtub or from a bar in Rome. You can use leverage as a replacement for work! Well, okay, I was a little wrong about trading: one cannot work from a bathtub, but, when done right, the job allows considerable free time.

The same property applies to recording artists or movie actors: you let the sound engineers and projectionists do the work; there is no need to show up at every performance in order to perform. Similarly, a writer expends the same effort to attract one single reader as she would to capture several hundred million. J. K. Rowling, the author of the Harry Potter books, does not have to write each book again every time someone wants to read it. But this is not so for a baker: he needs to bake every single piece of bread in order to satisfy each additional customer.

So the distinction between writer and baker, speculator and doctor, fraudster and prostitute, is a helpful way to look at the world of activities. It separates those professions in which one can add zeroes of income with no greater labor from those in which one needs to add labor and time (both of which are in limited supply)—in other words, those subjected to gravity.

But why was the advice from my fellow student bad?

If the advice was helpful, and it was, in creating a classification for ranking uncertainty and knowledge, it was a mistake as far as choices of profession went. It might have paid off for me, but only because I was lucky and happened to be "in the right place at the right time," as the saying goes. If I myself had to give advice, I would recommend someone pick a profession that is *not* scalable! A scalable profession is good only if you are successful; they are more competitive, produce monstrous inequalities, and are far more random, with huge disparities between efforts and rewards—a few can take a large share of the pie, leaving others out entirely at no fault of their own.

One category of profession is driven by the mediocre, the average, and the middle-of-the-road. In it, the mediocre is collectively consequential. The other has either giants or dwarves—more precisely, a very small number of giants and a huge number of dwarves.

Let us see what is behind the formation of unexpected giants—the Black Swan formation.

The Advent of Scalability

Consider the fate of Giaccomo, an opera singer at the end of the nineteenth century, before sound recording was invented. Say he performs in a small and remote town in central Italy. He is shielded from those big egos at La Scala in Milan and other major opera houses. He feels safe as his vocal cords will always be in demand somewhere in the district. There is no way for him to export his singing, and there is no way for the big guns to export theirs and threaten his local franchise. It is not yet possible for him to store his work, so his presence is needed at every performance, just as a barber is (still) needed today for every haircut. So the total pie is unevenly split, but only mildly so, much like your calorie consumption. It is cut in a few pieces and everyone has a share; the big guns have larger audiences and get more invitations than the small guy, but this is not too worrisome. Inequalities exist, but let us call them *mild*. There is no scalability yet, no way to double the largest in-person audience without having to sing twice.

Now consider the effect of the first music recording, an invention that

introduced a great deal of injustice. Our ability to reproduce and repeat performances allows me to listen on my laptop to hours of background music of the pianist Vladimir Horowitz (now extremely dead) performing Rachmaninoff's *Preludes*, instead of to the local Russian émigré musician (still living), who is now reduced to giving piano lessons to generally untalented children for close to minimum wage. Horowitz, though dead, is putting the poor man out of business. I would rather listen to Vladimir Horowitz or Arthur Rubinstein for $10.99 a CD than pay $9.99 for one by some unknown (but very talented) graduate of the Juilliard School or the Prague Conservatory. If you ask me why I select Horowitz, I will answer that it is because of the order, rhythm, or passion, when in fact there are probably a legion of people I have never heard about, and will never hear about—those who did not make it to the stage, but who might play just as well.

Some people naïvely believe that the process of unfairness started with the gramophone, according to the logic that I just presented. I disagree. I am convinced that the process started much, much earlier, with our DNA, which stores information about our selves and allows us to repeat our performance without our being there by spreading our genes down the generations. Evolution is *scalable:* the DNA that wins (whether by luck or survival advantage) will reproduce itself, like a bestselling book or a successful record, and become pervasive. Other DNA will vanish. Just consider the difference between us humans (excluding financial economists and businessmen) and other living beings on our planet.

Furthermore, I believe that the big transition in social life came not with the gramophone, but when someone had the great but unjust idea to invent the alphabet, thus allowing us to store information and reproduce it. It accelerated further when another inventor had the even more dangerous and iniquitous notion of starting a printing press, thus promoting texts across boundaries and triggering what ultimately grew into a winner-take-all ecology. Now, what was so unjust about the spread of books? The alphabet allowed stories and ideas to be replicated with high fidelity and without limit, without any additional expenditure of energy on the author's part for the subsequent performances. He didn't even have to be alive for them—death is often a good career move for an author. This implies that those who, for some reason, start getting some attention can quickly reach more minds than others and displace the competitors from the bookshelves. In the days of bards and troubadours, everyone had an audience. A storyteller, like a baker or a coppersmith, had a market, and the assurance that

none from far away could dislodge him from his territory. Today, a few take almost everything; the rest, next to nothing.

By the same mechanism, the advent of the cinema displaced neighborhood actors, putting the small guys out of business. But there is a difference. In pursuits that have a technical component, like being a pianist or a brain surgeon, talent is easy to ascertain, with subjective opinion playing a relatively small part. The inequity comes when someone perceived as being marginally better gets the whole pie.

In the arts—say the cinema—things are far more vicious. What we call "talent" generally comes from success, rather than its opposite. A great deal of empiricism has been done on the subject, most notably by Art De Vany, an insightful and original thinker who singlemindedly studied wild uncertainty in the movies. He showed that, sadly, much of what we ascribe to skills is an after-the-fact attribution. The movie makes the actor, he claims—and a large dose of nonlinear luck makes the movie.

The success of movies depends severely on contagions. Such contagions do not just apply to the movies: they seem to affect a wide range of cultural products. It is hard for us to accept that people do not fall in love with works of art only for their own sake, but also in order to feel that they belong to a community. By imitating, we get closer to others—that is, other imitators. It fights solitude.

This discussion shows the difficulty in predicting outcomes in an environment of concentrated success. So for now let us note that the division between professions can be used to understand the division between types of random variables. Let us go further into the issue of knowledge, of inference about the unknown and the properties of the known.

SCALABILITY AND GLOBALIZATION

Whenever you hear a snotty (and frustrated) European middlebrow presenting his stereotypes about Americans, he will often describe them as “uncultured,” “unintellectual,” and “poor in math” because, unlike his peers, Americans are not into equation drills and the constructions middlebrows call “high culture”—like knowledge of Goethe’s inspirational (and central) trip to Italy, or familiarity with the Delft school of painting. Yet the person making these statements is likely to be addicted to his iPod, wear blue jeans, and use Microsoft Word to jot down his “cultural” statements on his PC, with some Google searches here and there interrupting his composition. Well, it so happens that America is currently far, far more creative than these nations of museumgoers and equation solvers. It is also far more tolerant of bottom-up tinkering and undirected trial and error. And globalization has allowed the United States to specialize in the creative aspect of things, the production of concepts and ideas, that is, the scalable part of the products, and, increasingly, by exporting jobs, separate the less scalable components and assign them to those happy to be paid by the hour. There is more money in designing a shoe than in actually making it: Nike, Dell, and Boeing can get paid for just thinking, organizing, and leveraging their know-how and ideas while subcontracted factories in developing countries do the grunt work and engineers in cultured and mathematical states do the noncreative technical grind. The American economy has leveraged itself heavily on the idea generation, which explains why losing manufacturing jobs can be coupled with a rising standard of living. Clearly the drawback of a world economy where the payoff goes to ideas is higher inequality among the idea generators together with a greater role for both opportunity and luck—but I will leave the socioeconomic discussion for Part Three and focus here on knowledge.

This scalable/nonscalable distinction allows us to make a clear-cut differentiation between two varieties of uncertainties, two types of randomness.

Let's play the following thought experiment. Assume that you round up a thousand people randomly selected from the general population and have them stand next to one another in a stadium. You can even include Frenchmen (but please, not too many out of consideration for the others in the group), Mafia members, non-Mafia members, and vegetarians.

Imagine the heaviest person you can think of and add him to that sample. Assuming he weighs three times the average, between four hundred and five hundred pounds, he will rarely represent more than a very small fraction of the weight of the entire population (in this case, about a half of a percent).

You can get even more aggressive. If you picked the heaviest biologically possible human on the planet (who yet can still be called a human), he would not represent more than, say, 0.6 percent of the total, a very negligible increase. And if you had ten thousand persons, his contribution would be vanishingly small.

In the utopian province of Mediocristan, particular events don't contribute much individually—only collectively. I can state the supreme law of Mediocristan as follows: *When your sample is large, no single instance will significantly change the aggregate or the total*. The largest observation will remain impressive, but eventually insignificant, to the sum.

I'll borrow another example from my friend Bruce Goldberg: your caloric consumption. Look at how much you consume per year—if you are classified as human, close to eight hundred thousand calories. No single day, not even Thanksgiving at your great-aunt's, will represent a large share of that. Even if you tried to kill yourself by eating, that day's calories would not seriously affect your yearly consumption.

Now, if I told you that it is possible to run into someone who weighs several thousand tons, or stands several hundred miles tall, you would be perfectly justified in having my frontal lobe examined, or in suggesting that I switch to science-fiction writing. But you cannot so easily rule out extreme variations with a different brand of quantities, to which we turn next.

The Strange Country of Extremistan

Consider by comparison the net worth of the thousand people you lined up in the stadium. Add to them the wealthiest person to be found on the planet—say, Bill Gates, the founder of Microsoft. Assume his net worth to be close to $80 billion —with the total capital of the others around a few million. How much of the total wealth would he represent? 99.9 percent? Indeed, all the others would represent no more than a rounding error for his net worth, the variation of his personal portfolio over the past second. For someone's weight to represent such a share, he would need to weigh fifty million pounds!

Try it again with, say, book sales. Line up a thousand authors (or people begging to get published, but calling themselves authors instead of waiters), and check their book sales. Then add the living writer who (currently) has the most readers. J. K. Rowling, the author of the Harry Potter series, with several hundred million books sold, will dwarf the remaining thousand authors with, say, collectively, a few hundred thousand readers at most.

Try it also with academic citations (the mention of one academic by another academic in a formal publication), media references, income, company size, and so on. Let us call these *social* matters, as they are man-made, as opposed to physical ones, like the size of waistlines.

In Extremistan, inequalities are such that one single observation can disproportionately impact the aggregate, or the total.

So while weight, height, and calorie consumption are from Mediocristan, wealth is not. Almost all social matters are from Extremistan. Another way to say it is that social quantities are informational, not physical: you cannot touch them. Money in a bank account is something important, but certainly *not physical*. As such it can take any value without necessitating the expenditure of energy. It is just a number!

Note that before the advent of modern technology, wars used to belong to Mediocristan. It is hard to kill many people if you need to slaughter them one at the time. Today, with tools of mass destruction, all it takes is a button, a nutcase, or a small error to wipe out the planet.

Look at the implication for the Black Swan. Extremistan can produce Black Swans, and does, since a few occurrences have had huge influences on history. This is the main idea of this book.

Extremistan and Knowledge

While this distinction (between Mediocristan and Extremistan) has severe ramifications for both social fairness and the dynamics of events, let us see its application to knowledge, which is where most of its value lies. If a Martian came to earth and engaged in the business of measuring the heights of the denizens of this happy planet, he could safely stop at a hundred humans to get a good picture of the average height. If you live in Mediocristan, you can be comfortable with what you have measured—provided that you know for sure that it comes from Mediocristan. You can also be comfortable with *what you have learned* from the data. The epistemological consequence is that with Mediocristan-style randomness it is not *possible*[*] to have a Black Swan surprise such that a single event can dominate a phenomenon. *Primo*, the first hundred days should reveal all you need to know about the data. *Secondo,* even if you do have a surprise, as we saw in the case of the heaviest human, it would not be consequential.

If you are dealing with quantities from Extremistan, you will have trouble figuring out the average from any sample since it can depend so much on one single observation. The idea is not more difficult than that. In Extremistan, one unit can easily affect the total in a disproportionate way. In this world, you should always be suspicious of the knowledge you derive from data. This is a very simple test of uncertainty that allows you to distinguish between the two kinds of randomness. Capish?

What you can know from data in Mediocristan augments very rapidly with the supply of information. But knowledge in Extremistan grows slowly and erratically with the addition of data, some of it extreme, possibly at an unknown rate.

Wild and Mild

If we follow my distinction of scalable versus nonscalable, we can see clear differences shaping up between Mediocristan and Extremistan. Here are a few examples.

Matters that seem to belong to Mediocristan (subjected to what we call type 1 randomness): height, weight, calorie consumption, income for a baker, a small restaurant owner, a prostitute, or an orthodontist; gambling profits (in the very special case, assuming the person goes to a casino and maintains a constant betting size), car accidents, mortality rates, “IQ” (as measured).

Matters that seem to belong to Extremistan (subjected to what we call type 2 randomness): wealth, income, book sales per author, book citations per author, name recognition as a "celebrity," number of references on Google, populations of cities, uses of words in a vocabulary, numbers of speakers per language, damage caused by earthquakes, deaths in war, deaths from terrorist incidents, sizes of planets, sizes of companies, stock ownership, height between species (consider elephants and mice), financial markets (but your investment manager does not know it), commodity prices, inflation rates, economic data. The Extremistan list is much longer than the prior one.

The Tyranny of the Accident

Another way to rephrase the general distinction is as follows: Mediocristan is where we must endure the tyranny of the collective, the routine, the obvious, and the predicted; Extremistan is where we are subjected to the tyranny of the singular, the accidental, the unseen, and the unpredicted. As hard as you try, you will never lose a lot of weight in a single day; you need the collective effect of many days, weeks, even months. Likewise, if you work as a dentist, you will never get rich in a single day—but you can do very well over thirty years of motivated, diligent, disciplined, and regular attendance to teeth-drilling sessions. If you are subject to Extremistan-based speculation, however, you can gain or lose your fortune in a single minute.

Table 1 summarizes the differences between the two dynamics, to which I will refer in the rest of the book; confusing the left column with the right one can lead to dire (or extremely lucky) consequences.

TABLE 1

Mediocristan	***Extremistan***
Nonscalable	Scalable
Mild or type 1 randomness	Wild (even superwild) or type 2 randomness
The most typical member is mediocre	The most "typical" is either giant or dwarf, i.e., there is no typical member
Winners get a small segment of the total pie	Winner-take-almost-all effects
Example: audience of an opera singer before the gramophone	Today's audience for an artist

More likely to be found in our ancestral environment	More likely to be found in our modern environment
Impervious to the Black Swan	Vulnerable to the Black Swan
Subject to gravity	There are no physical constraints on what a number can be
Corresponds (generally) to physical quantities, i.e., height	Corresponds to numbers, say, wealth
As close to utopian equality as reality can spontaneously deliver	Dominated by extreme winner-take-all inequality
Total is not determined by a single instance or observation	Total will be determined by a small number of extreme events
When you observe for a while you can get to know what's going on	It takes a long time to know what's going on
Tyranny of the collective	Tyranny of the accidental
Easy to predict from what you see and extend to what you do not see	Hard to predict from past information
History crawls	History makes jumps
Events are distributed* according to the "bell curve" (the GIF) or its variations	The distribution is either Mandelbrotian "gray" Swans (tractable scientifically) or totally intractable Black Swans

* What I call "probability distribution" here is the model used to calculate the odds of different events, how they are distributed. When I say that an event is distributed according to the "bell curve," I mean that the Gaussian bell curve (after C. F. Gauss; more on him later) can help provide probabilities of various occurrences.

This framework, showing that Extremistan is where most of the Black Swan action is, is only a rough approximation—please do not Platonify it; don't simplify it beyond what's necessary.

Extremistan does not always imply Black Swans. Some events can be rare and consequential, but somewhat predictable, particularly to those who are prepared for them and have the tools to understand them (instead of listening to statisticians, economists, and charlatans of the bell-curve variety). They are near–Black Swans. They are somewhat tractable scientifically—knowing about

their incidence should lower your surprise; these events are rare but expected. I call this special case of "gray" swans Mandelbrotian randomness. This category encompasses the randomness that produces phenomena commonly known by terms such as *scalable*, *scale-invariant*, *power laws*, *Pareto-Zipf laws*, *Yule's law*, *Paretian-stable processes*, *Levy-stable*, and *fractal laws*, and we will leave them aside for now since they will be covered in some depth in Part Three. They are scalable, according to the logic of this chapter, but you can know a little more about *how* they scale since they share much with the laws of nature.

You can still experience severe Black Swans in Mediocristan, though not easily. How? You may forget that something is random, think that it is deterministic, then have a surprise. Or you can tunnel and miss on a source of uncertainty, whether mild or wild, owing to lack of imagination—most Black Swans result from this "tunneling" disease, which I will discuss in Chapter 9.*

This has been a "literary" overview of the central distinction of this book, offering a trick to distinguish between what can belong in Mediocristan and what belongs in Extremistan. I said that I will get into a more thorough examination in Part Three, so let us focus on epistemology for now and see how the distinction affects our knowledge.

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* To those readers who Googled Yevgenia Krasnova, I am sorry to say that she is (officially) a fictional character.

* I emphasize *possible* because the chance of these occurrences is typically in the order of one in several trillion trillion, as close to impossible as it gets.

* It is worth mentioning here that one of the mistakes people make in the interpretation of the Black Swan idea is that they believe that Black Swans are more frequent than in our imagination. Not quite the point. Black Swans are more consequential, not necessarily more frequent. There are actually fewer remote events, but they are more and more extreme in their impact, which confuses people, as they tend to write them off more easily.

Chapter Four

ONE THOUSAND AND ONE DAYS, OR HOW NOT TO BE A SUCKER

Surprise, surprise—Sophisticated methods for learning from the future—Sextus was always ahead—The main idea is not to be a sucker—Let us move to Mediocristan, if we can find it

Which brings us to the Black Swan problem in its original form.

Imagine someone of authority and rank, operating in a place where rank matters—say, a government agency or a large corporation. He could be a verbose political commentator on Fox News stuck in front of you at the health club (impossible to avoid looking at the screen), the chairman of a company discussing the "bright future ahead," a Platonic medical doctor who has categorically ruled out the utility of mother's milk (because he did not see anything special in it), or a Harvard Business School professor who does not laugh at your jokes. He takes what he knows a little too seriously.

Say that a prankster surprises him one day by surreptitiously sliding a thin feather up his nose during a moment of relaxation. How would his dignified pompousness fare after the surprise? Contrast his authoritative demeanor with the shock of being hit by something totally unexpected that he does not understand. For a brief moment, before he regains his bearings, you will see disarray in his face.

I confess having developed an incorrigible taste for this kind of prank during my first sleepaway summer camp. Introduced into the nostril of a sleeping camper, a feather would induce sudden panic. I spent part of my childhood practicing variations on the prank: in place of a thin feather you can roll the corner of a tissue to make it long and narrow. I got some practice on my younger brother. An equally effective prank would be to drop an ice cube down someone's collar when he expects it least, say during an official dinner. I had to stop these pranks as I got deeper into adulthood, of course, but I am often

involuntarily hit with such an image when bored out of my wits in meetings with serious-looking businesspersons (dark suits and standardized minds) theorizing, explaining things, or talking about random events with plenty of "because" in their conversation. I zoom in on one of them and imagine the ice cube sliding down his back—it would be less fashionable, though certainly more spectacular, if you put a living mouse there, particularly if the person is ticklish and is wearing a tie, which would block the rodent's normal route of exit.*

Pranks can be compassionate. I remember in my early trading days, at age twenty-five or so, when money was starting to become easy. I would take taxis, and if the driver spoke skeletal English and looked particularly depressed, I'd give him a $100 bill as a tip, just to give him a little jolt and get a kick out of his surprise. I'd watch him unfold the bill and look at it with some degree of consternation ($1 million certainly would have been better but it was not within my means). It was also a simple hedonic experiment: it felt elevating to make someone's day with the trifle of $100. I eventually stopped; we all become stingy and calculating when our wealth grows and we start taking money seriously.

I don't need much help from fate to get larger-scale entertainment: reality provides such forced revisions of beliefs at quite a high frequency. Many are quite spectacular. In fact, the entire knowledge-seeking enterprise is based on taking conventional wisdom and accepted scientific beliefs and shattering them into pieces with new counterintuitive evidence, whether at a micro scale (every scientific discovery is an attempt to produce a micro–Black Swan) or at a larger one (as with Poincaré's and Einstein's relativity). Scientists may be in the business of laughing at their predecessors, but owing to an array of human mental dispositions, few realize that someone will laugh at their beliefs in the (disappointingly near) future. In this case, my readers and I are laughing at the *present* state of social knowledge. These big guns do not see the inevitable overhaul of their work coming, which means that you can usually count on them to be in for a surprise.

HOW TO LEARN FROM THE TURKEY

The überphilosopher Bertrand Russell presents a particularly toxic variant of my surprise jolt in his illustration of what people in his line of business call the Problem of Induction or Problem of Inductive Knowledge (capitalized for its seriousness)—certainly the mother of all problems in life. How can we *logically* go from specific instances to reach general conclusions? How do we know what we know? How do we know that what we have observed from given objects and events suffices to enable us to figure out their other properties? There are traps built into any kind of knowledge gained from observation.

Consider a turkey that is fed every day. Every single feeding will firm up the bird's belief that it is the general rule of life to be fed every day by friendly members of the human race "looking out for its best interests," as a politician would say. On the afternoon of the Wednesday before Thanksgiving, something *unexpected* will happen to the turkey. It will incur a revision of belief.*

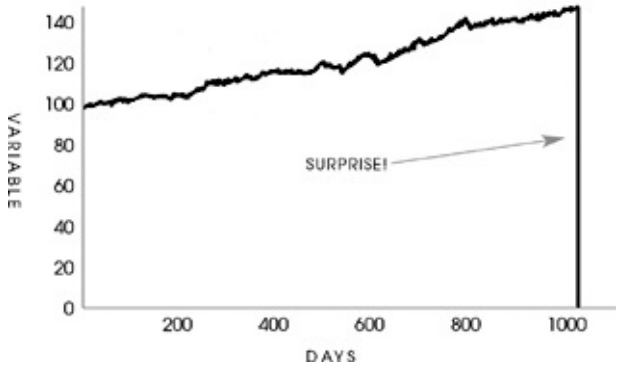
The rest of this chapter will outline the Black Swan problem in its original form: How can we know the future, given knowledge of the past; or, more generally, how can we figure out properties of the (infinite) unknown based on the (finite) known? Think of the feeding again: What can a turkey learn about what is in store for it tomorrow from the events of yesterday? A lot, perhaps, but certainly a little less than it thinks, and it is just that "little less" that may make all the difference.

The turkey problem can be generalized to any situation where *the same hand that feeds you can be the one that wrings your neck*. Consider the case of the increasingly integrated German Jews in the 1930s—or my description in Chapter 1 of how the population of Lebanon got lulled into a false sense of security by the appearance of mutual friendliness and tolerance.

Let us go one step further and consider induction's most *worrisome* aspect: learning backward. Consider that the turkey's experience may have, rather than no value, a *negative* value. It learned from observation, as we are all advised to do (hey, after all, this is what is believed to be the scientific method). Its confidence increased as the number of friendly feedings grew, and it felt increasingly safe even though the slaughter was more and more imminent. Consider that the feeling of safety reached its maximum when the risk was at the highest! But the problem is even more general than that; it strikes at the nature of empirical knowledge itself. Something has worked in the past, until—well, it

unexpectedly no longer does, and what we have learned from the past turns out to be at best irrelevant or false, at worst viciously misleading.

FIGURE 1: ONE THOUSAND AND ONE DAYS OF HISTORY



A turkey before and after Thanksgiving. The history of a process over a thousand days tells you nothing about what is to happen next. This naïve projection of the future from the past can be applied to anything.

Figure 1 provides the prototypical case of the problem of induction as encountered in real life. You observe a hypothetical variable for one thousand days. It could be anything (with a few mild transformations): book sales, blood pressure, crimes, your personal income, a given stock, the interest on a loan, or Sunday attendance at a specific Greek Orthodox church. You subsequently derive *solely from past data* a few conclusions concerning the properties of the pattern with projections for the next thousand, even five thousand, days. On the one thousand and first day—boom! A big change takes place that is completely unprepared for by the past.

Consider the surprise of the Great War. After the Napoleonic conflicts, the world had experienced a period of peace that would lead any observer to believe in the disappearance of severely destructive conflicts. Yet, surprise! It turned out to be the deadliest conflict, up until then, in the history of mankind.

Note that after the event you start predicting the possibility of other outliers happening locally, that is, in the process you were just surprised by, *but not elsewhere*. After the stock market crash of 1987 half of America's traders braced for another one every October—not taking into account that there was no antecedent for the first one. We worry too late—ex post. Mistaking a naïve observation of the past as something definitive or representative of the future is

the one and only cause of our inability to understand the Black Swan.

It would appear to a quoting dilettante—i.e., one of those writers and scholars who fill up their texts with phrases from some dead authority—that, as phrased by Hobbes, "from like antecedents flow like consequents." Those who believe in the unconditional benefits of past experience should consider this pearl of wisdom allegedly voiced by a famous ship's captain:

> *But in all my experience, I have never been in any accident… of any sort worth speaking about. I have seen but one vessel in distress in all my years at sea. I never saw a wreck and never have been wrecked nor was I ever in any predicament that threatened to end in disaster of any sort.*
>
> E. J. Smith, 1907, Captain, RMS *Titanic*

Captain Smith's ship sank in 1912 in what became the most talked-about shipwreck in history.*

Trained to Be Dull

Similarly, think of a bank chairman whose institution makes steady profits over a long time, only to lose everything in a single reversal of fortune. Traditionally, bankers of the lending variety have been pear-shaped, clean-shaven, and dress in possibly the most comforting and boring manner, in dark suits, white shirts, and red ties. Indeed, for their lending business, banks hire dull people and train them to be even more dull. But this is for show. If they look conservative, it is because their loans only go bust on rare, very rare, occasions. There is no way to gauge the effectiveness of their lending activity by observing it over a day, a week, a month, or … even a century! In the summer of 1982, large American banks lost close to all their past earnings (cumulatively), about everything they ever made in the history of American banking—everything. They had been lending to South and Central American countries that all defaulted at the same time—"an event of an exceptional nature." So it took just one summer to figure out that this was a sucker's business and that all their earnings came from a very risky game. All that while the bankers led everyone, especially themselves, into believing that they were "conservative." They are not conservative; just phenomenally skilled at self-deception by burying the possibility of a large, devastating loss under the rug. In fact, the travesty repeated itself a decade later, with the "risk-conscious" large banks once again under financial strain, many of them near-bankrupt, after the real-estate collapse of the early 1990s in which the now defunct savings and loan industry required a taxpayer-funded bailout of more

than half a trillion dollars. The Federal Reserve bank protected them at our expense: when "conservative" bankers make profits, they get the benefits; when they are hurt, we pay the costs.

After graduating from Wharton, I initially went to work for Bankers Trust (now defunct). There, the chairman's office, rapidly forgetting about the story of 1982, broadcast the results of every quarter with an announcement explaining how smart, profitable, conservative (and good looking) they were. It was obvious that their profits were simply cash borrowed from destiny with some random payback time. I have no problem with risk taking, just please, please, do not call yourself conservative and act superior to other businesses who are not as vulnerable to Black Swans.

Another recent event is the almost-instant bankruptcy, in 1998, of a financial investment company (hedge fund) called Long-Term Capital Management (LTCM), which used the methods and risk expertise of two "Nobel economists," who were called "geniuses" but were in fact using phony, bell curve–style mathematics while managing to convince themselves that it was great science and thus turning the entire financial establishment into suckers. One of the largest trading losses ever in history took place in almost the blink of an eye, with no warning signal (more, much more on that in Chapter 17).*

A Black Swan Is Relative to Knowledge

From the standpoint of the turkey, the nonfeeding of the one thousand and first day is a Black Swan. For the butcher, it is not, since its occurrence is not unexpected. So you can see here that the Black Swan is a sucker's problem. In other words, it occurs relative to your expectation. You realize that you can eliminate a Black Swan by science (if you're able), or by keeping an open mind. Of course, like the LTCM people, you can create Black Swans with science, by giving people confidence that the Black Swan cannot happen—this is when science turns normal citizens into suckers.

Note that these events do not have to be *instantaneous* surprises. Some of the historical fractures I mention in Chapter 1 have lasted a few decades, like, say, the computer that brought consequential effects on society without its invasion of our lives being noticeable from day to day. Some Black Swans can come from the slow building up of incremental changes in the same direction, as with books that sell large amounts over years, never showing up on the bestseller lists, or

from technologies that creep up on us slowly, but surely. Likewise, the growth of Nasdaq stocks in the late 1990s took a few years—but the growth would seem sharper if you were to plot it on a long historical line. Matters should be seen on some relative, not absolute, timescale: earthquakes last minutes, 9/11 lasted hours, but historical changes and technological implementations are Black Swans that can take decades. In general, positive Black Swans take time to show their effect while negative ones happen very quickly—it is much easier and much faster to destroy than to build. (During the Lebanese war, my parents' house in Amioun and my grandfather's house in a nearby village were destroyed in just a few hours, dynamited by my grandfather's enemies who controlled the area. It took seven thousand times longer—two years—to rebuild them. This asymmetry in timescales explains the difficulty in reversing time.)

A BRIEF HISTORY OF THE BLACK SWAN PROBLEM

This turkey problem (a.k.a. the problem of induction) is a very old one, but for some reason it is likely to be called "Hume's problem" by your local philosophy professor.

People imagine us skeptics and empiricists to be morose, paranoid, and tortured in our private lives, which may be the exact opposite of what history (and my private experience) reports. Like many of the skeptics I hang around with, Hume was jovial and a bon vivant, eager for literary fame, salon company, and pleasant conversation. His life was not devoid of anecdotes. He once fell into a swamp near the house he was building in Edinburgh. Owing to his reputation among the locals as an atheist, a woman refused to pull him out of it until he recited the Lord's Prayer and the Belief, which, being practical-minded, he did. But not before he argued with her about whether Christians were obligated to help their enemies. Hume looked unprepossessing. "He exhibited that preoccupied stare of the thoughtful scholar that so commonly impresses the undiscerning as imbecile," writes a biographer.

Strangely, Hume during his day was not mainly known for the works that generated his current reputation—he became rich and famous through writing a bestselling history of England. Ironically, when Hume was alive, his philosophical works, to which we now attach his fame, "fell deadborn off the presses," while the works for which he was famous at the time are now harder to find. Hume wrote with such clarity that he puts to shame almost all current thinkers, and certainly the entire German graduate curriculum. Unlike Kant, Fichte, Schopenhauer, and Hegel, Hume is the kind of thinker who is *sometimes* read by the person mentioning his work.

I often hear "Hume's problem" mentioned in connection with the problem of induction, but the problem is old, older than the interesting Scotsman, perhaps as old as philosophy itself, maybe as old as olive-grove conversations. Let us go back into the past, as it was formulated with no less precision by the ancients.

Sextus the (Alas) Empirical

The violently antiacademic writer, and antidogma activist, Sextus Empiricus operated close to a millennium and a half before Hume, and formulated the turkey problem with great precision. We know very little about him; we do not

know whether he was a philosopher or more of a copyist of philosophical texts by authors obscure to us today. We surmise that he lived in Alexandria in the second century of our era. He belonged to a school of medicine called "empirical," since its practitioners doubted theories and causality and relied on past experience as guidance in their treatment, though not putting much trust in it. Furthermore, they did not trust that anatomy revealed function too obviously. The most famous proponent of the empirical school, Menodotus of Nicomedia, who merged empiricism and philosophical skepticism, was said to keep medicine an art, not a "science," and insulate its practice from the problems of dogmatic science. The practice of medicine explains the addition of *empiricus* ("the empirical") to Sextus's name.

Sextus represented and jotted down the ideas of the school of the Pyrrhonian skeptics who were after some form of intellectual therapy resulting from the suspension of belief. Do you face the possibility of an adverse event? Don't worry. Who knows, it may turn out to be good for you. Doubting the consequences of an outcome will allow you to remain imperturbable. The Pyrrhonian skeptics were docile citizens who followed customs and traditions whenever possible, but taught themselves to systematically doubt everything, and thus attain a level of serenity. But while conservative in their habits, they were rabid in their fight against dogma.

Among the surviving works of Sextus's is a diatribe with the beautiful title *Adversos Mathematicos*, sometimes translated as *Against the Professors*. Much of it could have been written last Wednesday night!

Where Sextus is mostly interesting for my ideas is in his rare mixing of philosophy and decision making in his practice. He was a doer, hence classical scholars don't say nice things about him. The methods of empirical medicine, relying on seemingly purposeless trial and error, will be central to my ideas on planning and prediction, on how to benefit from the Black Swan.

In 1998, when I went out on my own, I called my research laboratory and trading firm Empirica, not for the same antidogmatist reasons, but on account of the far more depressing reminder that it took at least another fourteen centuries after the works of the school of empirical medicine before medicine changed and finally became adogmatic, suspicious of theorizing, profoundly skeptical, and evidence-based! Lesson? That awareness of a problem does not mean much—particularly when you have special interests and self-serving institutions in play.

Algazel

The third major thinker who dealt with the problem was the eleventh-century Arabic-language skeptic Al-Ghazali, known in Latin as Algazel. His name for a class of dogmatic scholars was *ghabi*, literally "the imbeciles," an Arabic form that is funnier than "moron" and more expressive than "obscurantist." Algazel wrote his own *Against the Professors*, a diatribe called *Tahafut al falasifah*, which I translate as "The Incompetence of Philosophers." It was directed at members of the school called *falasifah*—the Arabic intellectual establishment was the direct heir of the classical philosophy of the academy, and they managed to reconcile it with Islam through rational argument.

Algazel's attack on "scientific" knowledge started a debate with Averroës, the medieval philosopher who ended up having the most profound influence of any medieval thinker (on Jews and Christians, though not on Moslems). The debate between Algazel and Averroës was finally, but sadly, won by both. In its aftermath, many Arab religious thinkers integrated and exaggerated Algazel's skepticism of the scientific method, preferring to leave causal considerations to God (in fact it was a stretch of his idea). The West embraced Averroës's rationalism, built upon Aristotle's, which survived through Aquinas and the Jewish philosophers who called themselves Averroan for a long time. Many thinkers blame the Arabs' later abandonment of scientific method on Algazel's huge influence—though apparently this took place a few centuries later. He ended up fueling Sufi mysticism, in which the worshipper attempts to enter into communion with God, severing all connections with earthly matters. All of this came from the Black Swan problem.

The Skeptic, Friend of Religion

While the ancient skeptics advocated learned ignorance as the first step in honest inquiries toward truth, later medieval skeptics, both Moslems and Christians, used skepticism as a tool to avoid accepting what today we call science. Belief in the importance of the Black Swan problem, worries about induction, and skepticism can make some religious arguments more appealing, though in stripped-down, anticlerical, theistic form. This idea of relying on faith, not reason, was known as fideism. So there is a tradition of Black Swan skeptics who found solace in religion, best represented by Pierre Bayle, a French-speaking Protestant erudite, philosopher, and theologian, who, exiled in Holland,

built an extensive philosophical architecture related to the Pyrrhonian skeptics. Bayle's writings exerted some considerable influence on Hume, introducing him to ancient skepticism—to the point where Hume took ideas wholesale from Bayle. Bayle's *Dictionnaire historique et critique* was the most read piece of scholarship of the eighteenth century, but like many of my French heroes (such as Frédéric Bastiat), Bayle does not seem to be part of the French curriculum and is nearly impossible to find in the original French language. Nor is the fourteenth-century Algazelist Nicolas of Autrecourt.

Indeed, it is not a well-known fact that the most complete exposition of the ideas of skepticism, until recently, remains the work of a powerful Catholic bishop who was an august member of the French Academy. Pierre-Daniel Huet wrote his *Philosophical Treatise on the Weaknesses of the Human Mind* in 1690, a remarkable book that tears through dogmas and questions human perception. Huet presents arguments against causality that are quite potent—he states, for instance, that any event can have an infinity of possible causes.

Both Huet and Bayle were erudites and spent their lives reading. Huet, who lived into his nineties, had a servant follow him with a book to read aloud to him during meals and breaks and thus avoid lost time. He was deemed the most read person in his day. Let me insist that erudition is important to me. It signals genuine intellectual curiosity. It accompanies an open mind and the desire to probe the ideas of others. Above all, an erudite can be dissatisfied with his own knowledge, and such dissatisfaction is a wonderful shield against Platonicity, the simplifications of the five-minute manager, or the philistinism of the overspecialized scholar. Indeed, scholarship without erudition can lead to disasters.

I Don't Want to Be a Turkey

But promoting philosophical skepticism is not quite the mission of this book. If awareness of the Black Swan problem can lead us into withdrawal and extreme skepticism, I take here the exact opposite direction. I am interested in deeds and true empiricism. So, this book was not written by a Sufi mystic, or even by a skeptic in the ancient or medieval sense, or even (we will see) in a philosophical sense, but by a practitioner whose principal aim is to not be a sucker in things that matter, period.

Hume was radically skeptical in the philosophical cabinet, but abandoned

such ideas when it came to daily life, since he could not handle them. I am doing here the exact opposite: I am skeptical in matters that have implications for daily life. In a way, all I care about is making a decision without being the turkey.

Many middlebrows have asked me over the past twenty years, "How do you, Taleb, cross the street given your extreme risk consciousness?" or have stated the more foolish "You are asking us to take *no* risks." Of course I am not advocating total risk phobia (we will see that I favor an aggressive type of risk taking): all I will be showing you in this book is how to avoid crossing the street *blindfolded*.

They Want to Live in Mediocristan

I have just presented the Black Swan problem in its historical form: the central difficulty of generalizing from available information, or of learning from the past, the known, and the seen. I have also presented the list of those who, I believe, are the most relevant historical figures.

You can see that it is extremely convenient for us to assume that we live in Mediocristan. Why? Because it allows you to rule out these Black Swan surprises! The Black Swan problem either does not exist or is of small consequence if you live in Mediocristan!

Such an assumption magically drives away the problem of induction, which since Sextus Empiricus has been plaguing the history of thinking. The statistician can do away with epistemology.

Wishful thinking! We do not live in Mediocristan, so the Black Swan needs a different mentality. As we cannot push the problem under the rug, we will have to dig deeper into it. This is not a terminal difficulty—and we can even benefit from it.

• • •

Now, there are other themes arising from our blindness to the Black Swan:

a. We focus on preselected segments of the seen and generalize from it to the unseen: the error of confirmation.
b. We fool ourselves with stories that cater to our Platonic thirst for distinct patterns: the narrative fallacy.

c. We behave as if the Black Swan does not exist: human nature is not programmed for Black Swans.
d. What we see is not necessarily all that is there. History hides Black Swans from us and gives us a mistaken idea about the odds of these events: this is the distortion of silent evidence.
e. We "tunnel": that is, we focus on a few well-defined sources of uncertainty, on too specific a list of Black Swans (at the expense of the others that do not easily come to mind).

I will discuss each of the points in the next five chapters. Then, in the conclusion of Part One, I will show how, in effect, they are the *same* topic.

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* I am safe since I never wear ties (except at funerals).

* Since Russell's original example used a chicken, this is the enhanced North American adaptation.

* Statements like those of Captain Smith are so common that it is not even funny. In September 2006, a fund called Amaranth, ironically named after a flower that "never dies," had to shut down after it lost close to $7 billion in a few days, the most impressive loss in trading history (another irony: I shared office space with the traders). A few days prior to the event, the company made a statement to the effect that investors should not worry because they had twelve risk managers—people who use models of the past to produce risk measures on the odds of such an event. Even if they had one hundred and twelve risk managers, there would be no meaningful difference; they still would have blown up. Clearly you cannot manufacture more information than the past can deliver; if you buy one hundred copies of *The New York Times*, I am not too certain that it would help you gain incremental knowledge of the future. We just don't know how much information there is in the past.

* The main tragedy of the high impact-low probability event comes from the mismatch between the time taken to compensate someone and the time one needs to be comfortable that he is not making a bet against the rare event. People have an incentive to bet against it, or to game the system since they can be paid a bonus reflecting their yearly performance when in fact all they are doing is producing illusory profits that they will lose back one day. Indeed, the tragedy of capitalism is that since the quality of the returns is not observable from past data, owners of companies, namely shareholders, can be taken for a ride by the managers who show returns and cosmetic profitability but in fact might be taking hidden risks.

Chapter Five

CONFIRMATION SHMONFIRMATION!

I have so much evidence—Can Zoogles be (sometimes) Boogles?—Corroboration shmorroboration—Popper's idea

As much as it is ingrained in our habits and conventional wisdom, confirmation can be a dangerous error.

Assume I told you that I had evidence that the football player O. J. Simpson (who was accused of killing his wife in the 1990s) was not a criminal. Look, the other day I had breakfast with him and *he didn't kill anybody*. I am serious, I did not see him kill a single person. Wouldn't that *confirm* his innocence? If I said such a thing you would certainly call a shrink, an ambulance, or perhaps even the police, since you might think that I spent too much time in trading rooms or in cafés thinking about this Black Swan topic, and that my logic may represent such an immediate danger to society that I myself need to be locked up immediately.

You would have the same reaction if I told you that I took a nap the other day on the railroad track in New Rochelle, New York, and was not killed. Hey, look at me, I am alive, I would say, and that is evidence that lying on train tracks is risk-free. Yet consider the following. Look again at Figure 1 in Chapter 4; someone who observed the turkey's first thousand days (but not the shock of the thousand and first) would tell you, and rightly so, that there is *no evidence* of the possibility of large events, i.e., Black Swans. You are likely to confuse that statement, however, particularly if you do not pay close attention, with the statement that there is *evidence of no possible* Black Swans. Even though it is in fact vast, the logical distance between the two assertions will seem very narrow in your mind, so that one can be easily substituted for the other. Ten days from now, if you manage to remember the first statement at all, you will be likely to retain the second, inaccurate version—that there is *proof of no Black Swans*. I call this confusion the round-trip fallacy, since these statements are not

interchangeable.

Such confusion of the two statements partakes of a trivial, very trivial (but crucial), logical error—but we are not immune to trivial, logical errors, nor are professors and thinkers particularly immune to them (complicated equations do not tend to cohabit happily with clarity of mind). Unless we concentrate very hard, we are likely to unwittingly simplify the problem because our minds routinely do so without our knowing it.

It is worth a deeper examination here.

Many people confuse the statement "almost all terrorists are Moslems" with "almost all Moslems are terrorists." Assume that the first statement is true, that 99 percent of terrorists are Moslems. This would mean that only about .001 percent of Moslems are terrorists, since there are more than one billion Moslems and only, say, ten thousand terrorists, one in a hundred thousand. So the logical mistake makes you (unconsciously) overestimate the odds of a randomly drawn individual Moslem person (between the age of, say, fifteen and fifty) being a terrorist by close to fifty thousand times!

The reader might see in this round-trip fallacy the unfairness of stereotypes—minorities in urban areas in the United States have suffered from the same confusion: even if most criminals come from their ethnic subgroup, most of their ethnic subgroup are not criminals, but they still suffer from discrimination by people who should know better.

"I never meant to say that the Conservatives are generally stupid. I meant to say that stupid people are generally Conservative," John Stuart Mill once complained. This problem is chronic: if you tell people that the key to success is not always skills, they think that you are telling them that it is never skills, always luck.

Our inferential machinery, that which we use in daily life, is not made for a complicated environment in which a statement changes markedly when its wording is slightly modified. Consider that in a primitive environment there is no consequential difference between the statements *most killers are wild animals* and *most wild animals are killers*. There is an error here, but it is almost inconsequential. Our statistical intuitions have not evolved for a habitat in which these subtleties can make a big difference.

Zoogles Are Not All Boogles

All zoogles are boogles. You saw a boogle. Is it a zoogle? Not necessarily, *since not all boogles are zoogles;* adolescents who make a mistake in answering this kind of question on their SAT test might not make it to college. Yet another person can get very high scores on the SATs and still feel a chill of fear when someone from the wrong side of town steps into the elevator. This inability to automatically transfer knowledge and sophistication from one situation to another, or from theory to practice, is a quite disturbing attribute of human nature.

Let us call it the *domain specificity* of our reactions. By domain-specific I mean that our reactions, our mode of thinking, our intuitions, depend on the context in which the matter is presented, what evolutionary psychologists call the "domain" of the object or the event. The classroom is a domain; real life is another. We react to a piece of information not on its logical merit, but on the basis of which framework surrounds it, and how it registers with our social-emotional system. Logical problems approached one way in the classroom might be treated differently in daily life. Indeed they *are* treated differently in daily life.

Knowledge, even when it is exact, does not often lead to appropriate actions because we tend to forget what we know, or forget how to process it properly if we do not pay attention, even when we are experts. Statisticians, it has been shown, tend to leave their brains in the classroom and engage in the most trivial inferential errors once they are let out on the streets. In 1971, the psychologists Danny Kahneman and Amos Tversky plied professors of statistics with statistical questions not phrased as statistical questions. One was similar to the following (changing the example for clarity): Assume that you live in a town with two hospitals—one large, the other small. On a given day 60 percent of those born in one of the two hospitals are boys. Which hospital is it likely to be? Many statisticians made the equivalent of the mistake (during a casual conversation) of choosing the larger hospital, when in fact the very basis of statistics is that large samples are more stable and should fluctuate less from the long-term average—here, 50 percent for each of the sexes—than smaller samples. These statisticians would have flunked their own exams. During my days as a quant I counted hundreds of such severe inferential mistakes made by statisticians who forgot that they were statisticians.

For another illustration of the way we can be ludicrously domain-specific in daily life, go to the luxury Reebok Sports Club in New York City, and look at

the number of people who, after riding the escalator for a couple of floors, head directly to the StairMasters.

This domain specificity of our inferences and reactions works both ways: some problems we can understand in their applications but not in textbooks; others we are better at capturing in the textbook than in the practical application. People can manage to effortlessly solve a problem in a social situation but struggle when it is presented as an abstract logical problem. We tend to use different mental machinery—so-called modules—in different situations: our brain lacks a central all-purpose computer that starts with logical rules and applies them equally to all possible situations.

And as I've said, we can commit *a logical mistake in reality but not in the classroom*. This asymmetry is best visible in cancer detection. Take doctors examining a patient for signs of cancer; tests are typically done on patients who want to know if they are cured or if there is "recurrence." (In fact, recurrence is a misnomer; it simply means that the treatment did not kill all the cancerous cells and that these undetected malignant cells have started to multiply out of control.) It is not feasible, in the present state of technology, to examine every single one of the patient's cells to see if all of them are nonmalignant, so the doctor takes a sample by scanning the body with as much precision as possible. Then she makes an assumption about what she did not see. I was once taken aback when a doctor told me after a routine cancer checkup, "Stop worrying, we have evidence of cure." "Why?" I asked. "There is evidence of *no* cancer" was the reply. "How do you know?" I asked. He replied, "The scan is negative." Yet he went around calling himself doctor!

An acronym used in the medical literature is NED, which stands for No Evidence of Disease. There is no such thing as END, Evidence of No Disease. Yet my experience discussing this matter with plenty of doctors, even those who publish papers on their results, is that many slip into the round-trip fallacy during conversation.

Doctors in the midst of the scientific arrogance of the 1960s looked down at mothers' milk as something primitive, as if it could be replicated by their laboratories—not realizing that mothers' milk might include useful components that could have eluded their scientific understanding—a simple confusion of *absence of evidence* of the benefits of mothers' milk with *evidence of absence* of the benefits (another case of Platonicity as "it did not make sense" to breast-feed when we could simply use bottles). Many people paid the price for this naïve

inference: those who were not breast-fed as infants turned out to be at an increased risk of a collection of health problems, including a higher likelihood of developing certain types of cancer—there had to be in mothers' milk some necessary nutrients that still elude us. Furthermore, benefits to mothers who breast-feed were also neglected, such as a reduction in the risk of breast cancer.

Likewise with tonsils: the removal of tonsils may lead to a higher incidence of throat cancer, but for decades doctors never suspected that this "useless" tissue might actually have a use that escaped their detection. The same with the dietary fiber found in fruits and vegetables: doctors in the 1960s found it useless because they saw no immediate evidence of its necessity, and so they created a malnourished generation. Fiber, it turns out, acts to slow down the absorption of sugars in the blood and scrapes the intestinal tract of precancerous cells. Indeed medicine has caused plenty of damage throughout history, owing to this simple kind of inferential confusion.

I am not saying here that doctors should not have beliefs, only that some kinds of definitive, closed beliefs need to be avoided—this is what Menodotus and his school seemed to be advocating with their brand of skeptical-empirical medicine that avoided theorizing. Medicine has gotten better—but many kinds of knowledge have not.

Evidence

By a mental mechanism I call naïve empiricism, we have a natural tendency to look for instances that confirm our story and our vision of the world—these instances are always easy to find. Alas, with tools, and fools, anything can be easy to find. You take past instances that corroborate your theories and you treat them as *evidence*. For instance, a diplomat will show you his "accomplishments," not what he failed to do. Mathematicians will try to convince you that their science is useful to society by pointing out instances where it proved helpful, not those where it was a waste of time, or, worse, those numerous mathematical applications that inflicted a severe cost on society owing to the highly unempirical nature of elegant mathematical theories.

Even in testing a hypothesis, we tend to look for instances where the hypothesis proved true. Of course we can easily find confirmation; all we have to do is look, or have a researcher do it for us. I can *find confirmation* for just about anything, the way a skilled London cabbie can find traffic to increase the

fare, even on a holiday.

Some people go further and give me examples of events that we have been able to foresee with some success—indeed there are a few, like landing a man on the moon and the economic growth of the twenty-first century. One can find plenty of “counterevidence” to the points in this book, the best being that newspapers are excellent at predicting movie and theater schedules. Look, I predicted yesterday that the sun would rise today, and it did!

NEGATIVE EMPIRICISM

The good news is that there is a way around this naïve empiricism. I am saying that a series of corroborative facts is not *necessarily* evidence. Seeing white swans does not confirm the nonexistence of black swans. There is an exception, however: I know what statement is wrong, but not necessarily what statement is correct. If I see a black swan I can certify that *all swans are not white!* If I see someone kill, then I can be practically certain that he is a criminal. If I don't see him kill, I cannot be certain that he is innocent. The same applies to cancer detection: the finding of a single malignant tumor proves that you have cancer, but the absence of such a finding cannot allow you to say with certainty that you are cancer-free.

We can get closer to the truth by negative instances, not by verification! It is misleading to build a general rule from observed facts. Contrary to conventional wisdom, our body of knowledge does not increase from a series of confirmatory observations, like the turkey's. But there are some things I can remain skeptical about, and others I can safely consider certain. This makes the consequences of observations one-sided. It is not much more difficult than that.

This asymmetry is immensely practical. It tells us that we do not have to be complete skeptics, just semiskeptics. The subtlety of real life over the books is that, in your decision making, you need be interested only in one side of the story: if you seek *certainty* about whether the patient has cancer, not *certainty* about whether he is healthy, then you might be satisfied with negative inference, since it will supply you the certainty you seek. So we can learn a lot from data—but not as much as we expect. Sometimes a lot of data can be meaningless; at other times one single piece of information can be very meaningful. It is true that a thousand days cannot prove you right, but one day can prove you to be wrong.

The person who is credited with the promotion of this idea of one-sided semiskepticism is Sir Doktor Professor Karl Raimund Popper, who may be the only philosopher of science who is actually read and discussed by actors in the real world (though not as enthusiastically by professional philosophers). As I am writing these lines, a black-and-white picture of him is hanging on the wall of my study. It was a gift I got in Munich from the essayist Jochen Wegner, who, like me, considers Popper to be about all "we've got" among modern thinkers—well, almost. He writes to us, not to other philosophers. "We" are the empirical

decision makers who hold that uncertainty is our discipline, and that understanding how to act under conditions of incomplete information is the highest and most urgent human pursuit.

Popper generated a large-scale theory around this asymmetry, based on a technique called "falsification" (to falsify is to prove wrong) meant to distinguish between science and nonscience, and people immediately started splitting hairs about its technicalities, even though it is not the most interesting, or the most original, of Popper's ideas. This idea about the asymmetry of knowledge is so liked by practitioners, because it is obvious to them; it is the way they run their business. The philosopher *maudit* Charles Sanders Peirce, who, like an artist, got only posthumous respect, also came up with a version of this Black Swan solution when Popper was wearing diapers—some people even called it the Peirce-Popper approach. Popper's far more powerful and original idea is the "open" society, one that relies on skepticism as a modus operandi, refusing and resisting definitive truths. He accused Plato of closing our minds, according to the arguments I described in the Prologue. But Popper's biggest idea was his insight concerning the fundamental, severe, and incurable unpredictability of the world, and that I will leave for the chapter on prediction.*

Of course, it is not so easy to "falsify," i.e., to state that something is wrong with full certainty. Imperfections in your testing method may yield a mistaken "no." The doctor discovering cancer cells might have faulty equipment causing optical illusions; or he could be a bell-curve-using economist disguised as a doctor. An eyewitness to a crime might be drunk. *But it remains the case that you know what is wrong with a lot more confidence than you know what is right*. All pieces of information are not equal in importance.

Popper introduced the mechanism of conjectures and refutations, which works as follows: you formulate a (bold) conjecture and you start looking for the observation that would prove you wrong. This is the alternative to our search for confirmatory instances. If you think the task is easy, you will be disappointed—few humans have a natural ability to do this. I confess that I am not one of them; it does not come naturally to me.*

Counting to Three

Cognitive scientists have studied our natural tendency to look only for corroboration; they call this vulnerability to the corroboration error the

confirmation bias. There are some experiments showing that people focus only on the books read in Umberto Eco's library. You can test a given rule either directly, by looking at instances where it works, or indirectly, by focusing on where it does not work. As we saw earlier, disconfirming instances are far more powerful in establishing truth. Yet we tend to not be aware of this property.

The first experiment I know of concerning this phenomenon was done by the psychologist P. C. Wason. He presented subjects with the three-number sequence 2, 4, 6, and asked them to try to guess the rule generating it. Their method of guessing was to produce other three-number sequences, to which the experimenter would respond "yes" or "no" depending on whether the new sequences were consistent with the rule. Once confident with their answers, the subjects would formulate the rule. (Note the similarity of this experiment to the discussion in Chapter 1 of the way history presents itself to us: assuming history is generated according to some logic, we see only the events, never the rules, but need to guess how it works.) The correct rule was "numbers in ascending order," nothing more. Very few subjects discovered it because in order to do so they had to offer a series in descending order (that the experimenter would say "no" to). Wason noticed that the subjects had a rule in mind, but gave him examples aimed at confirming it instead of trying to supply series that were inconsistent with their hypothesis. Subjects tenaciously kept trying to confirm the rules that *they* had made up.

This experiment inspired a collection of similar tests, of which another example: Subjects were asked which questions to ask to find out whether a person was extroverted or not, purportedly for another type of experiment. It was established that subjects supplied mostly questions for which a "yes" answer would *support* the hypothesis.

But there are exceptions. Among them figure chess grand masters, who, it has been shown, actually do focus on where a speculative move might be weak; rookies, by comparison, look for confirmatory instances instead of falsifying ones. But don't play chess to practice skepticism. Scientists believe that it is the search for their own weaknesses that makes them good chess players, not the practice of chess that turns them into skeptics. Similarly, the speculator George Soros, when making a financial bet, keeps looking for instances that would prove his initial theory wrong. This, perhaps, is true self-confidence: the ability to look at the world without the need to find signs that stroke one's ego.*

Sadly, the notion of corroboration is rooted in our intellectual habits and

discourse. Consider this comment by the writer and critic John Updike: "When Julian Jaynes … speculates that until late in the second millennium B.C. men had no consciousness but were automatically obeying the voices of gods, we are astounded but compelled to follow this remarkable thesis through all the corroborative evidence." Jaynes's thesis may be right, but, Mr. Updike, the central problem of knowledge (and the point of this chapter) is that there is no such animal as *corroborative* evidence.

Saw Another Red Mini!

The following point further illustrates the absurdity of confirmation. If you believe that witnessing an additional white swan will bring confirmation that there are no black swans, then you should also accept the statement, on purely logical grounds, that the sighting of a red Mini Cooper should confirm that there are *no black swans*.

Why? Just consider that the statement "all swans are white" is equivalent to "all nonwhite objects are not swans." What confirms the latter statement should confirm the former. Therefore, a mind with a confirmation bent would infer that the sighting of a nonwhite object that is not a swan should bring such confirmation. This argument, known as Hempel's raven paradox, was rediscovered by my friend the (thinking) mathematician Bruno Dupire during one of our intense meditating walks in London—one of those intense walk-discussions, intense to the point of our not noticing the rain. He pointed to a red Mini and shouted, "Look, Nassim, look! No Black Swan!"

Not Everything

We are not naïve enough to believe that someone will be immortal because we have never seen him die, or that someone is innocent of murder because we have never seen him kill. The problem of naïve generalization does not plague us everywhere. But such smart pockets of inductive skepticism tend to involve events that we have encountered in our natural environment, matters from which we have learned to avoid foolish generalization.

For instance, when children are presented with the picture of a single member of a group and are asked to guess the properties of other unseen members, they are capable of selecting *which* attributes to generalize. Show a child a

photograph of someone overweight, tell her that he is a member of a tribe, and ask her to describe the rest of the population: she will (most likely) not jump to the conclusion that all the members of the tribe are weight-challenged. But she would respond differently to generalizations involving skin color. If you show her people of dark complexion and ask her to describe their co-tribesmen, she will assume that they too have dark skin.

So it seems that we are endowed with specific and elaborate inductive instincts showing us the way. Contrary to the opinion held by the great David Hume, and that of the British empiricist tradition, that *belief arises from custom*, as they assumed that we learn generalizations solely from experience and empirical observations, it was shown from studies of infant behavior that we come equipped with mental machinery that causes us to *selectively* generalize from experiences (i.e., to selectively acquire inductive learning in some domains but remain skeptical in others). By doing so, we are not learning from a mere thousand days, but benefiting, thanks to evolution, from the learning of our ancestors—which found its way into our biology.

Back to Mediocristan

And we may have learned things wrong from our ancestors. I speculate here that we probably inherited the instincts adequate for survival in the East African Great Lakes region where we presumably hail from, but these instincts are certainly not well adapted to the present, post-alphabet, intensely informational, and statistically complex environment.

Indeed our environment is a bit more complex than we (and our institutions) seem to realize. How? The modern world, being Extremistan, is dominated by rare—very rare—events. It can deliver a Black Swan after thousands and thousands of white ones, so we need to withhold judgment for longer than we are inclined to. As I said in Chapter 3, it is impossible—biologically impossible—to run into a human several hundred miles tall, so our intuitions rule these events out. But the sales of a book or the magnitude of social events do not follow such strictures. It takes a lot more than a thousand days to accept that a writer is ungifted, a market will not crash, a war will not happen, a project is hopeless, a country is “our ally,” a company will not go bust, a brokerage-house security analyst is not a charlatan, or a neighbor will not attack us. In the distant past, humans could make inferences far more accurately and quickly.

Furthermore, the sources of Black Swans today have multiplied beyond measurability.* In the primitive environment they were limited to newly encountered wild animals, new enemies, and abrupt weather changes. These events were repeatable enough for us to have built an innate fear of them. This instinct to make inferences rather quickly, and to "tunnel" (i.e., focus on a small number of sources of uncertainty, or causes of known Black Swans) remains rather ingrained in us. This instinct, in a word, is our predicament.

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* Neither Peirce nor Popper was the first to come up with this asymmetry. The philosopher Victor Brochard mentioned the importance of negative empiricism in 1878, as if it were a matter held by the empiricists to be the sound way to do business—ancients understood it implicitly. Out-of-print books deliver many surprises.

* As I said in the Prologue, the likely not happening is also a Black Swan. So disconfirming the likely is equivalent to confirming the unlikely.

* This confirmation problem pervades our modern life, since most conflicts have at their root the following mental bias: when Arabs and Israelis watch news reports they see different stories in the same succession of events. Likewise, Democrats and Republicans look at different parts of the same data and never converge to the same opinions. Once your mind is inhabited with a certain view of the world, you will tend to only consider instances proving you to be right. Paradoxically, the more information you have, the more justified you will feel in your views.

* Clearly, weather-related and geodesic events (such as tornadoes and earthquakes) have not changed much over the past millennium, but what have changed are the socioeconomic consequences of such occurrences. Today, an earthquake or hurricane commands more and more severe economic consequences than it did in the past because of the interlocking relationships between economic entities and the intensification of the "network effects" that we will discuss in Part Three. Matters that used to have mild effects now command a high impact. Tokyo's 1923 earthquake caused a drop of about a third in Japan's GNP. Extrapolating from the tragedy of Kobe in 1994, we can easily infer that the consequences of another such earthquake in Tokyo would be far costlier than that of its predecessor.

Chapter Six

THE NARRATIVE FALLACY

The cause of the because—How to split a brain—Effective methods of pointing at the ceiling—Dopamine will help you win—I will stop riding motorcycles (but not today)—Both empirical and psychologist? Since when?

ON THE CAUSES OF MY REJECTION OF CAUSES

During the fall of 2004, I attended a conference on aesthetics and science in Rome, perhaps the best possible location for such a meeting since aesthetics permeates everything there, down to one's personal behavior and tone of voice. At lunch, a prominent professor from a university in southern Italy greeted me with extreme enthusiasm. I had listened earlier that morning to his impassioned presentation; he was so charismatic, so convinced, and so convincing that, although I could not understand much of what he said, I found myself fully agreeing with everything. I could only make out a sentence here and there, since my knowledge of Italian worked better in cocktail parties than in intellectual and scholarly venues. At some point during his speech, he turned all red with anger —thus convincing me (and the audience) that he was definitely right.

He assailed me during lunch to congratulate me for showing the effects of those causal links that are more prevalent in the human mind than in reality. The conversation got so animated that we stood together near the buffet table, blocking the other delegates from getting close to the food. He was speaking accented French (with his hands), I was answering in primitive Italian (with my hands), and we were so vivacious that the other guests were afraid to interrupt a conversation of such importance and animation. He was emphatic about my previous book on randomness, a sort of angry trader's reaction against blindness to luck in life and in the markets, which had been published there under the musical title *Giocati dal caso*. I had been lucky to have a translator who knew almost more about the topic than I did, and the book found a small following among Italian intellectuals. "I am a huge fan of your ideas, but I feel slighted. These are truly mine too, and you wrote the book that I (almost) planned to write," he said. "You are a lucky man; you presented in such a comprehensive way the effect of chance on society and the overestimation of cause and effect. You show how stupid we are to systematically try to *explain* skills."

He stopped, then added, in a calmer tone: "But, *mon cher ami*, let me tell you *quelque chose* [uttered very slowly, with his thumb hitting his index and middle fingers]: had you grown up in a Protestant society where people are told that efforts are linked to rewards and individual responsibility is emphasized, you would never have seen the world in such a manner. You were able to see luck and separate cause and effect *because* of your Eastern Orthodox Mediterranean heritage." He was using the French *à cause*. And he was so convincing that, for a

minute, I agreed with his interpretation.

We like stories, we like to summarize, and we like to simplify, i.e., to reduce the dimension of matters. The first of the problems of human nature that we examine in this section, the one just illustrated above, is what I call the *narrative fallacy*. (It is actually a fraud, but, to be more polite, I will call it a fallacy.) The fallacy is associated with our vulnerability to overinterpretation and our predilection for compact stories over raw truths. It severely distorts our mental representation of the world; it is particularly acute when it comes to the rare event.

Notice how my thoughtful Italian fellow traveler shared my militancy against overinterpretation and against the overestimation of cause, yet was unable to see me and my work without a reason, a cause, tagged to both, as anything other than part of a story. He had to *invent* a cause. Furthermore, he was not aware of his having fallen into the causation trap, nor was I immediately aware of it myself.

The narrative fallacy addresses our limited ability to look at sequences of facts without weaving an explanation into them, or, equivalently, forcing a logical link, an *arrow of relationship*, upon them. Explanations bind facts together. They make them all the more easily remembered; they help them *make more sense*. Where this propensity can go wrong is when it increases our *impression* of understanding.

This chapter will cover, just like the preceding one, a single problem, but seemingly in different disciplines. The problem of narrativity, although extensively studied in one of its versions by psychologists, is not so "psychological": something about the way disciplines are designed masks the point that it is more generally a problem of *information*. While narrativity comes from an ingrained biological need to reduce dimensionality, robots would be prone to the same process of reduction. Information *wants* to be reduced.

To help the reader locate himself: in studying the problem of induction in the previous chapter, we examined what could be inferred about the unseen, what lies *outside* our information set. Here, we look at the seen, what lies *within* the information set, and we examine the distortions in the act of processing it. There is plenty to say on this topic, but the angle I take concerns narrativity's simplification of the world around us and its effects on our perception of the

Black Swan and wild uncertainty.

SPLITTING BRAINS

Ferreting out antilogics is an exhilarating activity. For a few months, you experience the titillating sensation that you've just entered a new world. After that, the novelty fades, and your thinking returns to business as usual. The world is dull again until you find another subject to be excited about (or manage to put another hotshot in a state of total rage).

For me, one such antilogic came with the discovery—thanks to the literature on cognition—that, counter to what everyone believes, *not theorizing* is an act—that theorizing can correspond to the absence of willed activity, the "default" option. It takes considerable effort to see facts (and remember them) while withholding judgment and resisting explanations. And this theorizing disease is rarely under our control: it is largely anatomical, part of our biology, so fighting it requires fighting one's own self. So the ancient skeptics' precepts to withhold judgment go against our nature. Talk is cheap, a problem with advice-giving philosophy we will see in Chapter 13.

Try to be a true skeptic with respect to your interpretations and you will be worn out in no time. You will also be humiliated for resisting to theorize. (There are tricks to achieving true skepticism; but you have to go through the back door rather than engage in a frontal attack on yourself.) Even from an anatomical perspective, it is impossible for our brain to see anything in raw form without some interpretation. We may not even always be conscious of it.

Post hoc rationalization. In an experiment, psychologists asked women to select from among twelve pairs of nylon stockings the ones they preferred. The researchers then asked the women their reasons for their choices. Texture, "feel," and color featured among the selected reasons. All the pairs of stockings were, in fact, identical. The women supplied backfit, *post hoc* explanations. Does this suggest that we are better at explaining than at understanding? Let us see.

A series of famous experiments on split-brain patients gives us convincing physical—that is, biological—evidence of the automatic aspect of the act of interpretation. There appears to be a sense-making organ in us—though it may not be easy to zoom in on it with any precision. Let us see how it is detected.

Split-brain patients have no connection between the left and the right sides of their brains, which prevents information from being shared between the two cerebral hemispheres. These patients are jewels, rare and invaluable for

researchers. You literally have two different persons, and you can communicate with each one of them separately; the differences between the two individuals give you some indication about the specialization of each of the hemispheres. This splitting is usually the result of surgery to remedy more serious conditions like severe epilepsy; no, scientists in Western countries (and most Eastern ones) are no longer allowed to cut human brains in half, even if it is for the pursuit of knowledge and wisdom.

Now, say that you induced such a person to perform an act—raise his finger, laugh, or grab a shovel—in order to ascertain how he ascribes a reason to his act (when in fact you know that there is no reason for it other than your inducing it). If you ask the right hemisphere, here isolated from the left side, to perform the action, then ask the other hemisphere for an explanation, the patient will invariably offer some interpretation: "I was pointing at the ceiling in order to …," "I saw something interesting on the wall," or, if you ask this author, I will offer my usual "because I am originally from the Greek Orthodox village of Amioun, northern Lebanon," et cetera.

Now, if you do the opposite, namely instruct the isolated left hemisphere of a right-handed person to perform an act and ask the right hemisphere for the reasons, you will be plainly told, "I don't know." Note that the left hemisphere is where language and deduction generally reside. I warn the reader hungry for "science" against attempts to build a neural map: all I'm trying to show is the biological basis of this tendency toward causality, not its precise location. There are reasons for us to be suspicious of these "right brain/left brain" distinctions and subsequent pop-science generalizations about personality. Indeed, the idea that the left brain controls language may not be so accurate: the left brain seems more precisely to be where pattern interpretation resides, and it may control language only insofar as language has a pattern-interpretation attribute. Another difference between the hemispheres is that the right brain deals with novelty. It tends to see the gestalt (the general, or the forest), in a parallel mode, while the left brain is concerned with the trees, in a serial mode.

To see an illustration of our biological dependence on a story, consider the following experiment. First, read this:

A BIRD IN THE
THE HAND IS WORTH
TWO IN THE BUSH

Do you see anything unusual? Try again.*

The Sydney-based brain scientist Alan Snyder (who has a Philadelphia accent) made the following discovery. If you inhibit the left hemisphere of a right-handed person (more technically, by directing low-frequency magnetic pulses into the left frontotemporal lobes), you lower his rate of error in reading the above caption. Our propensity to impose meaning and concepts blocks our awareness of the details making up the concept. However, if you zap people's left hemispheres, they become more realistic—they can draw better and with more verisimilitude. Their minds become better at seeing the objects themselves, cleared of theories, narratives, and prejudice.

Why is it hard to avoid interpretation? It is key that, as we saw with the vignette of the Italian scholar, brain functions often operate outside our awareness. You interpret pretty much as you perform other activities deemed automatic and outside your control, like breathing.

What makes nontheorizing *cost* you so much more energy than theorizing? First, there is the impenetrability of the activity. I said that much of it takes place outside of our awareness: if you don't know that you are making the inference, how can you stop yourself unless you stay in a continuous state of alert? And if you need to be continuously on the watch, doesn't that cause fatigue? Try it for an afternoon and see.

A Little More Dopamine

In addition to the story of the left-brain interpreter, we have more physiological evidence of our ingrained pattern seeking, thanks to our growing knowledge of the role of neurotransmitters, the chemicals that are assumed to transport signals between different parts of the brain. It appears that pattern perception increases along with the concentration in the brain of the chemical dopamine. Dopamine also regulates moods and supplies an internal reward system in the brain (not surprisingly, it is found in slightly higher concentrations in the left side of the brains of right-handed persons than on the right side). A higher concentration of dopamine appears to lower skepticism and result in greater vulnerability to pattern detection; an injection of L-dopa, a substance used to treat patients with Parkinson's disease, seems to increase such activity and lowers one's suspension of belief. The person becomes vulnerable to all manner of fads, such as astrology, superstitions, economics, and tarot-card reading.

Actually, as I am writing this, there is news of a pending lawsuit by a patient

going after his doctor for more than $200,000—an amount he allegedly lost while gambling. The patient claims that the treatment of his Parkinson's disease caused him to go on wild betting sprees in casinos. It turns out that one of the side effects of L-dopa is that a small but significant minority of patients become compulsive gamblers. Since such gambling is associated with their seeing what they believe to be clear patterns in random numbers, this illustrates the *relation between knowledge and randomness*. It also shows that some aspects of what we call "knowledge" (and what I call narrative) are an ailment.

Once again, I warn the reader that I am not focusing on dopamine as the *reason* for our overinterpreting; rather, my point is that there is a physical and neural correlate to such operation and that our minds are largely victims of our physical embodiment. Our minds are like inmates, captive to our biology, unless we manage a cunning escape. It is the lack of our control of such inferences that I am stressing. Tomorrow, someone may discover another chemical or organic basis for our perception of patterns, or counter what I said about the left-brain interpreter by showing the role of a more complex structure; but it would not negate the idea that perception of causation has a biological foundation.

Andrey Nikolayevich's Rule

There is another, even deeper reason for our inclination to narrate, and it is not psychological. It has to do with the effect of order on information storage and retrieval in any system, and it's worth explaining here because of what I consider the central problems of probability and information theory.

The first problem is that information is *costly to obtain*.

The second problem is that information is also *costly to store*—like real estate in New York. The more orderly, less random, patterned, and *narratized* a series of words or symbols, the easier it is to store that series in one's mind or jot it down in a book so your grandchildren can read it someday.

Finally, information is costly to manipulate and retrieve.

With so many brain cells—one hundred billion (and counting)—the attic is quite large, so the difficulties probably do not arise from storage-capacity limitations, but may be just indexing problems. Your conscious, or working, memory, the one you are using to read these lines and make sense of their meaning, is considerably smaller than the attic. Consider that your working memory has difficulty holding a mere phone number longer than seven digits.

Change metaphors slightly and imagine that your consciousness is a desk in the Library of Congress: no matter how many books the library holds, and makes available for retrieval, the size of your desk sets some processing limitations. Compression is vital to the performance of conscious work.

Consider a collection of words glued together to constitute a 500-page book. If the words are purely random, picked up from the dictionary in a totally unpredictable way, you will not be able to summarize, transfer, or reduce the dimensions of that book without losing something significant from it. You need 100,000 words to carry the exact message of a random 100,000 words with you on your next trip to Siberia. Now consider the opposite: a book filled with the repetition of the following sentence: "The chairman of *[insert here your company name]* is a lucky fellow who happened to be in the right place at the right time and claims credit for the company's success, without making a single allowance for luck," running ten times per page for 500 pages. The entire book can be accurately compressed, as I have just done, into 34 words (out of 100,000); you could reproduce it with total fidelity out of such a kernel. By finding the pattern, the logic of the series, you no longer need to memorize it all. You just store the pattern. And, as we can see here, a pattern is obviously more compact than raw information. You looked into the book and found a *rule*. It is along these lines that the great probabilist Andrey Nikolayevich Kolmogorov defined the degree of randomness; it is called "Kolmogorov complexity."

We, members of the human variety of primates, have a hunger for rules because we need to reduce the dimension of matters so they can get into our heads. Or, rather, sadly, so we can *squeeze* them into our heads. The more random information is, the greater the dimensionality, and thus the more difficult to summarize. The more you summarize, the more order you put in, the less randomness. Hence *the same condition that makes us simplify pushes us to think that the world is less random than it actually is.*

And the Black Swan is what we leave out of simplification.

Both the artistic and scientific enterprises are the product of our need to reduce dimensions and inflict some order on things. Think of the world around you, laden with trillions of details. Try to describe it and you will find yourself tempted to weave a thread into what you are saying. A novel, a story, a myth, or a tale, all have the same function: they spare us from the complexity of the world and shield us from its randomness. Myths impart order to the disorder of human perception and the perceived "chaos of human experience."*

Indeed, many severe psychological disorders accompany the feeling of loss of control of—being able to "make sense" of—one's environment.

Platonicity affects us here once again. The very same desire for order, interestingly, applies to scientific pursuits—it is just that, unlike art, the (stated) purpose of science is to get to the truth, not to give you a feeling of organization or make you feel better. We tend to use knowledge as therapy.

A Better Way to Die

To view the potency of narrative, consider the following statement: "The king died and the queen died." Compare it to "The king died, and then the queen died of grief." This exercise, presented by the novelist E. M. Forster, shows the distinction between mere succession of information and a plot. But notice the hitch here: although we added information to the second statement, we effectively reduced the dimension of the total. The second sentence is, in a way, much lighter to carry and easier to remember; we now have one single piece of information in place of two. As we can remember it with less effort, we can also sell it to others, that is, market it better as a packaged idea. This, in a nutshell, is the definition and function of a *narrative*.

To see how the narrative can lead to a mistake in the assessment of the odds, do the following experiment. Give someone a well-written detective story—say, an Agatha Christie novel with a handful of characters who can all be plausibly deemed guilty. Now question your subject about the probabilities of each character's being the murderer. Unless she writes down the percentages to keep an exact tally of them, they should add up to well over 100 percent (even well over 200 percent for a good novel). The better the detective writer, the higher that number.

REMEMBRANCE OF THINGS NOT QUITE PAST

Our tendency to perceive—to impose—*narrativity* and *causality* are symptoms of the same disease—dimension reduction. Moreover, like causality, narrativity has a chronological dimension and leads to the perception of the flow of time. Causality makes time flow in a single direction, and so does narrativity.

But memory and the arrow of time can get mixed up. Narrativity can viciously affect the remembrance of past events as follows: we will tend to more easily remember those facts from our past that fit a narrative, while we tend to neglect others that do not *appear* to play a causal role in that narrative. Consider that we recall events in our memory all the while knowing the answer of what happened subsequently. It is literally impossible to ignore posterior information when solving a problem. This simple inability to remember not the true sequence of events but a reconstructed one will make history appear in hindsight to be far more explainable than it actually was—or is.

Conventional wisdom holds that memory is like a serial recording device like a computer diskette. In reality, memory is dynamic—not static—like a paper on which new texts (or new versions of the same text) will be continuously recorded, thanks to the power of posterior information. (In a remarkable insight, the nineteenth-century Parisian poet Charles Baudelaire compared our memory to a palimpsest, a type of parchment on which old texts can be erased and new ones written over them.) Memory is more of a self-serving dynamic revision machine: you remember the last time you remembered the event and, without realizing it, *change the story at every subsequent remembrance*.

So we pull memories along causative lines, revising them involuntarily and unconsciously. We continuously renarrate past events in the light of what appears to make what we think of as logical sense after these events occur.

By a process called reverberation, a memory corresponds to the strengthening of connections from an increase of brain activity in a given sector of the brain—the more activity, the stronger the memory. While we believe that the memory is fixed, constant, and connected, all this is very far from truth. What makes sense according to information obtained subsequently will be remembered more vividly. We invent some of our memories—a sore point in courts of law since it has been shown that plenty of people have invented child-abuse stories by dint of listening to theories.

The Madman's Narrative

We have far too many possible ways to interpret past events for our own good.

Consider the behavior of paranoid people. I have had the privilege to work with colleagues who have hidden paranoid disorders that come to the surface on occasion. When the person is highly intelligent, he can astonish you with the most far-fetched, yet completely plausible interpretations of the most innocuous remark. If I say to them, "I am afraid that …," in reference to an undesirable state of the world, they may interpret it literally, that I am experiencing actual fright, and it triggers an episode of fear on the part of the paranoid person. Someone hit with such a disorder can muster the most insignificant of details and construct an elaborate and coherent theory of why there is a conspiracy against him. And if you gather, say, ten paranoid people, all in the same state of episodic delusion, the ten of them will provide ten distinct, yet coherent, interpretations of events.

When I was about seven, my schoolteacher showed us a painting of an assembly of impecunious Frenchmen in the Middle Ages at a banquet held by one of their benefactors, some benevolent king, as I recall. They were holding the soup bowls to their lips. The schoolteacher asked me why they had their noses in the bowls and I answered, "Because they were not taught manners." She replied, "Wrong. The reason is that they are hungry." I felt stupid at not having thought of this, but I could not understand what made one explanation more likely than the other, or why we weren't both wrong (there was no, or little, silverware at the time, which seems the most likely explanation).

Beyond our perceptional distortions, there is a problem with logic itself. How can someone have no clue yet be able to hold a set of perfectly sound and coherent viewpoints that match the observations and abide by every single possible rule of logic? Consider that two people can hold incompatible beliefs based on the exact same data. Does this mean that there are possible families of explanations and that each of these can be equally perfect and sound? Certainly not. One may have a million ways to explain things, but the true explanation is unique, whether or not it is within our reach.

In a famous argument, the logician W. V. Quine showed that there exist families of logically consistent interpretations and theories that can match a given series of facts. Such insight should warn us that mere absence of nonsense may not be sufficient to make something true.

Quine's problem is related to his finding difficulty in translating statements between languages, simply because one could interpret any sentence in an infinity of ways. (Note here that someone splitting hairs could find a self-canceling aspect to Quine's own writing. I wonder how he expects us to understand this very point in a noninfinity of ways).

This does not mean that we cannot talk about causes; there are ways to escape the narrative fallacy. How? By making conjectures and running experiments, or as we will see in Part Two (alas), by making testable predictions.* The psychology experiments I am discussing here do so: they select a population and run a test. The results should hold in Tennessee, in China, even in France.

Narrative and Therapy

If narrativity causes us to see past events as more predictable, more expected, and less random than they actually were, then we should be able to make it work for us as therapy against some of the stings of randomness.

Say some unpleasant event, such as a car accident for which you feel indirectly responsible, leaves you with a bad lingering aftertaste. You are tortured by the thought that you caused injuries to your passengers; you are continuously aware that you could have avoided the accident. Your mind keeps playing alternative scenarios branching out of a main tree: if you did not wake up three minutes later than usual, you would have avoided the car accident. It was not your intension to injure your passengers, yet your mind is inhabited with remorse and guilt. People in professions with high randomness (such as in the markets) can suffer more than their share of the toxic effect of look-back stings: I should have sold my portfolio at the top; I could have bought that stock years ago for pennies and I would now be driving a pink convertible; et cetera. If you are a professional, you can feel that you "made a mistake," or, worse, that "mistakes were made," when you failed to do the equivalent of buying the winning lottery ticket for your investors, and feel the need to apologize for your "reckless" investment strategy (that is, what seems reckless in retrospect).

How can you get rid of such a persistent throb? Don't try to willingly avoid thinking about it: this will almost surely backfire. A more appropriate solution is to make the event appear more unavoidable. Hey, it was bound to take place and it seems futile to agonize over it. How can you do so? Well, *with a narrative*. Patients who spend fifteen minutes every day writing an account of their daily

troubles feel indeed better about what has befallen them. You feel less guilty for not having avoided certain events; you feel less responsible for it. Things appear as if they were bound to happen.

If you work in a randomness-laden profession, as we see, you are likely to suffer burnout effects from that constant second-guessing of your past actions in terms of what played out subsequently. Keeping a diary is the least you can do in these circumstances.

TO BE WRONG WITH INFINITE PRECISION

We harbor a crippling dislike for the abstract.

One day in December 2003, when Saddam Hussein was captured, Bloomberg News flashed the following headline at 13:01: U.S. TREASURIES RISE; HUSSEIN CAPTURE MAY NOT CURB TERRORISM.

Whenever there is a market move, the news media feel obligated to give the "reason." Half an hour later, they had to issue a new headline. As these U.S. Treasury bonds fell in price (they fluctuate all day long, so there was nothing special about that), Bloomberg News had a new reason for the fall: Saddam's capture (the same Saddam). At 13:31 they issued the next bulletin: U.S. TREASURIES FALL; HUSSEIN CAPTURE BOOSTS ALLURE OF RISKY ASSETS.

So it was the same capture (the cause) explaining one event and its exact opposite. Clearly, this can't be; these two facts cannot be linked.

Do media journalists repair to the nurse's office every morning to get their daily dopamine injection so that they can narrate better? (Note the irony that the word *dope*, used to designate the illegal drugs athletes take to improve performance, has the same root as *dopamine.)*

It happens all the time: a cause is proposed to make you swallow the news and make matters more concrete. After a candidate's defeat in an election, you will be supplied with the "cause" of the voters' disgruntlement. Any conceivable cause can do. The media, however, go to great lengths to make the process "thorough" with their armies of fact-checkers. It is as if they wanted to be wrong with infinite precision (instead of accepting being approximately right, like a fable writer).

Note that in the absence of any other information about a person you encounter, you tend to fall back on her nationality and background as a salient attribute (as the Italian scholar did with me). How do I know that this attribution to the background is bogus? I did my own empirical test by checking how many traders with my background who experienced the same war became skeptical empiricists, and found none out of twenty-six. This nationality business helps you make a great story and satisfies your hunger for ascription of causes. It seems to be the dump site where all explanations go until one can ferret out a more obvious one (such as, say, some evolutionary argument that "makes sense"). Indeed, people tend to fool themselves with their self-narrative of

"national identity," which, in a breakthrough paper in *Science* by sixty-five authors, was shown to be a total fiction. ("National traits" might be great for movies, they might help a lot with war, but they are Platonic notions that carry no empirical validity—yet, for example, both the English and the non-English erroneously believe in an English "national temperament.") Empirically, sex, social class, and profession seem to be better predictors of someone's behavior than nationality (a male from Sweden resembles a male from Togo more than a female from Sweden; a philosopher from Peru resembles a philosopher from Scotland more than a janitor from Peru; and so on).

The problem of overcausation does not lie with the journalist, but with the public. Nobody would pay one dollar to buy a series of abstract statistics reminiscent of a boring college lecture. We want to be told stories, and there is nothing wrong with that—except that we should check more thoroughly whether the story provides consequential distortions of reality. Could it be that fiction reveals truth while nonfiction is a harbor for the liar? Could it be that fables and stories are closer to the truth than is the thoroughly fact-checked ABC News? Just consider that the newspapers try to get impeccable facts, but weave them into a narrative in such a way as to convey the impression of causality (and knowledge). There are fact-checkers, not intellect-checkers. Alas.

But there is no reason to single out journalists. Academics in narrative disciplines do the same thing, but dress it up in a formal language—we will catch up to them in Chapter 10, on prediction.

Besides narrative and causality, journalists and public intellectuals of the sound-bite variety do not make the world simpler. Instead, they almost invariably make it look far more complicated than it is. The next time you are asked to discuss world events, plead ignorance, and give the arguments I offered in this chapter casting doubt on the visibility of the immediate cause. You will be told that "you overanalyze," or that "you are too complicated." All you will be saying is that you don't know!

Dispassionate Science

Now, if you think that science is an abstract subject free of sensationalism and distortions, I have some sobering news. Empirical researchers have found evidence that scientists too are vulnerable to narratives, emphasizing titles and "sexy" attention-grabbing punch lines over more substantive matters. They too

are human and get their attention from sensational matters. The way to remedy this is through meta-analyses of scientific studies, in which an überresearcher peruses the entire literature, which includes the less-advertised articles, and produces a synthesis.

THE SENSATIONAL AND THE BLACK SWAN

Let us see how narrativity affects our understanding of the Black Swan. Narrative, as well as its associated mechanism of salience of the sensational fact, can mess up our projection of the odds. Take the following experiment conducted by Kahneman and Tversky, the pair introduced in the previous chapter: the subjects were forecasting professionals who were asked to imagine the following scenarios and estimate their odds.

a. A massive flood somewhere in America in which more than a thousand people die.
b. *An earthquake in California*, causing massive flooding, in which more than a thousand people die.

Respondents estimated the first event to be *less* likely than the second. An earthquake in California, however, is a readily imaginable *cause*, which greatly increases the mental availability—hence the assessed probability—of the flood scenario.

Likewise, if I asked you how many cases of lung cancer are likely to take place in the country, you would supply some number, say half a million. Now, if instead I asked you many cases of lung cancer are likely to take place *because* of smoking, odds are that you would give me a much higher number (I would guess more than twice as high). Adding the *because* makes these matters far more plausible, and far more *likely*. Cancer from smoking seems more likely than cancer without a cause attached to it—an unspecified cause means no cause at all.

I return to the example of E. M. Forster's plot from earlier in this chapter, but seen from the standpoint of probability. Which of these two statements seems more likely?

Joey seemed happily married. He killed his wife.

Joey seemed happily married. He killed his wife to get her inheritance.

Clearly the second statement seems more likely at first blush, which is a pure mistake of logic, since the first, being broader, can accommodate more causes, such as he killed his wife because he went mad, because she cheated with both the postman and the ski instructor, because he entered a state of delusion and mistook her for a financial forecaster.

All this can lead to pathologies in our decision making. How?

Just imagine that, as shown by Paul Slovic and his collaborators, people are more likely to pay for terrorism insurance than for plain insurance (which covers, among other things, terrorism).

The Black Swans we imagine, discuss, and worry about do not resemble those likely to be Black Swans. We worry about the wrong "improbable" events, as we will see next.

Black Swan Blindness

The first question about the paradox of the perception of Black Swans is as follows: How is it that *some* Black Swans are overblown in our minds when the topic of this book is that we mainly neglect Black Swans?

The answer is that there are two varieties of rare events: a) the *narrated* Black Swans, those that are present in the current discourse and that you are likely to hear about on television, and b) those nobody talks about, since they escape models—those that you would feel ashamed discussing in public because they do not seem plausible. I can safely say that it is entirely compatible with human nature that the incidences of Black Swans would be overestimated in the first case, but severely underestimated in the second one.

Indeed, lottery buyers overestimate their chances of winning because they visualize such a potent payoff—in fact, they are so blind to the odds that they treat odds of one in a thousand and one in a million almost in the same way.

Much of the empirical research agrees with this pattern of overestimation and underestimation of Black Swans. Kahneman and Tversky initially showed that people overreact to low-probability outcomes *when you discuss the event with them*, when you make them aware of it. If you ask someone, "What is the probability of death from a plane crash?" for instance, they will raise it. However, Slovic and his colleagues found, in insurance patterns, neglect of these highly improbable events in people's insurance purchases. They call it the "preference for insuring against probable small losses"—at the expense of the less probable but larger impact ones.

Finally, after years of searching for empirical tests of our scorn of the abstract, I found researchers in Israel that ran the experiments I had been waiting for. Greg Barron and Ido Erev provide experimental evidence that agents