INCERTO

NASSIM NICHOLAS TALEB

ANTIFRAGILE

THE BLACK SWAN

FOOLED BY RANDOMNESS

THE BED OF PROCRUSTES

Nassim Nicholas Taleb

Incerto

Antifragile

The Black Swan

Fooled by Randomness

The Bed of Procrustes

Random House

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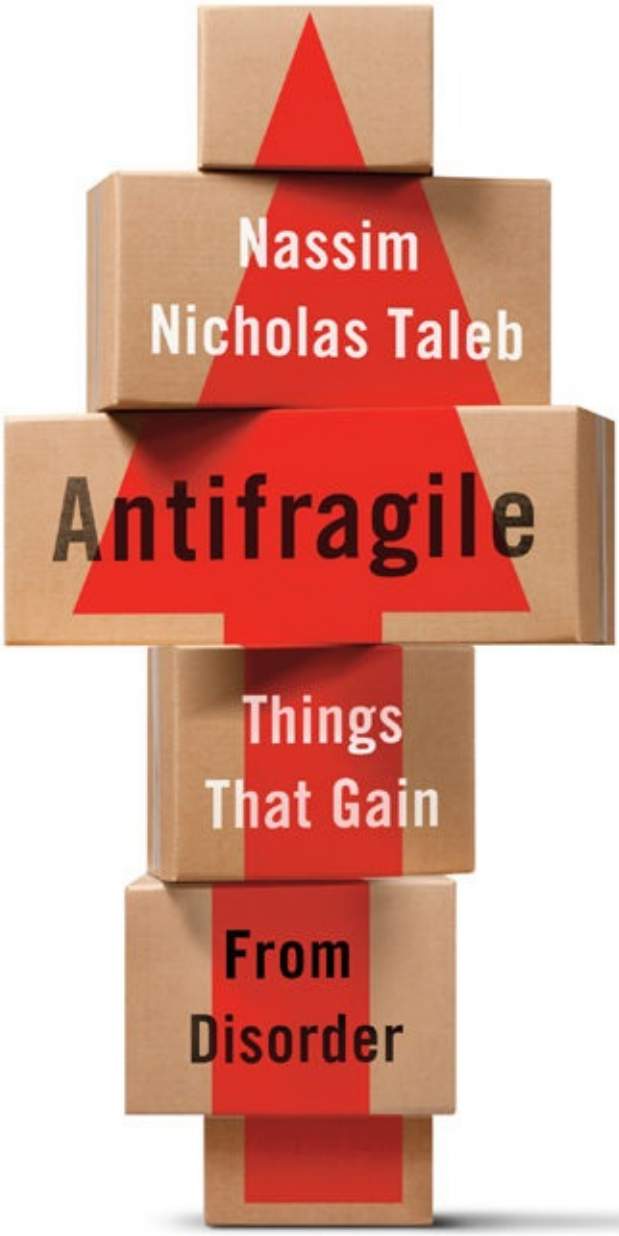

ANTIFRAGILE

THINGS THAT GAIN FROM DISORDER

NASSIM
NICHOLAS TALEB

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PROLOGUE

I. HOW TO LOVE THE WIND

Wind extinguishes a candle and energizes fire.

Likewise with randomness, uncertainty, chaos: you want to use them, not hide from them. You want to be the fire and wish for the wind. This summarizes this author's nonmeek attitude to randomness and uncertainty.

We just don't want to just survive uncertainty, to just about make it. We want to survive uncertainty and, in addition—like a certain class of aggressive Roman Stoics—have the last word. The mission is how to domesticate, even dominate, even conquer, the unseen, the opaque, and the inexplicable.

How?

II. THE ANTIFRAGILE

Some things benefit from shocks; they thrive and grow when exposed to volatility, randomness, disorder, and stressors and love adventure, risk, and uncertainty. Yet, in spite of the ubiquity of the phenomenon, there is no word for the exact opposite of fragile. Let us call it antifragile.

Antifragility is beyond resilience or robustness. The resilient resists shocks and stays the same; the antifragile gets better. This property is behind everything that has changed with time: evolution, culture, ideas, revolutions, political systems, technological innovation, cultural and economic success, corporate survival, good recipes (say, chicken soup or steak tartare with a drop of cognac), the rise of cities, cultures, legal systems, equatorial forests, bacterial resistance … even our own existence as a species on this planet. And antifragility determines the boundary between what is living and organic (or complex), say, the human body, and what is inert, say, a physical object like the stapler on your desk.

The antifragile loves randomness and uncertainty, which also means—crucially—a love of errors, a certain class of errors. Antifragility has a singular property of allowing us to deal with the unknown, to do things without understanding them—and do them well. Let me be more aggressive: we are largely better at doing than we are at thinking, thanks to antifragility. I'd rather be dumb and antifragile than extremely smart and fragile, any time.

It is easy to see things around us that like a measure of stressors and volatility: economic systems, your body, your nutrition (diabetes and many similar modern ailments seem to be associated with a lack of randomness in feeding and the absence of the stressor of occasional starvation), your psyche. There are even financial contracts that are antifragile: they are explicitly designed to benefit from market volatility.

Antifragility makes us understand fragility better. Just as we cannot improve health without reducing disease, or increase wealth without first decreasing losses, antifragility and fragility are degrees on a spectrum.

Nonprediction

By grasping the mechanisms of antifragility we can build a systematic and broad guide to *nonpredictive* decision making under uncertainty in business, politics,

medicine, and life in general—anywhere the unknown preponderates, any situation in which there is randomness, unpredictability, opacity, or incomplete understanding of things.

It is far easier to figure out if something is fragile than to predict the occurrence of an event that may harm it. Fragility can be measured; risk is not measurable (outside of casinos or the minds of people who call themselves "risk experts"). This provides a solution to what I've called the Black Swan problem —the impossibility of calculating the risks of consequential rare events and predicting their occurrence. Sensitivity to harm from volatility is tractable, more so than forecasting the event that would cause the harm. So we propose to stand our current approaches to prediction, prognostication, and risk management on their heads.

In every domain or area of application, we propose rules for moving from the fragile toward the antifragile, through reduction of fragility or harnessing antifragility. And we can almost always detect antifragility (and fragility) using a simple test of asymmetry: anything that has more upside than downside from random events (or certain shocks) is antifragile; the reverse is fragile.

Deprivation of Antifragility

Crucially, if antifragility is the property of all those natural (and complex) systems that have survived, depriving these systems of volatility, randomness, and stressors will harm them. They will weaken, die, or blow up. We have been fragilizing the economy, our health, political life, education, almost everything … by suppressing randomness and volatility. Just as spending a month in bed (preferably with an unabridged version of *War and Peace* and access to *The Sopranos*' entire eighty-six episodes) leads to muscle atrophy, complex systems are weakened, even killed, when deprived of stressors. Much of our modern, structured, world has been harming us with top-down policies and contraptions (dubbed "Soviet-Harvard delusions" in the book) which do precisely this: an insult to the antifragility of systems.

This is the tragedy of modernity: as with neurotically overprotective parents, those trying to help are often hurting us the most.

If about everything top-down fragilizes and blocks antifragility and growth, everything bottom-up thrives under the right amount of stress and disorder. The process of discovery (or innovation, or technological progress) itself depends on antifragile tinkering, aggressive risk bearing rather than formal education.

Upside at the Expense of Others

Which brings us to the largest fragilizer of society, and greatest generator of crises, absence of "skin in the game." Some become antifragile at the expense of others by getting the upside (or gains) from volatility, variations, and disorder and exposing others to the downside risks of losses or harm. And such *antifragility-at-the-cost-of-fragility-of-others* is hidden—given the blindness to antifragility by the Soviet-Harvard intellectual circles, this asymmetry is rarely identified and (so far) never taught. Further, as we discovered during the financial crisis that started in 2008, these blowup risks-to-others are easily concealed owing to the growing complexity of modern institutions and political affairs. While in the past people of rank or status were those and only those who took risks, who had the downside for their actions, and heroes were those who did so for the sake of others, today the exact reverse is taking place. We are witnessing the rise of a new class of inverse heroes, that is, bureaucrats, bankers, Davos-attending members of the I.A.N.D. (International Association of Name Droppers), and academics with too much power and no real downside and/or accountability. They game the system while citizens pay the price.

At no point in history have so many non-risk-takers, that is, those with no personal exposure, exerted so much control.

The chief ethical rule is the following: Thou shalt not have antifragility at the expense of the fragility of others.

III. THE ANTIDOTE TO THE BLACK SWAN

I want to live happily in a world I don't understand.

Black Swans (capitalized) are large-scale unpredictable and irregular events of massive consequence—unpredicted by a certain observer, and such unpredictor is generally called the "turkey" when he is both surprised and harmed by these events. I have made the claim that most of history comes from Black Swan events, while we worry about fine-tuning our understanding of the ordinary, and hence develop models, theories, or representations that cannot possibly track them or measure the possibility of these shocks.

Black Swans hijack our brains, making us feel we "sort of" or "almost" predicted them, because they are retrospectively explainable. We don't realize the role of these Swans in life because of this illusion of predictability. Life is more, a lot more, labyrinthine than shown in our memory—our minds are in the business of turning history into something smooth and linear, which makes us underestimate randomness. But when we see it, we fear it and overreact. Because of this fear and thirst for order, some human systems, by disrupting the invisible or not so visible logic of things, tend to be exposed to harm from Black Swans and almost never get any benefit. You get pseudo-order when you seek order; you only get a measure of order and control when you embrace randomness.

Complex systems are full of interdependencies—hard to detect—and nonlinear responses. "Nonlinear" means that when you double the dose of, say, a medication, or when you double the number of employees in a factory, you don't get twice the initial effect, but rather a lot more or a lot less. Two weekends in Philadelphia are not twice as pleasant as a single one—I've tried. When the response is plotted on a graph, it does not show as a straight line ("linear"), rather as a curve. In such environments, simple causal associations are misplaced; it is hard to see how things work by looking at single parts.

Man-made complex systems tend to develop cascades and runaway chains of reactions that decrease, even eliminate, predictability and cause outsized events. So the modern world may be increasing in technological knowledge, but, paradoxically, it is making things a lot more unpredictable. Now for reasons that have to do with the increase of the artificial, the move away from ancestral and natural models, and the loss in robustness owing to complications in the design of everything, the role of Black Swans is increasing. Further, we are victims to a

new disease, called in this book *neomania*, that makes us build Black Swan–vulnerable systems—"progress."

An annoying aspect of the Black Swan problem—in fact the central, and largely missed, point—is that the odds of rare events are simply not computable. We know a lot less about hundred-year floods than five-year floods—model error swells when it comes to small probabilities. *The rarer the event, the less tractable, and the less we know about how frequent its occurrence*—yet the rarer the event, the more confident these "scientists" involved in predicting, modeling, and using PowerPoint in conferences with equations in multicolor background have become.

It is of great help that Mother Nature—thanks to its antifragility—is the best expert at rare events, and the best manager of Black Swans; in its billions of years it succeeded in getting here without much command-and-control instruction from an Ivy League–educated director nominated by a search committee. Antifragility is not just the antidote to the Black Swan; understanding it makes us less intellectually fearful in accepting the role of these events as necessary for history, technology, knowledge, everything.

Robust Is Not Robust Enough

Consider that Mother Nature is not just "safe." It is aggressive in destroying and replacing, in selecting and reshuffling. When it comes to random events, "robust" is certainly not good enough. In the long run everything with the most minute vulnerability breaks, given the ruthlessness of time—yet our planet has been around for perhaps four billion years and, convincingly, robustness can't just be it: you need perfect robustness for a crack not to end up crashing the system. Given the unattainability of perfect robustness, we need a mechanism by which the system regenerates itself continuously by using, rather than suffering from, random events, unpredictable shocks, stressors, and volatility.

The antifragile gains from prediction errors, in the long run. If you follow this idea to its conclusion, then many things that gain from randomness should be dominating the world today—and things that are hurt by it should be gone. Well, this turns out to be the case. We have the illusion that the world functions thanks to programmed design, university research, and bureaucratic funding, but there is compelling—very compelling—evidence to show that this is an illusion, the illusion I call *lecturing birds how to fly.* Technology is the result of antifragility, exploited by risk-takers in the form of tinkering and trial and error, with nerd-

driven design confined to the backstage. Engineers and tinkerers develop things while history books are written by academics; we will have to refine historical interpretations of growth, innovation, and many such things.

On the Measurability of (Some) Things

Fragility is quite measurable, risk not so at all, particularly risk associated with rare events.[1]

I said that we can estimate, even measure, fragility and antifragility, while we cannot calculate risks and probabilities of shocks and rare events, no matter how sophisticated we get. Risk management as practiced is the study of an event taking place in the future, and only some economists and other lunatics can claim—against experience—to "measure" the future incidence of these rare events, with suckers listening to them—against experience and the track record of such claims. But fragility and antifragility are part of the current property of an object, a coffee table, a company, an industry, a country, a political system. We can detect fragility, see it, even in many cases measure it, or at least measure comparative fragility with a small error while comparisons of risk have been (so far) unreliable. You cannot say with any reliability that a certain remote event or shock is more likely than another (unless you enjoy deceiving yourself), but you can state with a lot more confidence that an object or a structure is more fragile than another should a certain event happen. You can easily tell that your grandmother is more fragile to abrupt changes in temperature than you, that some military dictatorship is more fragile than Switzerland should political change happen, that a bank is more fragile than another should a crisis occur, or that a poorly built modern building is more fragile than the Cathedral of Chartres should an earthquake happen. And—centrally—you can even make the prediction of which one will last longer.

Instead of a discussion of risk (which is both predictive and sissy) I advocate the notion of fragility, which is not predictive—and, unlike risk, has an interesting word that can describe its functional opposite, the nonsissy concept of antifragility.

To measure antifragility, there is a philosopher's-stone-like recipe using a compact and simplified rule that allows us to identify it across domains, from health to the construction of societies.

We have been unconsciously exploiting antifragility in practical life and, consciously, rejecting it—particularly in intellectual life.

The Fragilista

Our idea is to avoid interference with things we don't understand. Well, some people are prone to the opposite. The fragilista belongs to that category of persons who are usually in suit and tie, often on Fridays; he faces your jokes with icy solemnity, and tends to develop back problems early in life from sitting at a desk, riding airplanes, and studying newspapers. He is often involved in a strange ritual, something commonly called "a meeting." Now, in addition to these traits, he defaults to thinking that what he doesn't see is not there, or what he does not understand does not exist. At the core, he tends to mistake the unknown for the nonexistent.

The fragilista falls for the *Soviet-Harvard delusion*, the (unscientific) overestimation of the reach of scientific knowledge. Because of such delusion, he is what is called a *naive rationalist*, a *rationalizer*, or sometimes just a *rationalist*, in the sense that he believes that the *reasons* behind things are automatically accessible to him. And let us not confuse rationalizing with rational—the two are almost always exact opposites. Outside of physics, and generally in complex domains, the reasons behind things have had a tendency to make themselves less obvious to us, and even less to the fragilista. This property of natural things not to advertise themselves in a user's manual is, alas, not much of a hindrance: some fragilistas will get together to write the user's manual themselves, thanks to their definition of "science."

So thanks to the fragilista, modern culture has been increasingly building blindness to the mysterious, the impenetrable, what Nietzsche called the Dionysian, in life.

Or to translate Nietzsche into the less poetic but no less insightful Brooklyn vernacular, this is what our character Fat Tony calls a "sucker game."

In short, the fragilista (medical, economic, social planning) is one who makes you engage in policies and actions, all artificial, in which *the benefits are small and visible, and the side effects potentially severe and invisible*.

There is the medical fragilista who overintervenes in denying the body's natural ability to heal and gives you medications with potentially very severe side effects; the policy fragilista (the interventionist social planner) who mistakes the economy for a washing machine that continuously needs fixing (by him) and blows it up; the psychiatric fragilista who medicates children to "improve" their intellectual and emotional life; the soccer-mom fragilista; the financial fragilista who makes people use "risk" models that destroy the banking system (then uses them again); the military fragilista who disturbs complex

systems; the predictor fragilista who encourages you to take more risks; and many more.[2]

Indeed, the political discourse is lacking a concept. Politicians in their speeches, goals, and promises aim at the timid concepts of "resilience," "solidity," not antifragility, and in the process are stifling the mechanisms of growth and evolution. We didn't get where we are thanks to the sissy notion of resilience. And, what's worse, we didn't get where we are today thanks to policy makers—but thanks to the appetite for risks and errors of a certain class of people we need to encourage, protect, and respect.

Where Simple Is More Sophisticated

A complex system, contrary to what people believe, does not require complicated systems and regulations and intricate policies. The simpler, the better. Complications lead to multiplicative chains of unanticipated effects. Because of opacity, an intervention leads to unforeseen consequences, followed by apologies about the "unforeseen" aspect of the consequences, then to another intervention to correct the secondary effects, leading to an explosive series of branching "unforeseen" responses, each one worse than the preceding one.

Yet simplicity has been difficult to implement in modern life because it is against the spirit of a certain brand of people who seek sophistication so they can justify their profession.

Less is more and usually more effective. Thus I will produce a small number of tricks, directives, and interdicts—how to live in a world we don't understand, or, rather, how to *not be afraid* to work with things we patently don't understand, and, more principally, in what manner we should work with these. Or, even better, how to dare to look our ignorance in the face and not be ashamed of being human—be aggressively and proudly human. But that may require some structural changes.

What I propose is a road map to modify our man-made systems to let the simple—and natural—take their course.

But simplicity is not so simple to attain. Steve Jobs figured out that "you have to work hard to get your thinking clean to make it simple." The Arabs have an expression for trenchant prose: *no skill to understand it, mastery to write it*.

Heuristics are simplified rules of thumb that make things simple and easy to implement. But their main advantage is that the user knows that they are not perfect, just expedient, and is therefore less fooled by their powers. They

become dangerous when we forget that.

IV. THIS BOOK

The journey to this idea of antifragility was, if anything, nonlinear.

I suddenly realized one day that fragility—which had been lacking a technical definition—could be expressed as *what does not like volatility,* and that *what does not like volatility* does not like randomness, uncertainty, disorder, errors, stressors, *etc.* Think of anything fragile, say, objects in your living room such as the glass frame, the television set, or, even better, the china in the cupboards. If you label them "fragile," then you necessarily want them to be left alone in peace, quiet, order, and predictability. A fragile object would not possibly benefit from an earthquake or the visit of your hyperactive nephew. Further, everything that does not like volatility does not like stressors, harm, chaos, events, disorder, "unforeseen" consequences, uncertainty, and, critically, time.

And antifragility flows—sort of—from this explicit definition of fragility. It likes volatility *et al.* It also likes time. And there is a powerful and helpful link to nonlinearity: everything nonlinear in response is either fragile or antifragile to a certain source of randomness.

The strangest thing is that this obvious property that *anything fragile hates volatility,* and vice versa, has been sitting completely outside the scientific and philosophical discourse. Completely. And the study of the sensitivity of things to volatility is the strange business specialty in which I spent most of my adult life, two decades—I know it is a strange specialty, I promise to explain later. My focus in that profession has been on identifying items that "love volatility" or "hate volatility"; so all I had to do was expand the ideas from the financial domain in which I had been focused to the broader notion of decision making under uncertainty across various fields, from political science to medicine to dinner plans.[3]

And in that strange profession of people who work with volatility, there were two types. First category, academics, report-writers, and commentators who study future events and write books and papers; and, second category, practitioners who, instead of studying future events, try to understand how things react to volatility (but practitioners are usually too busy practitioning to write books, articles, papers, speeches, equations, theories and get honored by Highly Constipated and Honorable Members of Academies). The difference between the two categories is central: as we saw, it is much easier to understand if something is harmed by volatility—hence fragile—than try to forecast harmful events, such

as these oversized Black Swans. But only practitioners (or people who do things) tend to spontaneously get the point.

The (Rather Happy) Disorder Family

One technical comment. We keep saying that fragility and antifragility mean potential gain or harm from exposure to *something* related to volatility. What is that something? Simply, membership in the extended disorder family.

> The Extended Disorder Family (or Cluster): (i) uncertainty, (ii) variability, (iii) imperfect, incomplete knowledge, (iv) chance, (v) chaos, (vi) volatility, (vii) disorder, (viii) entropy, (ix) time, (x) the unknown, (xi) randomness, (xii) turmoil, (xiii) stressor, (xiv) error, (xv) dispersion of outcomes, (xvi) unknowledge.

It happens that uncertainty, disorder, and the unknown are completely equivalent in their effect: antifragile systems benefit (to some degree) from, and the fragile is penalized by, almost all of them—even if you have to find them in separate buildings of the university campuses and some philosophaster who has never taken real risks in his life, or, worse, never had a life, would inform you that "they are *clearly* not the same thing."

Why item (ix), time? Time is functionally similar to volatility: the more time, the more events, the more disorder. Consider that if you can suffer limited harm and are antifragile to small errors, time brings the kind of errors or reverse errors that end up benefiting you. This is simply what your grandmother calls experience. The fragile breaks with time.

Only One Book

This makes this book my central work. I've had only one master idea, each time taken to its next step, the last step—this book—being more like a big jump. I am reconnected to my "practical self," my soul of a practitioner, as this is a merger of my entire history as practitioner and "volatility specialist" combined with my intellectual and philosophical interests in randomness and uncertainty, which had previously taken separate paths.

My writings are not stand-alone essays on specific topics, with beginnings, ends, and expiration dates; rather, they are nonoverlapping chapters from that central idea, a main corpus focused on uncertainty, randomness, probability,

disorder, and what to do in a world we don't understand, a world with unseen elements and properties, the random and the complex; that is, decision making under opacity. The corpus is called *Incerto* and is constituted (so far) of a trilogy plus philosophical and technical addenda. The rule is that the distance between a random chapter of one book, say, *Antifragile,* and another random chapter of another, say, *Fooled by Randomness,* should be similar to the one between chapters of a long book. The rule allows the corpus to cross domains (by shifting across science, philosophy, business, psychology, literature, and autobiographical segments) without lapsing into promiscuity.

So the relationship of this book to *The Black Swan* would be as follows: in spite of the chronology (and the fact that this book takes the Black Swan idea to its natural and prescriptive conclusion), *Antifragile* would be the main volume and *The Black Swan* its backup of sorts, and a theoretical one, perhaps even its junior appendix. Why? Because *The Black Swan* (and its predecessor, *Fooled by Randomness*) were written to convince us of a dire situation, and worked hard at it; this one starts from the position that one does not need convincing that (a) Black Swans dominate society and history (and people, because of ex post rationalization, think themselves capable of understanding them); (b) as a consequence, we don't quite know what's going on, particularly under severe nonlinearities; so we can get to practical business right away.

No Guts, No Belief

To accord with the practitioner's ethos, the rule in this book is as follows: I eat my own cooking.

I have only written, in every line I have composed in my professional life, about things I have done, and the risks I have recommended that others take or avoid were risks I have been taking or avoiding myself. I will be the first to be hurt if I am wrong. When I warned about the fragility of the banking system in *The Black Swan,* I was betting on its collapse (particularly when my message went unheeded); otherwise I felt it would not have been ethical to write about it. That personal stricture applies to every domain, including medicine, technical innovation, and simple matters in life. It does not mean that one's personal experiences constitute a sufficient sample to derive a conclusion about an idea; it is just that one's personal experience gives the stamp of authenticity and sincerity of opinion. Experience is devoid of the cherry-picking that we find in studies, particularly those called "observational," ones in which the researcher

finds past patterns, and, thanks to the sheer amount of data, can therefore fall into the trap of an invented narrative.

Further, in writing, I feel corrupt and unethical if I have to look up a subject in a library as part of the writing itself. This acts as a filter—it is the only filter. If the subject is not interesting enough for me to look it up *independently*, for my own curiosity or purposes, and I have not done so before, then I should not be writing about it at all, period. It does not mean that libraries (physical and virtual) are not acceptable; it means that they should not be the *source* of any idea. Students pay to write essays on topics for which they have to derive knowledge from a library as a self-enhancement exercise; a professional who is compensated to write and is taken seriously by others should use a more potent filter. Only distilled ideas, ones that sit in us for a long time, are acceptable—and those that come from reality.

It is time to revive the not well-known philosophical notion of *doxastic commitment*, a class of beliefs that go beyond talk, and to which we are committed enough to take personal risks.

If You See Something

Modernity has replaced ethics with legalese, and the law can be gamed with a good lawyer.

So I will expose the transfer of fragility, or rather the theft of antifragility, by people "arbitraging" the system. These people will be named by name. Poets and painters are free, *liberi poetae et pictores*, and there are severe moral imperatives that come with such freedom. First ethical rule:

If you see fraud and do not say fraud, you are a fraud.

Just as being nice to the arrogant is no better than being arrogant toward the nice, being accommodating toward anyone committing a nefarious action condones it.

Further, many writers and scholars speak in private, say, after half a bottle of wine, differently from the way they do in print. Their writing is certifiably fake, fake. And many of the problems of society come from the argument "other people are doing it." So if I call someone a dangerous ethically challenged fragilista in private after the third glass of Lebanese wine (white), I will be obligated to do so here.

Calling people and institutions fraudulent in print when they are not (yet)

called so by others carries a cost, but is too small to be a deterrent. After the mathematical scientist Benoît Mandelbrot read the galleys of *The Black Swan*, a book dedicated to him, he called me and quietly said: “In what language should I say ‘good luck’ to you?” I did not need any luck, it turned out; I was antifragile to all manner of attacks: the more attacks I got from the Central Fragilista Delegation, the more my message spread as it drove people to examine my arguments. I am now ashamed of not having gone further in calling a spade a spade.

Compromising is condoning. The only modern dictum I follow is one by George Santayana: *A man is morally free when … he judges the world, and judges other men, with uncompromising sincerity*. This is not just an aim but an obligation.

Defossilizing Things

Second ethical point.

I am obligated to submit myself to the scientific process simply because I require it from others, but no more than that. When I read empirical claims in medicine or other sciences, I like these claims to go through the peer-review mechanism, a fact-checking of sorts, an examination of the rigor of the approach. Logical statements, or those backed by mathematical reasoning, on the other hand, do not require such a mechanism: they can and must stand on their own legs. So I publish technical footnotes for these books in specialized and academic outlets, and nothing more (and limit them to statements that require proofs or more elaborate technical arguments). But for the sake of authenticity and to avoid careerism (the debasing of knowledge by turning it into a competitive sport), I ban myself from publishing anything outside of these footnotes.

After more than twenty years as a transactional trader and businessman in what I called the “strange profession,” I tried what one calls an academic career. And I have something to report—actually that was the driver behind this idea of antifragility in life and the dichotomy between the *natural* and the alienation of the *unnatural*. Commerce is fun, thrilling, lively, and natural; academia as currently professionalized is none of these. And for those who think that academia is “quieter” and an emotionally relaxing transition after the volatile and risk-taking business life, a surprise: when in action, new problems and scares emerge every day to displace and eliminate the previous day’s headaches,

resentments, and conflicts. A nail displaces another nail, with astonishing variety. But academics (particularly in social science) seem to distrust each other; they live in petty obsessions, envy, and icy-cold hatreds, with small snubs developing into grudges, fossilized over time in the loneliness of the transaction with a computer screen and the immutability of their environment. Not to mention a level of envy I have almost never seen in business.… My experience is that money and transactions purify relations; ideas and abstract matters like "recognition" and "credit" warp them, creating an atmosphere of perpetual rivalry. I grew to find people greedy for credentials nauseating, repulsive, and untrustworthy.

Commerce, business, Levantine souks (though not large-scale markets and corporations) are activities and places that bring out the best in people, making most of them forgiving, honest, loving, trusting, and open-minded. As a member of the Christian minority in the Near East, I can vouch that commerce, particularly small commerce, is the door to tolerance—the only door, in my opinion, to any form of tolerance. It beats rationalizations and lectures. Like antifragile tinkering, mistakes are small and rapidly forgotten.

I want to be happy to be human and be in an environment in which other people are in love with their fate—and never, until my brush with academia, did I think that that environment was a certain form of commerce (combined with solitary scholarship). The biologist-writer and libertarian economist Matt Ridley made me feel that it was truly the Phoenician trader in me (or, more exactly, the Canaanite) that was the intellectual.[4]

V. ORGANIZATION

Antifragile is composed of seven books and a notes section.

Why "books"? The novelist and essayist Rolf Dobelli's first reaction upon reading my ethics and *via negativa* chapters, which I supplied separately, was that each should be a separate book and published as a short or medium-length essay. Someone in the business of "summarizing" books would have to write four or five separate descriptions. But I saw that they were not stand-alone essays at all; each deals with the applications of a central idea, going either deeper or into different territories: evolution, politics, business innovation, scientific discovery, economics, ethics, epistemology, and general philosophy. So I call them books rather than sections or parts. Books to me are not expanded journal articles, but reading experiences; and the academics who tend to read in order to cite in their writing—rather than read for enjoyment, curiosity, or simply because they like to read—tend to be frustrated when they can't rapidly scan the text and summarize it in one sentence that connects it to some existing discourse in which they have been involved. Further, the essay is the polar opposite of the textbook—mixing autobiographical musings and parables with more philosophical and scientific investigations. I write about probability with my entire soul and my entire experiences in the risk-taking business; I write with my scars, hence my thought is inseparable from autobiography. The personal essay form is ideal for the topic of incertitude.

The sequence is as follows.

The Appendix to this prologue presents the Triad as a table, a comprehensive map of the world along the fragility spectrum.

Book I, *The Antifragile: An Introduction*, presents the new property and discusses evolution and the organic as the typical antifragile system. It also looks at the tradeoff between the antifragility of the collective and the fragility of the individual.

Book II, *Modernity and the Denial of Antifragility*, describes what happens when we starve systems—mostly political systems—of volatility. It discusses this invention called the nation-state, as well as the idea of harm done by the healer, someone who tries to help you and ends up harming you very badly.

Book III, *A Nonpredictive View of the World*, introduces Fat Tony and his intuitive detection of fragility and presents the foundational asymmetry of things grounded in the writings of Seneca, the Roman philosopher and doer.

Book IV, *Optionality, Technology, and the Intelligence of Antifragility*, presents the mysterious property of the world, by which a certain asymmetry is behind things, rather than human "intelligence," and how optionality drove us here. It is opposed to what I call the Soviet-Harvard method. And Fat Tony argues with Socrates about how we do things one cannot quite explain.

Book V, *The Nonlinear and the Nonlinear* (*sic*), is about the philosopher's stone and its opposite: how to turn lead into gold, and gold into lead. Two chapters constitute the central technical section—the plumbing of the book—mapping fragility (as nonlinearity, more specifically, convexity effects) and showing the edge coming from a certain class of convex strategies.

Book VI, *Via Negativa*, shows the wisdom and effectiveness of subtraction over addition (acts of omission over acts of commission). This section introduces the notion of convexity effects. Of course the first application is to medicine. I look at medicine only from an epistemological, risk-management approach—and it looks different from there.

Book VII, *The Ethics of Fragility and Antifragility*, grounds ethics in transfers of fragility, with one party getting the benefits and the other one the harm, and points out problems arising from absence of skin in the game.

The end of the book consists of graphs, notes, and a technical appendix.

The book is written at three levels.

First, the literary and philosophical, with parables and illustrations but minimal if any technical arguments, except in Book V (the philosopher's stone), which presents the convexity arguments. (The enlightened reader is invited to skip Book V, as the ideas are distilled elsewhere.)

Second, the appendix, with graphs and more technical discussion, but no elaborate derivations.

Third, the backup material with more elaborate arguments, all in the form of technical papers and notes (don't mistake my illustrations and parables for proof; remember, a personal essay is not a scientific document, but a scientific document is a scientific document). All these backup documents are gathered as a freely available electronic technical companion.

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[1] Outside of casinos and some narrowly defined areas such as man-made situations and constructions.

[2] Hayek did not take his idea about organic price formation into risk and fragility. For Hayek, bureaucrats were inefficient, not fragilistas. This discussion starts with fragility and antifragility, and gets us as a side discussion into organic price formation.

[3] The technical term I used for “hates volatility” was “short vega” or “short gamma,” meaning “harmed should volatility increase,” and “long vega” or “long gamma” for things that benefit. In the rest of the book we will use “short” and “long” to describe negative and positive exposures, respectively. It is critical that I never believed in our ability to forecast volatility, as I just focused on how things react to it.

[4] Once again, please, no, *itisnotresilience*. I am used to facing, at the end of a conference lecture, the question “So what is the difference between robust and antifragile?” or the more unenlightened and even more irritating “Antifragile is resilient, no?” The reaction to my answer is usually “Ah,” with the look “Why didn’t you say that before?” (of course I had said that before). Even the initial referee of the scientific article I wrote on defining and detecting antifragility entirely missed the point, conflating antifragility and robustness—and that was the scientist who pored over my definitions. It is worth re-explaining the following: the robust or resilient is neither harmed nor helped by volatility and disorder, while the antifragile benefits from them. But it takes some effort for the concept to sink in. A lot of things people call robust or resilient are just robust or resilient, the other half are antifragile.

APPENDIX: THE TRIAD, OR A MAP OF THE WORLD AND THINGS ALONG THE THREE PROPERTIES

Now we aim—after some work—to connect in the reader's mind, with a single thread, elements seemingly far apart, such as Cato the Elder, Nietzsche, Thales of Miletus, the potency of the system of city-states, the sustainability of artisans, the process of discovery, the onesidedness of opacity, financial derivatives, antibiotic resistance, bottom-up systems, Socrates' invitation to overrationalize, how to lecture birds, obsessive love, Darwinian evolution, the mathematical concept of Jensen's inequality, optionality and option theory, the idea of ancestral heuristics, the works of Joseph de Maistre and Edmund Burke, Wittgenstein's antirationalism, the fraudulent theories of the economics establishment, tinkering and bricolage, terrorism exacerbated by death of its members, an apologia for artisanal societies, the ethical flaws of the middle class, Paleo-style workouts (and nutrition), the idea of medical iatrogenics, the glorious notion of the magnificent (*megalopsychon*), my obsession with the idea of convexity (and my phobia of concavity), the late-2000s banking and economic crisis, the misunderstanding of redundancy, the difference between tourist and flâneur, *etc.* All in one single—and, I am certain, simple—thread.

How? We can begin by seeing how things—just about anything that matters—can be mapped or classified into three categories, what I call the Triad.

Things Come in Triples

In the Prologue, we saw that the idea is to focus on fragility rather than predicting and calculating future probabilities, and that fragility and antifragility come on a spectrum of varying degrees. The task here is to build a map of exposures. (This is what is called "real-world solution," though only academics and other non-real-world operators use the expression "real-world solution" instead of simply "solution.") The Triad classifies items in three columns along the designation

FRAGILE ROBUST ANTIFRAGILE

Recall that the fragile wants tranquility, the antifragile grows from disorder, and the robust doesn't care too much. The reader is invited to navigate the Triad

to see how the ideas of the book apply across domains. Simply, in a given subject, when you discuss an item or a policy, the task is to find in which category of the Triad one should put it and what to do in order to improve its condition. For example: the centralized nation-state is on the far left of the Triad, squarely in the fragile category, and a decentralized system of city-states on the far right, in the antifragile one. By getting the characteristics of the latter, we can move away from the undesirable fragility of the large state. Or look at errors. On the left, in the fragile category, the mistakes are rare and large when they occur, hence irreversible; to the right the mistakes are small and benign, even reversible and quickly overcome. They are also rich in information. So a certain system of tinkering and trial and error would have the attributes of antifragility. If you want to become antifragile, put yourself in the situation "loves mistakes"—to the right of "hates mistakes"—by making these numerous and small in harm. We will call this process and approach the "barbell" strategy.

Or take the health category. Adding is on the left, removing to the right. *Removing* medication, or some other unnatural stressor—say, gluten, fructose, tranquilizers, nail polish, or some such substance—by trial and error is more robust than *adding* medication, with unknown side effects, unknown in spite of the statements about "evidence" and shmevidence.

As the reader can see, the map uninhibitedly spreads across domains and human pursuits, such as culture, health, biology, political systems, technology, urban organization, socioeconomic life, and other matters of more or less direct interest to the reader. I have even managed to merge decision making and *flâneur* in the same breath. So a simple method would lead us to both a risk-based political philosophy and medical decision-making.

The Triad in Action

Note that fragile and antifragile here are relative terms, not quite absolute properties: one item to the right of the Triad is more antifragile than another to the left. For instance, artisans are more antifragile than small businesses, but a rock star will be more antifragile than any artisan. Debt always puts you on the left, fragilizes economic systems. And things are antifragile up to a certain level of stress. Your body benefits from some amount of mishandling, but up to a point—it would not benefit too much from being thrown down from the top of the Tower of Babel.

The Golden Robust: Further, the *robust* here in the middle column is not

equivalent to Aristotle's "golden middle" (commonly mislabeled the "golden mean"), in the way that, say, generosity is the middle between profligacy and stinginess—it can be, but it is not necessarily so. Antifragility is desirable in general, but not always, as there are cases in which antifragility will be costly, extremely so. Further, it is hard to consider robustness as always desirable—to quote Nietzsche, one can die from being immortal.

Finally, by now the reader, grappling with a new word, might ask too much from it. If the designation *antifragile* is rather vague and limited to specific sources of harm or volatility, and up to a certain range of exposure, it is no more and no less so than the designation *fragile*. Antifragility is relative to a given situation. A boxer might be robust, hale when it comes to his physical condition, and might improve from fight to fight, but he can easily be emotionally fragile and break into tears when dumped by his girlfriend. Your grandmother might have opposite qualities, fragile in build but equipped with a strong personality. I remember the following vivid image from the Lebanese civil war: A diminutive old lady, a widow (she was dressed in black), was chastising militiamen from the enemy side for having caused the shattering of the glass in her window during a battle. They were pointing their guns at her; a single bullet would have terminated her but they were visibly having a bad moment, intimidated and scared by her. She was the opposite of the boxer: physically fragile, but not fragile in character.

Now the Triad.

Click here for a larger image of this table.

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*.

BOOK I

The Antifragile: An Introduction

The first two chapters introduce and illustrate antifragility. Chapter 3 introduces a distinction between the organic and the mechanical, say, between your cat and a washing machine. Chapter 4 is about how the antifragility of some comes from the fragility of others, how errors benefit some, not others—the sort of things people tend to call evolution and write a lot, a lot about.

CHAPTER 1

Between Damocles and Hydra

Please cut my head off—How by some magic, colors become colors—How to lift weight in Dubai

HALF OF LIFE HAS NO NAME

You are in the post office about to send a gift, a package full of champagne glasses, to a cousin in Central Siberia. As the package can be damaged during transportation, you would stamp “fragile,” “breakable,” or “handle with care” on it (in red). Now what is the exact opposite of such situation, the exact opposite of “fragile”?

Almost all people answer that the opposite of “fragile” is “robust,” “resilient,” “solid,” or something of the sort. But the resilient, robust (and company) are items that neither break nor improve, so you would not need to write anything on them—have you ever seen a package with “robust” in thick green letters stamped on it? Logically, the exact opposite of a “fragile” parcel would be a package on which one has written “please mishandle” or “please handle carelessly.” Its contents would not just be unbreakable, but would benefit from shocks and a wide array of trauma. The fragile is the package that would be *at best* unharmed, the robust would be *at best* and *at worst* unharmed. And the opposite of fragile is therefore what is *at worst* unharmed.

We gave the appellation “antifragile” to such a package; a neologism was necessary as there is no simple, noncompound word in the *Oxford English Dictionary* that expresses the point of reverse fragility. For the idea of antifragility is not part of our consciousness—but, luckily, it is part of our ancestral behavior, our biological apparatus, and a ubiquitous property of every system that has survived.

FIGURE 1. A package begging for stressors and disorder. Credit: Giotto Enterprise and George Nasr.

To see how alien the concept is to our minds, repeat the experiment and ask around at the next gathering, picnic, or pre-riot congregation what's the antonym of fragile (and specify insistently that you mean the *exact reverse*, something that has opposite properties and payoff). The likely answers will be, aside from robust: unbreakable, solid, well-built, resilient, strong, something-proof (say, waterproof, windproof, rustproof)—unless they've heard of this book. Wrong—and it is not just individuals but branches of knowledge that are confused by it; this is a mistake made in every dictionary of synonyms and antonyms I've found.

Another way to view it: since the opposite of *positive* is *negative*, not *neutral*, the opposite of positive fragility should be negative fragility (hence my appellation "antifragility"), not neutral, which would just convey robustness, strength, and unbreakability. Indeed, when one writes things down mathematically, antifragility is fragility with a negative sign in front of it.[1]

This blind spot seems universal. There is no word for "antifragility" in the main known languages, modern, ancient, colloquial, or slang. Even Russian (Soviet version) and Standard Brooklyn English don't seem to have a designation for antifragility, conflating it with robustness.[2]

Half of life—the interesting half of life—we don't have a name for.

PLEASE BEHEAD ME

If we have no common name for antifragility, we can find a mythological equivalence, the expression of historical intelligence through potent metaphors. In a Roman recycled version of a Greek myth, the Sicilian tyrant Dionysius II has the fawning courtier Damocles enjoy the luxury of a fancy banquet, but with a sword hanging over his head, tied to the ceiling with a single hair from a horse's tail. A horse's hair is the kind of thing that eventually breaks under pressure, followed by a scene of blood, high-pitched screams, and the equivalent of ancient ambulances. Damocles is fragile—it is only a matter of time before the sword strikes him down.

In another ancient legend, this time the Greek recycling of an ancient Semitic and Egyptian legend, we find Phoenix, the bird with splendid colors. Whenever it is destroyed, it is reborn from it own ashes. It always returns to its initial state. Phoenix happens to be the ancient symbol of Beirut, the city where I grew up. According to legend, Berytus (Beirut's historical name) has been destroyed seven times in its close to five-thousand-year history, and has come back seven times. The story seems cogent, as I myself saw the eighth episode; central Beirut (the ancient part of the city) was completely destroyed for the eighth time during my late childhood, thanks to the brutal civil war. I also saw its eighth rebuilding.

But Beirut was, in its latest version, rebuilt in even better shape than the previous incarnation—and with an interesting irony: the earthquake of A.D. 551 had buried the Roman law school, which was discovered, like a bonus from history, during the reconstruction (with archeologists and real estate developers trading public insults). That's not Phoenix, but something else beyond the robust. Which brings us to the third mythological metaphor: Hydra.

Hydra, in Greek mythology, is a serpent-like creature that dwells in the lake of Lerna, near Argos, and has numerous heads. Each time one is cut off, two grow back. So harm is what it likes. Hydra represents antifragility.

The sword of Damocles represents the side effect of power and success: you cannot rise and rule without facing this continuous danger—someone out there will be actively working to topple you. And like the sword, the danger will be silent, inexorable, and discontinuous. It will fall abruptly after long periods of quiet, perhaps at the very moment one has gotten used to it and forgotten about its existence. Black Swans will be out there to get you as you now have much more to lose, a cost of success (and growth), perhaps an unavoidable penalty of

excessive success. At the end, what matters is the strength of the string—not the wealth and power of the dining party. But, luckily, this is an identifiable, measurable, and tractable vulnerability, for those who want to listen. The entire point of the Triad is that in many situations we can measure the strength of the string.

Further, consider how toxic such growth-followed-by-a-fall can be to society, as the fall of the dining guest, in response to the fall of the sword of Damocles, will bring what we now call collateral damage, harming others. For instance, the collapse of a large institution will have effects on society.

Sophistication, a certain brand of sophistication, also brings fragility to Black Swans: as societies gain in complexity, with more and more "cutting edge" sophistication in them, and more and more specialization, they become increasingly vulnerable to collapse. This idea has been brilliantly—and convincingly—adumbrated by the archeologist Joseph Tainter. But it does not have to be so: it is so only for those unwilling to go the extra step and understand the matrix of reality. To counter success, you need a high offsetting dose of robustness, even high doses of antifragility. You want to be Phoenix, or possibly Hydra. Otherwise the sword of Damocles will get you.

On the Necessity of Naming

We know more than we think we do, a lot more than we can articulate. If our formal systems of thought denigrate the natural, and in fact we don't have a name for antifragility, and fight the concept whenever we use our brains, it does not mean that our actions neglect it. Our perceptions and intuitions, as expressed in deeds, can be superior to what we know and tabulate, discuss in words, and teach in a classroom. We will have ample discussions of the point particularly with the potent notion of the *apophatic* (what cannot be explicitly said, or directly described, in our current vocabulary); so for now, take this curious phenomenon.

In *Through the Language Glass*, the linguist Guy Deutscher reports that many primitive populations, without being color-blind, have verbal designations for only two or three colors. But when given a simple test, they can successfully match strings to their corresponding colors. They are capable of detecting the differences between the various nuances of the rainbow, but they do not express these in their vocabularies. These populations are culturally, though not biologically, color-blind.

Just as we are intellectually, not organically, antifragility-blind. To see the difference just consider that you need the name “blue” for the construction of a narrative, but not when you engage in action.

It is not well known that many colors we take for granted had no name for a long time, and had no names in the central texts in Western culture. Ancient Mediterranean texts, both Greek and Semitic, also had a reduced vocabulary of a small number of colors polarized around the dark and the light—Homer and his contemporaries were limited to about three or four main colors: black, white, and some indeterminate part of the rainbow, often subsumed as red, or yellow.

I contacted Guy Deutscher. He was extremely generous with his help and pointed out to me that the ancients even lacked words for something as elementary as blue. This absence of the word “blue” in ancient Greek explains the recurring reference by Homer to the “wine-dark sea” (*oinopa ponton*), which has been quite puzzling to readers (including this one).

Interestingly, it was the British Prime Minister William Gladstone who first made this discovery in the 1850s (and was unfairly and thoughtlessly reviled for it by the usual journalists). Gladstone, quite an erudite, wrote, during his interregnum between political positions, an impressive seventeen-hundred-page treatise on Homer. In the last section, Gladstone announced this limitation of color vocabulary, attributing our modern sensitization to many more nuances of color to a cross-generational training of the eye. But regardless of these variations of color in the culture of the time, people were shown to be able to identify the nuances—unless physically color-blind.

Gladstone was impressive in many respects. Aside from his erudition, force of character, respect for the weak, and high level of energy, four very attractive attributes (respect for the weak being, after intellectual courage, the second most attractive quality to this author), he showed remarkable prescience. He figured out what few in his day dared to propose: that the *Iliad* corresponds to a true story (the city of Troy had not been discovered yet). In addition, even more prescient and of great relevance to this book, he was insistent upon a balanced fiscal budget: fiscal deficits have proven to be a prime source of fragility in social and economic systems.

PROTO-ANTIFRAGILITY

There have been names for two starter-antifragility concepts, with two precursor applications that cover some special cases of it. These are mild aspects of antifragility and limited to the medical field. But they are a good way to start.

According to legend, Mithridates IV, king of Pontus in Asia Minor, while hiding after his father's assassination, got himself some protection against poisoning by ingesting sub-lethal doses of toxic material in progressively larger quantities. He later incorporated the process into a complicated religious ritual. But this immunity got him in trouble a bit later as his attempt to take his own life by poisoning failed, "having fortified himself against the drugs of others." So he had to ask for the services of an ally military commander to give him a blow with a sword.

The method named *Antidotum Mithridatium,* celebrated by Celsus, the ancient world's famous doctor, had to be rather fashionable in Rome, since about a century later it brought some complication to the emperor Nero's attempts at matricide. Nero had been obsessed with the idea of killing his mother, Agrippina, who, to make things more colorful, was Caligula's sister (and, even more colorful, was the alleged lover of the philosopher Seneca, more on whom later). But a mother tends to know her son rather well and predict his actions, particularly when he is her only child—and Agrippina knew something about poison, as she might have used the method to kill at least one of her husbands (I said things were quite colorful). So, suspecting that Nero had a contract on her, she got herself Mithridatized against the poisons that would have been available to her son's underlings. Like Mithridates, Agrippina eventually died by more mechanical methods as her son (supposedly) had assassins slay her, thus providing us with the small but meaningful lesson that one cannot be robust against everything. And, two thousand years later, nobody has found a method for us to get "fortified" against swords.

Let us call Mithridatization the result of an exposure to a small dose of a substance that, over time, makes one immune to additional, larger quantities of it. It is the sort of approach used in vaccination and allergy medicine. It is not quite antifragility, still at the more modest level of robustness, but we are on our way. And we already have a hint that perhaps being deprived of poison makes us fragile and that the road to robustification starts with a modicum of harm.

Now consider a case when the poisonous substance, in some dose, makes you

better off overall, one step up from robustness. Hormesis, a word coined by pharmacologists, is when a small dose of a harmful substance is actually beneficial for the organism, acting as medicine. A little bit of an otherwise offending substance, not too much, acts to benefit the organism and make it better overall as it triggers some overreaction. This was not interpreted at the time in the sense of "gains from harm" so much as "harm is dose dependent" or "medicine is dose dependent." The interest to scientists has been in the nonlinearity of the dose-response.

Hormesis was well known by the ancients (and like the color blue was known but not expressed). But it was only in 1888 that it was first "scientifically" described (though still not given a name) by a German toxicologist, Hugo Schulz, who observed that small doses of poison stimulate the growth of yeast while larger doses cause harm. Some researchers hold that the benefits of vegetables may not be so much in what we call the "vitamins" or some other rationalizing theories (that is, ideas that seem to make sense in narrative form but have not been subjected to rigorous empirical testing), but in the following: plants protect themselves from harm and fend off predators with poisonous substances that, ingested by us in the right quantities, may stimulate our organisms—or so goes the story. Again, limited, low-dose poisoning triggers healthy benefits.

Many claim that caloric restriction (permanent or episodic) activates healthy reactions and switches that, among other benefits, lengthen life expectancy in laboratory animals. We humans live too long for researchers to test if such restriction increases our life expectancy (if the hypothesis is true, then the subjects of the test would outlive the researchers). But it looks like such restriction makes humans healthier (and may also improve their sense of humor). But since abundance would bring the opposite effect, this episodic caloric restriction can be also interpreted as follows: too much regular food is bad for you, and depriving humans of the stressor of hunger may make them live less than their full potential; so all hormesis seems to be doing is reestablishing the natural dosage for food and hunger in humans. In other words, hormesis is the norm, and its absence is what hurts us.

Hormesis lost some scientific respect, interest, and practice after the 1930s because some people mistakenly associated it with homeopathy. The association was unfair, as the mechanisms are extremely different. Homeopathy is based on other principles, such as the one that minute, highly diluted parts of the agents of a disease (so small they can hardly be perceptible, hence cannot cause hormesis)

can help cure us of the disease itself. Homeopathy has shown little empirical backing and because of its testing methodologies belongs today to alternative medicine, while hormesis, as a phenomenon, has ample scientific evidence to back it up.

But the larger point is that we can now see that depriving systems of stressors, vital stressors, is not necessarily a good thing, and can be downright harmful.

DOMAIN INDEPENDENCE IS DOMAIN DEPENDENT

This idea that systems may need some stress and agitation has been missed by those who grasp it in one area and not in another. So we can now also see the *domain dependence* of our minds, a "domain" being an area or category of activity. Some people can understand an idea in one domain, say, medicine, and fail to recognize it in another, say, socioeconomic life. Or they get it in the classroom, but not in the more complicated texture of the street. Humans somehow fail to recognize situations outside the contexts in which they usually learn about them.

I had a vivid illustration of domain dependence in the driveway of a hotel in the pseudocity of Dubai. A fellow who looked like a banker had a uniformed porter carry his luggage (I can instantly tell if someone is a certain type of banker with minimal cues as I have physical allergies to them, even affecting my breathing). About fifteen minutes later I saw the banker lifting free weights at the gym, trying to replicate natural exercises using kettlebells as if he were swinging a suitcase. Domain dependence is pervasive.

Further, the problem is not just that Mithridatization and hormesis can be known in (some) medical circles and missed in other applications such as socioeconomic life. Even within medicine, some get it here and miss it there. The same doctor might recommend exercise so you "get tougher," and a few minutes later write a prescription for antibiotics in response to a trivial infection so you "don't get sick."

Another expression of domain dependence: ask a U.S. citizen if some semi-governmental agency with a great deal of independence (and no interference from Congress) should control the price of cars, morning newspapers, and Malbec wine, as its domain of specialty. He would jump in anger, as it appears to violate every principle the country stands for, and call you a Communist post-Soviet mole for even suggesting it. OK. Then ask him if that same government agency should control foreign exchange, mainly the rate of the dollar against the euro and the Mongolian tugrit. Same reaction: this is not France. Then very gently point out to him that the Federal Reserve Bank of the United States is in the business of controlling and managing the price of another good, another price, called the lending rate, the interest rate in the economy (and has proved to be good at it). The libertarian presidential candidate Ron Paul was called a crank for suggesting the abolition of the Federal Reserve, or even restricting its role.

But he would also have been called a crank for suggesting the creation of an agency to control other prices.

Imagine someone gifted in learning languages but unable to transfer concepts from one tongue to another, so he would need to relearn “chair” or “love” or “apple pie” every time he acquires a new language. He would not recognize “house” (English) or “casa” (Spanish) or “byt” (Semitic). We are all, in a way, similarly handicapped, unable to recognize the same idea when it is presented in a different context. It is as if we are doomed to be deceived by the most superficial part of things, the packaging, the gift wrapping. This is why we don’t see antifragility in places that are obvious, too obvious. It is not part of the accepted way of thinking about success, economic growth, or innovation that these may result only from overcompensation against stressors. Nor do we see this overcompensation at work elsewhere. (And domain dependence is also why it has been difficult for many researchers to realize that uncertainty, incomplete understanding, disorder, and volatility are members of the same close family.)

This lack of translation is a mental handicap that comes with being a human; and we will only start to attain wisdom or rationality when we make an effort to overcome and break through it.

Let us get deeper into overcompensation.

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[1] Just as concavity is convexity with a negative sign in front of it and is sometimes called anticonvexity.

[2] I checked in addition to Brooklyn English most Indo-European languages, both ancient (Latin, Greek) and modern branches: Romance (Italian, French, Spanish, Portuguese), Slavic (Russian, Polish, Serbian, Croatian), Germanic (German, Dutch, Afrikaans), and Indo-Iranian (Hindi, Urdu, Farsi). It is also absent from non-Indo-European families such as Semitic (Arabic, Hebrew, Aramaic) and Turkic (Turkish).

CHAPTER 2

Overcompensation and Overreaction Everywhere

Is it easy to write on a Heathrow runway?—Try to get the Pope to ban your work—How to beat up an economist (but not too hard, just enough to go to jail)

My own domain dependence was revealed to me one day as I was sitting in the office of David Halpern, a U.K. government advisor and policy maker. He informed me—in response to the idea of antifragility—of a phenomenon called post-traumatic growth, the opposite of post-traumatic stress syndrome, by which people harmed by past events surpass themselves. I had never heard about it before, and, to my great shame, had never made the effort to think of its existence: there is a small literature but it is not advertised outside a narrow discipline. We hear about the more lurid post-traumatic disorder, not post-traumatic growth, in the intellectual and so-called learned vocabulary. But popular culture has an awareness of its equivalent, revealed in the expression "it builds character." So do the ancient Mediterranean classics, along with grandmothers.

Intellectuals tend to focus on negative responses from randomness (fragility) rather than the positive ones (antifragility). This is not just in psychology: it prevails across the board.

How do you innovate? First, try to get in trouble. I mean serious, but not terminal, trouble. I hold—it is beyond speculation, rather a conviction—that innovation and sophistication spark from initial situations of necessity, in ways that go far beyond the satisfaction of such necessity (from the unintended side effects of, say, an initial invention or attempt at invention). Naturally, there are

classical thoughts on the subject, with a Latin saying that sophistication is born out of hunger (*artificia docuit fames*). The idea pervades classical literature: in Ovid, difficulty is what wakes up the genius (*ingenium mala saepe movent*), which translates in Brooklyn English into "When life gives you a lemon …"

The excess energy released from overreaction to setbacks is what innovates!

This message from the ancients is vastly deeper than it seems. It contradicts modern methods and ideas of innovation and progress on many levels, as we tend to think that innovation comes from bureaucratic funding, through planning, or by putting people through a Harvard Business School class by one Highly Decorated Professor of Innovation and Entrepreneurship (who never innovated anything) or hiring a consultant (who never innovated anything). This is a fallacy—note for now the disproportionate contribution of *uneducated* technicians and entrepreneurs to various technological leaps, from the Industrial Revolution to the emergence of Silicon Valley, and you will see what I mean.

Yet in spite of the visibility of the counterevidence, and the wisdom you can pick up free of charge from the ancients (or grandmothers), moderns try today to create inventions from situations of comfort, safety, and predictability instead of accepting the notion that "necessity really is the mother of invention."

Many, like the great Roman statesman Cato the Censor, looked at comfort, almost any form of comfort, as a road to waste.[1] He did not like it when we had it too easy, as he worried about the weakening of the will. And the softening he feared was not just at the personal level: an entire society can fall ill. Consider that as I am writing these lines, we are living in a debt crisis. The world as a whole has never been richer, and it has never been more heavily in debt, living off borrowed money. The record shows that, for society, the richer we become, the harder it gets to live within our means. Abundance is harder for us to handle than scarcity.

Cato would have smiled hearing about the recently observed effect in aeronautics that the automation of airplanes is underchallenging pilots, making flying too comfortable for them, dangerously comfortable. The dulling of the pilot's attention and skills from too *little* challenge is indeed causing deaths from flying accidents. Part of the problem is a Federal Aviation Administration (FAA) regulation that forced the industry to increase its reliance on automated flying. But, thankfully, the same FAA finally figured out the problem; it has recently found that pilots often "abdicate too much responsibility to automated systems."

HOW TO WIN A HORSE RACE

It is said that the best horses lose when they compete with slower ones, and win against better rivals. Undercompensation from the absence of a stressor, inverse hormesis, absence of challenge, degrades the best of the best. In Baudelaire's poem, "The albatross's giant wings prevent him from walking"—many do better in Calculus 103 than Calculus 101.

This mechanism of overcompensation hides in the most unlikely places. If tired after an intercontinental flight, go to the gym for some exertion instead of resting. Also, it is a well-known trick that if you need something urgently done, give the task to the busiest (or second busiest) person in the office. Most humans manage to squander their free time, as free time makes them dysfunctional, lazy, and unmotivated—the busier they get, the more active they are at other tasks. Overcompensation, here again.

I've discovered a trick when giving lectures. I have been told by conference organizers that one needs to be clear, to speak with the fake articulation of TV announcers, maybe even dance on the stage to get the attention of the crowd. Some try sending authors to "speech school"—the first time it was suggested to me I walked out, resolved to change publishers on the spot. I find it better to whisper, not shout. Better to be slightly inaudible, less clear. When I was a pit trader (one of those crazy people who stand in a crowded arena shouting and screaming in a continuous auction), I learned that the noise produced by the person is inverse to the pecking order: as with mafia dons, the most powerful traders were the least audible. One should have enough self-control to make the audience work hard to listen, which causes them to switch into intellectual overdrive. This paradox of attention has been a little bit investigated: there is empirical evidence of the effect of "disfluency." Mental effort moves us into higher gear, activating more vigorous and more analytical brain machinery.[2] The management guru Peter Drucker and the psychoanalyst Jacques Lacan, two persons who mesmerized the crowds the most in their respective areas, were the antithesis of the polished-swanky speaker or the consonant-trained television announcer.

The same or a similar mechanism of overcompensation makes us concentrate better in the presence of a modicum of background random noise, as if the act of countering such noise helps us hone our mental focus. Consider this remarkable ability humans have to filter out noise at happy hour and distinguish the signal

among so many other loud conversations. So not only are we made to overcompensate, but we sometimes *need* the noise. Like many writers, I like to sit in cafés, working, as they say, against resistance. Consider our bedtime predilection for the rustle of tree leaves or the sound of the ocean: there are even electric contraptions that produce "white noise"[3] that helps people sleep better. Now these small distractions, like hormetic responses, act up to a point. I haven't tried it yet, but I am certain that it would be hard to write an essay on the runway of Heathrow airport.

Antifragile Responses as Redundancy

Something flashed when I heard "post-traumatic" during that London visit. It hit me right there and then that these antifragile hormetic responses were just a form of redundancy, and all the ideas of Mother Nature converged in my mind. It is all about redundancy. Nature likes to overinsure itself.

Layers of redundancy are the central risk management property of natural systems. We humans have two kidneys (this may even include accountants), extra spare parts, and extra capacity in many, many things (say, lungs, neural system, arterial apparatus), while human design tends to be spare and inversely redundant, so to speak—we have a historical track record of engaging in debt, which is the opposite of redundancy (fifty thousand in extra cash in the bank or, better, under the mattress, is redundancy; owing the bank an equivalent amount, that is, debt, is the opposite of redundancy). Redundancy is ambiguous because it seems like a waste if nothing unusual happens. Except that something unusual happens—usually.

Further, redundancy is not necessarily wussy; it can be extremely aggressive. For instance, if you have extra inventory of, say, fertilizers in the warehouse, just to be safe, and there happens to be a shortage because of disruptions in China, you can sell the excess inventory at a huge premium. Or if you have extra oil reserves, you may sell them at a large profit during a squeeze.

Now, it turns out, the same, very same logic applies to overcompensation: it is just a form of redundancy. An additional head for Hydra is no different from an extra—that is, seemingly redundant—kidney for humans, and no different from the additional capacity to withstand an extra stressor. If you ingest, say, fifteen milligrams of a poisonous substance, your body may prepare for twenty or more, and as a side effect will get stronger overall. These extra five milligrams of poison that you can withstand are no different from additional stockpiles of vital

or necessary goods, say extra cash in the bank or more food in the basement. And to return to the drivers of innovation: the additional *quantities* of motivation and willpower, so to speak, stemming from setbacks can be also seen as extra capacity, no different from extra boxes of victuals.

A system that overcompensates is necessarily in overshooting mode, building extra capacity and strength in anticipation of a worse outcome and in response to information about the possibility of a hazard. And of course such extra capacity or strength may become useful by itself, opportunistically. We saw that redundancy is opportunistic, so such extra strength can be used to some benefit even in the absence of the hazard. Tell the next MBA analyst or business school professor you run into that redundancy is not defensive; it is more like investment than insurance. And tell them that what they call "inefficient" is often very efficient.

Indeed, our bodies discover probabilities in a very sophisticated manner and assess risks much better than our intellects do. To take one example, risk management professionals look in the past for information on the so-called *worst-case scenario* and use it to estimate future risks—this method is called "stress testing." They take the worst historical recession, the worst war, the worst historical move in interest rates, or the worst point in unemployment as an exact estimate for the worst future outcome. But they never notice the following inconsistency: this so-called worst-case event, when it happened, exceeded the worst case at the time.

I have called this mental defect *the Lucretius problem*, after the Latin poetic philosopher who wrote that the fool believes that the tallest mountain in the world will be equal to the tallest one he has observed. We consider the biggest object of any kind that we have seen in our lives or hear about as the largest item that can possibly exist. And we have been doing this for millennia. In Pharaonic Egypt, which happens to be the first complete top-down nation-state managed by bureaucrats, scribes tracked the high-water mark of the Nile and used it as an estimate for a future worst-case scenario.

The same can be seen in the Fukushima nuclear reactor, which experienced a catastrophic failure in 2011 when a tsunami struck. It had been built to withstand the worst past historical earthquake, with the builders not imagining much worse —and not thinking that the worst past event had to be a surprise, as it had no precedent. Likewise, the former chairman of the Federal Reserve, Fragilista Doctor Alan Greenspan, in his apology to Congress offered the classic "It never happened before." Well, nature, unlike Fragilista Greenspan, prepares for what

has not happened before, *assuming worse harm is possible*.[4]

If humans fight the last war, nature fights the next one. Your body is more imaginative about the future than you are. Consider how people train in weightlifting: the body overshoots in response to exposures and overprepares (up to the point of biological limit, of course). This is how bodies get stronger.

In the aftermath of the banking crisis, I received all manner of threats, and *The Wall Street Journal* suggested that I "stock up on bodyguards." I tried to tell myself no worries, stay calm, these threats were coming from disgruntled bankers; anyway, people get whacked first, then you read about it in the newspapers, not in the reverse sequence. But the argument did not register in my mind, and, when in New York or London, I could not relax, even after chamomile tea. I started feeling paranoia in public places, scrutinizing people to ascertain that I was not being followed. I started taking the bodyguard suggestion seriously, and I found it more appealing (and considerably more economical) to become one, or, better, to look like one. I found Lenny "Cake," a trainer, weighing around two hundred and eighty pounds (one hundred and thirty kilograms), who moonlighted as a security person. His nickname and weight both came from his predilection for cakes. Lenny Cake was the most physically intimidating person within five zip codes, and he was sixty. So, rather than taking lessons, I watched him train. He was into the "maximum lifts" type of training and swore by it, as he found it the most effective and least time-consuming. This method consisted of short episodes in the gym in which one focused solely on improving one's past maximum in a single lift, the heaviest weight one could haul, sort of the high-water mark. The workout was limited to trying to exceed that mark once or twice, rather than spending time on un-entertaining time-consuming repetitions. The exercise got me into a naturalistic form of weightlifting, and one that accords with the evidence-based literature: work on the maximum, spend the rest of the time resting and splurging on mafia-sized steaks. I have been trying to push my limit for four years now; it is amazing to see how something in my biology anticipates a higher level than the past maximum—until it reaches its ceiling. When I deadlift (i.e., mimic lifting a stone to waist level) using a bar with three hundred and thirty pounds, then rest, I can safely expect that I will build a certain amount of additional strength as my body *predicts* that next time I may need to lift three hundred and thirty-five pounds. The benefits, beyond the fading of my paranoia and my newfound calm in public places, includes small unexpected conveniences. When I am harassed

by limo drivers in the arrival hall at Kennedy airport insistently offering me a ride and I calmly tell them to “f*** off,” they go away immediately. But there are severe drawbacks: some of the readers I meet at conferences have a rough time dealing with an intellectual who has the appearance of a bodyguard—intellectuals can be svelte or flabby and out of shape (when they wear a tweed jacket), but they are not supposed to look like butchers.

Something that will give the Darwinists some work, an observation made to me by the risk analyst, my favorite intellectual opponent (and personal friend) Aaron Brown: the term “fitness” itself may be quite imprecise and even ambiguous, which is why the notion of antifragility as something exceeding mere fitness can elucidate the confusion. What does “fitness” mean? Being exactly tuned to a given past history of a specific environment, or extrapolating to an environment with stressors of higher intensity? Many seem to point to the first kind of adaptation, missing the notion of antifragility. But if one were to write down mathematically a standard model of selection, one would get overcompensation rather than mere “fitness.”[5]

Even the psychologists who studied the antifragile response of post-traumatic growth, and show the data for it, don’t quite get the full concept, as they lapse, when using words, into the concept of “resilience.”

ON THE ANTIFRAGILITY OF RIOTS, LOVE, AND OTHER UNEXPECTED BENEFICIARIES OF STRESS

Once one makes an effort to overcome domain dependence, the phenomenon of overcompensation appears ubiquitous.

Those who understand bacterial resistance in the biological domain completely fail to grasp the dictum by Seneca in *De clemencia* about the inverse effect of punishments. He wrote: "Repeated punishment, while it crushes the hatred of a few, stirs the hatred of all … just as trees that have been trimmed throw out again countless branches." For revolutions feed on repression, growing heads faster and faster as one *literally* cuts a few off by killing demonstrators. There is an Irish revolutionary song that encapsulates the effect:

The higher you build your barricades, the stronger we become.

The crowds, at some point, mutate, blinded by anger and a sense of outrage, fueled by the heroism of a few willing to sacrifice their lives for the cause (although they don't quite see it as sacrifice) and hungry for the privilege to become martyrs. It is that political movements and rebellions can be highly antifragile, and the sucker game is to try to repress them using brute force rather than manipulate them, give in, or find more astute ruses, as Heracles did with Hydra.

If antifragility is what wakes up and overreacts and overcompensates to stressors and damage, then one of the most antifragile things you will find outside economic life is a certain brand of refractory love (or hate), one that seems to overreact and overcompensate for impediments such as distance, family incompatibilities, and every conscious attempt to kill it. Literature is rife with characters trapped in a form of antifragile passion, seemingly against their will. In Proust's long novel *La recherche*, Swann, a socially sophisticated Jewish art dealer, falls for Odette, a demimondaine, a "kept" woman of sorts, a semi-or perhaps just a quarter-prostitute; she treats him badly. Her elusive behavior fuels his obsession, causing him to demean himself for the reward of a bit more time with her. He exhibits overt clinginess, follows her on her trysts with other men, hiding shamelessly in staircases, which of course causes her to treat him even more elusively. Supposedly, the story was a fictionalization of Proust's own entanglement with his (male) driver. Or take Dino Buzzati's

semiautobiographical novel *Un amore*, the story of a middle-aged Milanese man who falls—accidentally, of course—for a dancer at the Scala who moonlights as a prostitute. She of course mistreats him, exploits him, takes advantage of him, milks him; and the more she mistreats him, the more he exposes himself to abuse to satisfy the antifragile thirst of a few moments with her. But some form of happy ending there: from his biography, Buzzati himself ended up marrying, at sixty, a twenty-five year old, Almerina, a former dancer, seemingly the character of the story; when he died shortly after that, she became a good caretaker of his literary legacy.

Even when authors such as Lucretius (the same of the high mountains earlier in this chapter) rant against the dependence, imprisonment, and alienation of love, treating it as a (preventable) disease, they end up lying to us or themselves. Legend perhaps: Lucretius the priest of anti-romance might have been himself involved in uncontrollable—antifragile—infatuation.

Like tormenting love, some thoughts are so antifragile that you feed them by trying to get rid of them, turning them into obsessions. Psychologists have shown the irony of the process of thought control: the more energy you put into trying to control your ideas and what you think about, the more your ideas end up controlling you.

Please Ban My Book: The Antifragility of Information

Information is antifragile; it feeds more on attempts to harm it than it does on efforts to promote it. For instance, many wreck their reputations merely by trying to defend them.

The wily Venetians knew how to spread information by disguising it as a secret. Try it out with the following experiment in spreading gossip: tell someone a secret and qualify it by insisting that it is a secret, begging your listener “not to tell anyone”; the more you insist that it remain a secret, the more it will spread.

We all learn early on in life that books and ideas are antifragile and get nourishment from attacks—to borrow from the Roman emperor Marcus Aurelius (one of the doer-Stoic authors), “fire feeds on obstacles.” There is the attraction of banned books, their antifragility to interdicts. The first book I read, during my childhood, of Graham Greene’s was *The Power and the Glory*, selected for no other reason than its having been put on the *Index* (that is, banned) by the Vatican. Likewise, as a teenager, I gorged on the books of the American

expatriate Henry Miller—his major book sold a million copies in one year thanks to having been banned in twenty-three states. The same with *Madame Bovary* or *Lady Chatterley's Lover.*

Criticism, for a book, is a truthful, unfaked badge of attention, signaling that it is not boring; and boring is the only very bad thing for a book. Consider the Ayn Rand phenomenon: her books *Atlas Shrugged* and *The Fountainhead* have been read for more than half a century by millions of people, in spite of, or most likely thanks to, brutally nasty reviews and attempts to discredit her. The first-order information is the intensity: what matters is the effort the critic puts into trying to prevent others from reading the book, or, more generally in life, it is the effort in badmouthing someone that matters, not so much what is said. So if you really want people to read a book, tell them it is "overrated," with a sense of outrage (and use the attribute "underrated" for the opposite effect).

Balzac recounts how actresses paid journalists (often in kind) to write favorable accounts—but the wiliest got them to write unfavorable comments, knowing that it made them more interesting.

I have just bought Tom Holland's book on the rise of Islam for the sole reason that he was attacked by Glen Bowersock, considered to be the most prominent living scholar on the Roman Levant. Until then I had thought that Tom Holland was just a popularizer, and I would not have taken him seriously otherwise. I didn't even attempt to read Bowersock's review. So here is a simple rule of thumb (a heuristic): to estimate the quality of research, take the caliber of the highest detractor, or the caliber of the lowest detractor whom the author answers in print—whichever is lower.

Criticism itself can be antifragile to repression, when the fault finder wants to be attacked in return in order to get some validation. Jean Fréron, said to be a very envious thinker, with the mediocrity of envious thinkers, managed to play a role in intellectual history solely by irritating the otherwise brilliant Voltaire to the point of bringing him to write satirical poems against him. Voltaire, himself a gadfly and expert at ticking off people to benefit from their reactions, forgot how things worked when it came to himself. Perhaps Voltaire's charm was in that he did not know how to save his wit. So the same hidden antifragilities apply to attacks on our ideas and persons: we fear them and dislike negative publicity, but smear campaigns, if you can survive them, help enormously, conditional on the person appearing to be extremely motivated and adequately angry—just as when you hear a woman badmouthing another in front of a man (or vice versa). There is a visible selection bias: why did he attack *you* instead of

someone else, one of the millions of persons deserving but not worthy of attack? It is his energy in attacking or badmouthing that will, antifragile style, put you on the map.

My great-grandfather Nicolas Ghosn was a wily politician who managed to stay permanently in power and hold government positions in spite of his numerous enemies (most notably his archenemy, my great-great-grandfather on the Taleb side of the family). As my grandfather, his eldest son, was starting his administrative and hopefully political career, his father summoned him to his deathbed. “My son, I am very disappointed in you,” he said. “I never hear anything wrong said about you. You have proven yourself incapable of generating envy.”

Get Another Job

As we saw with the Voltaire story, it is not possible to stamp out criticism; if it harms you, get out. It is easier to change jobs than control your reputation or public perception.

Some jobs and professions are fragile to reputational harm, something that in the age of the Internet cannot possibly be controlled—these jobs aren’t worth having. You do not want to “control” your reputation; you won’t be able to do it by controlling information flow. Instead, focus on altering your exposure, say, by putting yourself in a position impervious to reputational damage. Or even put yourself in a situation to benefit from the antifragility of information. In that sense, a writer is antifragile, but we will see later most modernistic professions are usually not.

I was in Milan trying to explain antifragility to Luca Formenton, my Italian publisher (with great aid from body language and hand gestures). I was there partly for the Moscato dessert wines, partly for a convention in which the other main speaker was a famous fragilista economist. So, suddenly remembering that I was an author, I presented Luca with the following thought experiment: if I beat up the economist publicly, what would happen to me (other than a publicized trial causing great interest in the new notions of *fragilita* and *antifragilita*)? You know, this economist had what is called a *tête à baffe*, a face that invites you to slap it, just like a cannoli invites you to bite into it. Luca thought for a second … well, it’s not like he would like me to do it, but, you know, it wouldn’t hurt book sales. Nothing I can do as an author that makes it to the front page of *Corriere della Sera* would be detrimental for my book. Almost

no scandal would hurt an artist or writer.[6]

Now let's say I were a midlevel executive employee of some corporation listed on the London Stock Exchange, the sort who never take chances by dressing down, always wearing a suit and tie (even on the beach). What would happen to me if I attack the fragilista? My firing and arrest record would plague me forever. I would be the total victim of informational antifragility. But someone earning close to minimum wage, say, a construction worker or a taxi driver, does not overly depend on his reputation and is free to have his own opinions. He would be merely robust compared to the artist, who is antifragile. A midlevel bank employee with a mortgage would be fragile to the extreme. In fact he would be completely a prisoner of the value system that invites him to be corrupt to the core—because of his dependence on the annual vacation in Barbados. The same with a civil servant in Washington. Take this easy-to-use heuristic (which is, to repeat the definition, a simple compressed rule of thumb) to detect the independence and robustness of someone's reputation. With few exceptions, those who dress outrageously are robust or even antifragile in reputation; those clean-shaven types who dress in suits and ties are fragile to information about them.

Large corporations and governments do not seem to understand this rebound power of information and its ability to control those who try to control it. When you hear a corporation or a debt-laden government trying to "reinstill confidence" you know they are fragile, hence doomed. Information is merciless: one press conference "to tranquilize" and the investors will run away, causing a death spiral or a run on the bank. Which explains why I have an obsessive stance against government indebtedness, as a staunch proponent of what is called fiscal conservatism. When you don't have debt you don't care about your reputation in economics circles—and somehow it is only when you don't care about your reputation that you tend to have a good one. Just as in matters of seduction, people lend the most to those who need them the least.

And we are blind to this antifragility of information in even more domains. If I physically beat up a rival in an ancestral environment, I injure him, weaken him, perhaps eliminate him forever—and get some exercise in the process. If I use the mob to put a contract on his head, he is gone. But if I stage a barrage of informational attacks on websites and in journals, I may be just helping him and hurting myself.

So I end this section with a thought. It is quite perplexing that those from whom we have benefited the most aren't those who have tried to help us (say

with “advice”) but rather those who have actively tried—but eventually failed—to harm us.

Next we turn to a central distinction between the things that like stress and other things that don’t.

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[1] Cato was the statesman who, three books ago (*Fooled by Randomness*), expelled all philosophers from Rome.

[2] This little bit of effort seems to activate the switch between two distinct mental systems, one intuitive and the other analytical, what psychologists call “system 1” and “system 2.”

[3] There is nothing particularly “white” in white noise; it is simply random noise that follows a Normal Distribution.

[4] The obvious has not been tested empirically: Can the occurrence of extreme events be predicted from past history? Alas, according to a simple test: no, sorry.

[5] Set a simple filtering rule: all members of a species need to have a neck forty centimeters long in order to survive. After a few generations, the surviving population would have, on average, a neck *longer* than forty centimeters. (More technically, a stochastic process subjected to an absorbing barrier will have an observed mean higher than the barrier.)

[6] The French have a long series of authors who owe part of their status to their criminal record—which includes the poet Ronsard, the writer Jean Genet, and many others.

CHAPTER 3

The Cat and the Washing Machine

Stress is knowledge (and knowledge is stress)—The organic and the mechanical—No translator needed, for now—Waking up the animal in us, after two hundred years of modernity

The bold conjecture made here is that everything that has life in it is to some extent antifragile (but not the reverse). It looks like the secret of life is antifragility.

Typically, the natural—the biological—is both antifragile and fragile, depending on the source (and the range) of variation. A human body can benefit from stressors (to get stronger), but only to a point. For instance, your bones will get denser when episodic stress is applied to them, a mechanism formalized under the name Wolff's Law after an 1892 article by a German surgeon. But a dish, a car, an inanimate object will not—these may be robust but cannot be intrinsically antifragile.

Inanimate—that is, nonliving—material, typically, when subjected to stress, either undergoes material fatigue or breaks. One of the rare exceptions I've seen is in the report of a 2011 experiment by Brent Carey, a graduate student, in which he shows that composite material of carbon nanotubes arranged in a certain manner produces a self-strengthening response previously unseen in synthetic materials, "similar to the localized self-strengthening that occurs in biological structures." This crosses the boundary between the living and the inanimate, as it can lead to the development of adaptable load-bearing material.

We can use the distinction as a marker between living and nonliving. The fact that the artificial needs to be antifragile for us to be able to use it as tissue is quite a telling difference between the biological and the synthetic. Your house, your food processor, and your computer desk eventually wear down and don't

self-repair. They may look better with age (when artisanal), just as your jeans will look more fashionable with use, but eventually time will catch up with them and the hardest material will end up looking like Roman ruins. Your jeans may look improved and more fashionable when worn out, but their material did not get stronger, nor do they self-repair. But think of a material that would make them stronger, self-heal, and improve with time.[1]

True, while humans self-repair, they eventually wear out (hopefully leaving their genes, books, or some other information behind—another discussion). But the phenomenon of aging is misunderstood, largely fraught with mental biases and logical flaws. We observe old people and see them age, so we associate aging with their loss of muscle mass, bone weakness, loss of mental function, taste for Frank Sinatra music, and similar degenerative effects. But these failures to self-repair come largely from maladjustment—either too few stressors or too little time for recovery between them—and maladjustment for this author is the mismatch between one's design and the structure of the randomness of the environment (what I call more technically its "distributional or statistical properties"). What we observe in "aging" is a combination of maladjustment and senescence, and it appears that the two are separable—senescence might not be avoidable, and should not be avoided (it would contradict the logic of life, as we will see in the next chapter); maladjustment is avoidable. Much of aging comes from a misunderstanding of the effect of comfort—a disease of civilization: make life longer and longer, while people are more and more sick. In a natural environment, people die without aging—or after a very short period of aging. For instance, some markers, such as blood pressure, that tend to worsen over time for moderns do not change over the life of hunter-gatherers until the very end.

And this artificial aging comes from stifling internal antifragility.

The Complex

This organic-mechanical dichotomy is a good starter distinction to build intuitions about the difference between two kinds of phenomena, but we can do better. Many things such as society, economic activities and markets, and cultural behavior are apparently man-made but grow on their own to reach some kind of self-organization. They may not be strictly biological, but they resemble the biological in that, in a way, they multiply and replicate—think of rumors, ideas, technologies, and businesses. They are closer to the cat than to the

washing machine but tend to be mistaken for washing machines. Accordingly we can generalize our distinction beyond the biological-nonbiological. More effective is the distinction between noncomplex and complex systems.

Artificial, man-made mechanical and engineering contraptions with simple responses are complicated, but not “complex,” as they don’t have interdependencies. You push a button, say, a light switch, and get an exact response, with no possible ambiguity in the consequences, even in Russia. But with complex systems, interdependencies are severe. You need to think in terms of ecology: if you remove a specific animal you disrupt a food chain: its predators will starve and its prey will grow unchecked, causing complications and series of cascading side effects. Lions are exterminated by the Canaanites, Phoenicians, Romans, and later inhabitants of Mount Lebanon, leading to the proliferation of goats who crave tree roots, contributing to the deforestation of mountain areas, consequences that were hard to see ahead of time. Likewise, if you shut down a bank in New York, it will cause ripple effects from Iceland to Mongolia.

In the complex world, the notion of “cause” itself is suspect; it is either nearly impossible to detect or not really defined—another reason to ignore newspapers, with their constant supply of causes for things.

STRESSORS ARE INFORMATION

Now the crux of complex systems, those with interacting parts, is that they convey information to these component parts through stressors, or thanks to these stressors: your body gets information about the environment not through your logical apparatus, your intelligence and ability to reason, compute, and calculate, but through stress, via hormones or other messengers we haven't discovered yet. As we saw, your bones will get stronger when subjected to gravity, say, after your (short) employment with a piano moving company. They will become weaker after you spend the next Christmas vacation in a space station with zero gravity or (as few people realize) if you spend a lot of time riding a bicycle. The skin on the palms of your hands will get calloused if you spend a summer on a Soviet-style cooperative farm. Your skin lightens in the winter and tans in the summer (especially if you have Mediterranean origins, less so if you are of Irish or African descent or from other places with more uniform weather throughout the year).

Further, errors and their consequences are information; for small children, pain is the only risk management information, as their logical faculties are not very developed. For complex systems are, well, all about information. And there are many more conveyors of information around us than meet the eye. This is what we will call *causal opacity:* it is hard to see the arrow from cause to consequence, making much of conventional methods of analysis, in addition to standard logic, inapplicable. As I said, the predictability of specific events is low, and it is such opacity that makes it low. Not only that, but because of nonlinearities, one needs higher visibility than with regular systems—instead what we have is opacity.

FIGURE 2. This illustrates why I have a thing for bones. You see identical situations of head-loading water or grain in traditional societies in India, Africa, and the Americas. There is even a Levantine love song about an attractive woman with an amphora on her head. The health benefits could beat bone density medication—but such forms of therapy would not benefit pharma's bottom line. Credit: Creative Commons

Let us consider bones again. I have a thing for bones, and the idea I will discuss next made me focus on lifting heavy objects rather than using gym machines. This obsession with the skeleton got started when I found a paper published in the journal *Nature* in 2003 by Gerard Karsenty and colleagues. The tradition has been to think that aging *causes* bone weakness (bones lose density, become more brittle), as if there was a one-way relationship possibly brought about by hormones (females start experiencing osteoporosis after menopause). It turns out, as shown by Karsenty and others who have since embarked on the line of research, that the reverse is also largely true: loss of bone density and degradation of the health of the bones also *causes* aging, diabetes, and, for males, loss of fertility and sexual function. We just cannot isolate any causal relationship in a complex system. Further, the story of the bones and the associated misunderstanding of interconnectedness illustrates how lack of stress (here, bones under a weight-bearing load) can cause aging, and how depriving stress-hungry antifragile systems of stressors brings a great deal of fragility which we will transport to political systems in Book II. Lenny's exercise method, the one I watched and tried to imitate in the last chapter, seemed to be

as much about stressing and strengthening the bones as it was about strengthening the muscles—he didn't know much about the mechanism but had discovered, heuristically, that weight bearing did something to his system. The lady in Figure 2, thanks to a lifetime of head-loading water jugs, has outstanding health and excellent posture.

Our antifragilities have conditions. The frequency of stressors matters a bit. Humans tend to do better with acute than with chronic stressors, particularly when the former are followed by ample time for recovery, which allows the stressors to do their jobs as messengers. For instance, having an intense emotional shock from seeing a snake coming out of my keyboard or a vampire entering my room, followed by a period of soothing safety (with chamomile tea and baroque music) long enough for me to regain control of my emotions, would be beneficial for my health, provided of course that I manage to overcome the snake or vampire after an arduous, hopefully heroic fight and have a picture taken next to the dead predator. Such a stressor would be certainly better than the mild but continuous stress of a boss, mortgage, tax problems, guilt over procrastinating with one's tax return, exam pressures, chores, emails to answer, forms to complete, daily commutes—things that make you feel trapped in life. In other words, the pressures brought about by civilization. In fact, neurobiologists show that the former type of stressor is necessary, the second harmful, for one's health. For an idea of how harmful a low-level stressor without recovery can be, consider the so-called Chinese water torture: a drop continuously hitting the same spot on your head, never letting you recover.

Indeed, the way Heracles managed to control Hydra was by cauterizing the wounds on the stumps of the heads that he had just severed. He thus prevented the regrowth of the heads and the exercise of antifragility. In other words, he disrupted the recovery.

Table 2 shows the difference between the two types. Note that there may be intermediate steps between engineered and organic, though things tend to cluster in one bucket or the other.

The reader can get a hint of the central problem we face with top-down tampering with political systems (or similar complex systems), the subject of Book II. The fragilista mistakes the economy for a washing machine that needs monthly maintenance, or misconstrues the properties of your body for those of a compact disc player. Adam Smith himself made the analogy of the economy as a watch or a clock that once set in motion continues on its own. But I am certain that he did not quite think of matters in these terms, that he looked at the

economy in terms of organisms but lacked a framework to express it. For Smith understood the opacity of complex systems as well as the interdependencies, since he developed the notion of the "invisible hand."

Click here for a larger image of this table.

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.

But alas, unlike Adam Smith, Plato did not quite get it. Promoting the well-known metaphor of the *ship of state*, he likens a state to a naval vessel, which, of course, requires the monitoring of a captain. He ultimately argues that the only men fit to be captain of this ship are philosopher kings, benevolent men with absolute power who have access to the Form of the Good. And once in a while one hears shouts of "who is governing us?" as if the world needs someone to govern it.

Equilibrium, Not Again

Social scientists use the term "equilibrium" to describe balance between opposing forces, say, supply and demand, so small disturbances or deviations in one direction, like those of a pendulum, would be countered with an adjustment in the opposite direction that would bring things back to stability. In short, this is

thought to be the goal for an economy.

Looking deeper into what these social scientists want us to get into, such a goal can be death. For the complexity theorist Stuart Kaufman uses the idea of equilibrium to separate the two different worlds of Table 2. *For the nonorganic, noncomplex, say, an object on the table, equilibrium* (as traditionally defined) *happens in a state of inertia. So for something organic, equilibrium* (in that sense) *only happens with death.* Consider an example used by Kaufman: in your bathtub, a vortex starts forming and will keep going after that. Such type of situation is permanently "far from equilibrium"—and it looks like organisms and dynamic systems exist in such a state.[2] For them, a state of normalcy requires a certain degree of volatility, randomness, the continuous swapping of information, and stress, which explains the harm they may be subjected to when deprived of volatility.

CRIMES AGAINST CHILDREN

Not only are we averse to stressors, and don't understand them, but we are committing crimes against life, the living, science, and wisdom, for the sake of eliminating volatility and variation.

I feel anger and frustration when I think that one in ten Americans beyond the age of high school is on some kind of antidepressant, such as Prozac. Indeed, when you go through mood swings, you now have to justify why you *are not* on some medication. There may be a few good reasons to be on medication, in severely pathological cases, but my mood, my sadness, my bouts of anxiety, are a second source of intelligence—perhaps even the first source. I get mellow and lose physical energy when it rains, become more meditative, and tend to write more and more slowly then, with the raindrops hitting the window, what Verlaine called autumnal "sobs" (*sanglots*). Some days I enter poetic melancholic states, what the Portuguese call *saudade* or the Turks *hüzün* (from the Arabic word for sadness). Other days I am more aggressive, have more energy—and will write less, walk more, do other things, argue with researchers, answer emails, draw graphs on blackboards. Should I be turned into a vegetable or a happy imbecile?

Had Prozac been available last century, Baudelaire's "spleen," Edgar Allan Poe's moods, the poetry of Sylvia Plath, the lamentations of so many other poets, everything with a soul would have been silenced.[3]…

If large pharmaceutical companies were able to eliminate the seasons, they would probably do so—for a profit, of course.

There is another danger: in addition to harming children, we are harming society and our future. Measures that aim at reducing variability and swings in the lives of children are also reducing variability and differences within our said to be Great Culturally Globalized Society.

Punished by Translation

Another forgotten property of stressors is in language acquisition—I don't know anyone who ever learned to speak his mother tongue in a textbook, starting with grammar and, checked by biquarterly exams, systematically fitting words to the acquired rules. You pick up a language best thanks to situational difficulty, from error to error, when you need to communicate under more or less straining

circumstances, particularly to express urgent needs (say, physical ones, such those arising in the aftermath of dinner in a tropical location).

One learns new words without making a nerd-effort, but rather another type of effort: to communicate, mostly by being forced to read the mind of the other person—suspending one's fear of making mistakes. Success, wealth, and technology, alas, make this mode of acquisition much more difficult. A few years ago, when I was of no interest to anyone, foreign conference organizers did not assign to me the fawning "travel assistant" fluent in Facebook English, so I used to be forced to fend for myself, hence picking up vocabulary by finger pointing and trial and error (just as children do)—no handheld devices, no dictionary, nothing. Now I am punished by privilege and comfort—and I can't resist comfort. The punishment is in the form of a person, fluent in English, greeting me by displaying my misspelled name at the airport, no stress, no ambiguity, and no exposure to Russian, Turkish, Croatian, or Polish outside of ugly (and organized) textbooks. What is worse, the person is unctuous; obsequious verbosity is something rather painful under the condition of jet lag.

Yet the best way to learn a language may be an episode of jail in a foreign country. My friend Chad Gracia improved his Russian thanks to an involuntary stay in the quarantine section of a hospital in Moscow for an imagined disease. It was a cunning brand of medical kidnapping, as during the mess after the end of the Soviet rule, hospitals were able to extort travelers with forced hospital stays unless they paid large sums of money to have their papers cleared. Chad, then barely fluent in the language, was forced to read Tolstoy in the original, and picked up quite a bit of vocabulary.

Touristification

My friend Chad benefited from the kind of disorder that is less and less prevalent thanks to the modern disease of *touristification*. This is my term for an aspect of modern life that treats humans as washing machines, with simplified mechanical responses—and a detailed user's manual. It is the systematic removal of uncertainty and randomness from things, trying to make matters highly predictable in their smallest details. All that for the sake of comfort, convenience, and efficiency.

What a tourist is in relation to an adventurer, or a flâneur, touristification is to life; it consists in converting activities, and not just travel, into the equivalent of a script like those followed by actors. We will see how touristification castrates

systems and organisms that like uncertainty by sucking randomness out of them to the last drop—while providing them with the illusion of benefit. The guilty parties are the education system, planning the funding of teleological scientific research, the French baccalaureate, gym machines, *etc.*

And the electronic calendar.

But the worse touristification is the life we moderns have to lead in captivity, during our leisure hours: Friday night opera, scheduled parties, scheduled laughs. Again, golden jail.

This "goal-driven" attitude hurts deeply inside my existential self.

The Secret Thirst for Chance

Which brings us to the existential aspect of randomness. If you are not a washing machine or a cuckoo clock—in other words, if you are alive—something deep in your soul likes a certain measure of randomness and disorder.

There is a titillating feeling associated with randomness. We like the moderate (and highly domesticated) world of games, from spectator sports to having our breathing suspended between crap shoots during the next visit to Las Vegas. I myself, while writing these lines, try to avoid the tyranny of a precise and explicit plan, drawing from an opaque source inside me that gives me surprises. Writing is only worth it when it provides us with the tingling effect of adventure, which is why I enjoy the composition of books and dislike the straitjacket of the 750-word op-ed, which, even without the philistinism of the editor, bores me to tears. And, remarkably, what the author is bored writing bores the reader.

If I could predict what my day would exactly look like, I would feel a little bit dead.

Further, this randomness is necessary for true life. Consider that all the wealth of the world can't buy a liquid more pleasurable than water after intense thirst. Few objects bring more thrill than a recovered wallet (or laptop) lost on a train. Further, in an ancestral habitat we humans were prompted by natural stimuli—fear, hunger, desire—that made us work out and become fit for our environment. Consider how easy it is to find the energy to lift a car if a crying child is under it, or to run for your life if you see a wild animal crossing the street. Compare this to the heaviness of the obligation to visit the gym at the planned 6 P.M. and be bullied there by some personal trainer—unless of course you are under the imperative to look like a bodyguard. Also consider how easy it is to skip a meal when the randomness in the environment causes us to do so, because of lack of

food—as compared to the "discipline" of sticking to some eighteen-day diet plan.

There exist the kind of people for whom life is some kind of project. After talking to them, you stop feeling good for a few hours; life starts tasting like food cooked without salt. I, a thrill-seeking human, have a b***t detector that seems to match my boredom detector, as if we were equipped with a naturalistic filter, dullness-aversion. Ancestral life had no homework, no boss, no civil servants, no academic grades, no conversation with the dean, no consultant with an MBA, no table of procedure, no application form, no trip to New Jersey, no grammatical stickler, no conversation with someone boring you: all life was random stimuli and nothing, good or bad, ever felt like work.[4] Dangerous, yes, but boring, never.

Finally, an environment with variability (hence randomness) does not expose us to chronic stress injury, unlike human-designed systems. If you walk on uneven, not man-made terrain, no two steps will ever be identical—compare that to the randomness-free gym machine offering the exact opposite: forcing you into endless repetitions of the very same movement.

Much of modern life is preventable chronic stress injury.

Next, let us examine a wrinkle of evolution, that great expert on antifragility.

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[1] Another way to see it: machines are harmed by low-level stressors (material fatigue), organisms are harmed by the *absence* of low-level stressors (hormesis).

[2] These are the so-called dissipative structures, after the works of the physicist Ilya Prigogine, that have a quite different status from simple equilibrium structures: they are formed and maintained through the effect of exchange of energy and matter in permanent nonequilibrium conditions.

[3] This does not mean that Sylvia Plath should not have been medicated at all. The point is that pathologies should be medicated when there is a risk of suicide, not mood swings.

[4] Neither Rousseau nor Hobbes. True, life then was perhaps "brutal and short," but it is a severe logical mistake to present a tradeoff, to use unsavory aspects of early humanity as a necessary cost of avoiding modern tortures. There is no reason to not want advantages from both eras.

CHAPTER 4

What Kills Me Makes Others Stronger

Antifragility for one is fragility for someone else—Where we introduce the idea that we think too much, do very little—Fail for others to succeed—One day you may get a thank-you note

ANTIFRAGILITY BY LAYERS

This chapter is about error, evolution, and antifragility, with a hitch: it is largely about the errors of others—the antifragility of some comes necessarily at the expense of the fragility of others. In a system, the sacrifices of some units—fragile units, that is, or people—are often necessary for the well-being of other units or the whole. The fragility of every startup is necessary for the economy to be antifragile, and that's what makes, among other things, entrepreneurship work: the fragility of individual entrepreneurs and their necessarily high failure rate.

So antifragility gets a bit more intricate—and more interesting—in the presence of layers and hierarchies. A natural organism is not a single, final unit; it is composed of subunits and itself may be the subunit of some larger collective. These subunits may be contending with each other. Take another business example. Restaurants are fragile; they compete with each other, but the collective of local restaurants is antifragile for that very reason. Had restaurants been individually robust, hence immortal, the overall business would be either stagnant or weak, and would deliver nothing better than cafeteria food—and I mean Soviet-style cafeteria food. Further, it would be marred with systemic shortages, with, once in a while, a complete crisis and government bailout. All that quality, stability, and reliability are owed to the fragility of the restaurant itself.

So some parts *on the inside* of a system may be required to be fragile in order to make the system antifragile as a result. Or the organism itself might be fragile, but the information encoded in the genes reproducing it will be antifragile. The point is not trivial, as it is behind the logic of evolution. This applies equally to entrepreneurs and individual scientific researchers.

Further, we mentioned "sacrifice" a few paragraphs ago. Sadly, the benefits of errors are often conferred on others, the collective—as if individuals were designed to make errors for the greater good, not their own. Alas, we tend to discuss mistakes without taking into consideration this layering and transfer of fragility.

Evolution and Unpredictability

I said that the notions of Mithridatization and hormesis were "proto"-

antifragility, introductory concepts: they are even a bit naive, and we will need to refine, even transcend them, in order to look at a complex system as a whole. Hormesis is a metaphor; antifragility is a phenomenon.

Primo, Mithridatization and hormesis are just very weak forms of antifragility, with limited gains from volatility, accident, or harm and a certain reversal of the protective or beneficial effect beyond a certain dosage. Hormesis likes only a little bit of disorder, or, rather, *needs* a little bit of it. They are mostly interesting insofar as their deprivation is harmful, something we don't get intuitively—our minds cannot easily understand the complicated responses (we think linearly, and these dose-dependent responses are nonlinear). Our linear minds do not like nuances and reduce the information to the binary "harmful" or "helpful."

Secundo, and that's the central weakness, they see the organism from the outside and consider it as a whole, a single unit, when things can be a bit more nuanced.

There is a different, stronger variety of antifragility linked to evolution that is beyond hormesis—actually very different from hormesis; it is even its opposite. It can be described as hormesis—getting stronger under harm—if we look from the outside, not from the inside. This other variety of antifragility is evolutionary, and operates at the informational level—genes are information. Unlike with hormesis, the unit does not get stronger in response to stress; it dies. But it accomplishes a transfer of benefits; other units survive—and those that survive have attributes that improve the collective of units, leading to modifications commonly assigned the vague term "evolution" in textbooks and in the *New York Times* Tuesday science section. So the antifragility of concern here is not so much that of the organisms, inherently weak, but rather that of their genetic code, which can survive them. The code doesn't really care about the welfare of the unit itself—quite the contrary, since it destroys many things around it. Robert Trivers figured out the presence of competition between gene and organism in his idea of the "selfish gene."

In fact, the most interesting aspect of evolution is that it only works because of its *antifragility;* it is in love with stressors, randomness, uncertainty, and disorder—while individual organisms are relatively fragile, the gene pool takes advantage of shocks to enhance its fitness.

So from this we can see that there is a tension between nature and individual organisms.

Everything alive or organic in nature has a finite life and dies eventually—even Methuselah lived less than a thousand years. But it usually dies after

reproducing offspring with a genetic code in one way or another different from that of the parents, with their information modified. Methuselah's genetic information is still present in Damascus, Jerusalem, and, of course, Brooklyn, New York. Nature does not find its members very helpful after their reproductive abilities are depleted (except perhaps special situations in which animals live in groups, such as the need for grandmothers in the human and elephant domains to assist others in preparing offspring to take charge). Nature prefers to let the game continue at the informational level, the genetic code. So organisms need to die for nature to be antifragile—nature is opportunistic, ruthless, and selfish.

Consider, as a thought experiment, the situation of an immortal organism, one that is built without an expiration date. To survive, it would need to be completely fit for all possible random events that can take place in the environment, all *future* random events. By some nasty property, a random event is, well, random. It does not advertise its arrival ahead of time, allowing the organism to prepare and make adjustments to sustain shocks. For an immortal organism, pre-adaptation for all such events would be a necessity. When a random event happens, it is already too late to react, so the organism should be prepared to withstand the shock, or say goodbye. We saw that our bodies overshoot a bit in response to stressors, but this remains highly insufficient; they still can't see the future. They can prepare for the next war, but not win it. Post-event adaptation, no matter how fast, would always be a bit late.[1]

To satisfy the conditions for such immortality, the organisms need to predict the future with perfection—near perfection is not enough. But by letting the organisms go one lifespan at a time, with modifications between successive generations, nature does not need to predict future conditions beyond the extremely vague idea of which direction things should be heading. Actually, even a vague direction is not necessary. Every random event will bring its own antidote in the form of ecological variation. It is as if nature changed itself at every step and modified its strategy every instant.

Consider this in terms of economic and institutional life. If nature ran the economy, it would not continuously bail out its living members to make them live forever. Nor would it have permanent administrations and forecasting departments that try to outsmart the future—it would not let the scam artists of the United States Office of Management and Budget make such mistakes of epistemic arrogance.

If one looks at history as a complex system similar to nature, then, like nature,

it won’t let a single empire dominate the planet forever—even if every superpower from the Babylonians to the Egyptians to the Persians to the Romans to modern America has believed in the permanence of its domination and managed to produce historians to theorize to that effect. Systems subjected to randomness—and unpredictability—build a mechanism beyond the robust to opportunistically reinvent themselves each generation, with a continuous change of population and species.

Black Swan Management 101: nature (and nature-like systems) likes diversity *between* organisms rather than diversity *within* an immortal organism, unless you consider nature itself the immortal organism, as in the pantheism of Spinoza or that present in Asian religions, or the Stoicism of Chrisippus or Epictetus. If you run into a historian of civilizations, try to explain it to him.

Let us look at how evolution benefits from randomness and volatility (in some dose, of course). The more noise and disturbances in the system, up to a point, barring those extreme shocks that lead to extinction of a species, the more the effect of the reproduction of the fittest and that of random mutations will play a role in defining the properties of the next generation. Say an organism produces ten offspring. If the environment is perfectly stable, all ten will be able to reproduce. But if there is instability, pushing aside five of these descendants (likely to be on average weaker than their surviving siblings), then those that evolution considers (on balance) the better ones will reproduce, making the gene undergo some fitness. Likewise, if there is variability among the offspring, thanks to occasional random spontaneous mutation, a sort of copying mistake in the genetic code, then the best should reproduce, increasing the fitness of the species. So evolution benefits from randomness by two different routes: randomness in the mutations, and randomness in the environment—both act in a similar way to cause changes in the traits of the surviving next generations.

Even when there is extinction of an entire species after some extreme event, no big deal, it is part of the game. This is still evolution at work, as those species that survive are fittest and take over from the lost dinosaurs—evolution is not about a species, but at the service of the whole of nature.

But note that evolution likes randomness only up to some limit.[2] If a calamity completely kills life on the entire planet, the fittest will not survive. Likewise, if random mutations occur at too high a rate, then the fitness gain might not stick, might perhaps even reverse thanks to a new mutation: as I will keep repeating, nature is antifragile *up to a point* but such point is quite high—it can take a lot, a lot of shocks. Should a nuclear event eradicate most of life on earth, but not all

life, some rat or bacteria will emerge out of nowhere, perhaps the bottom of the oceans, and the story will start again, without us, and without the members of the Office of Management and Budget, of course.

So, in a way, while hormesis corresponds to situations by which the individual organism benefits from direct harm to itself, evolution occurs when harm makes the individual organism perish and the benefits are transferred to others, the surviving ones, and future generations.

For an illustration of how families of organisms like *harm* in order to evolve (again, up to a point), though not the organisms themselves, consider the phenomenon of antibiotic resistance. The harder you try to harm bacteria, the stronger the survivors will be—unless you can manage to eradicate them completely. The same with cancer therapy: quite often cancer cells that manage to survive the toxicity of chemotherapy and radiation reproduce faster and take over the void made by the weaker cells.

Organisms Are Populations and Populations Are Organisms

The idea of viewing things in terms of populations, not individuals, with benefits to the latter stemming from harm to the former, came to me from the works on antifragility by the physicist turned geneticist Antoine Danchin.[3] For him, analysis needs to accommodate the fact that an organism is not something isolated and stand-alone: there are layerings and hierarchies. If you view things in terms of populations, you must transcend the terms "hormesis" and "Mithridatization" as a characterization of antifragility. Why? To rephrase the argument made earlier, hormesis is a metaphor for direct antifragility, when an organism directly benefits from harm; with evolution, something hierarchically superior to that organism benefits from the damage. From the outside, it looks like there is hormesis, but from the inside, there are winners and losers.

How does this layering operate? A tree has many branches, and these look like small trees; further, these large branches have many more smaller branches that sort of look like even smaller trees. This is a manifestation of what is called *fractal self-similarity,* a vision by the mathematician Benoît Mandelbrot. There is a similar hierarchy in things and we just see the top layer from the outside. The cell has a population of intercellular molecules; in turn the organism has a population of cells, and the species has a population of organisms. A strengthening mechanism for the species comes at the expense of some organisms; in turn the organism strengthens at the expense of some cells, all the

way down and all the way up as well.

For instance, if you drink a poisonous substance in small amounts, the mechanism by which your organism gets better is, according to Danchin, evolutionary *within* your system, with bad (and weak) proteins in the cells replaced by stronger—and younger—ones and the stronger ones being spared (or some similar operation). When you starve yourself of food, it is the bad proteins that are broken down first and recycled by your own body—a process called *autophagy*. This is a purely evolutionary process, one that selects and *kills* the weakest for fitness. But one does not need to accept the specific biological theory (like aging proteins and autophagy) to buy the general idea that survival pressures within the organism play a role in its overall improvement under external stress.

THANK YOU, ERRORS

Now we get into errors and how the errors of some people carry benefits for others.

We can simplify the relationships between fragility, errors, and antifragility as follows. When you are fragile, you depend on things following the exact planned course, with as little deviation as possible—for deviations are more harmful than helpful. This is why the fragile *needs* to be very predictive in its approach, and, conversely, predictive systems cause fragility. When you want deviations, and you don't care about the possible dispersion of outcomes that the future can bring, since most will be helpful, you are antifragile.

Further, the random element in trial and error is not quite random, if it is carried out rationally, using error as a source of information. If every trial provides you with information about what *does not* work, you start zooming in on a solution—so every attempt becomes more valuable, more like an expense than an error. And of course you make discoveries along the way.

Learning from the Mistakes of Others

But recall that this chapter is about layering, units, hierarchies, fractal structure, and the difference between the interest of a unit and those of its subunits. So it is often the mistakes of others that benefit the rest of us—and, sadly, not them. We saw that stressors are information, in the right context. For the antifragile, harm from errors should be less than the benefits. We are talking about some, not all, errors, of course; those that do not destroy a system help prevent larger calamities. The engineer and historian of engineering Henry Petroski presents a very elegant point. Had the *Titanic* not had that famous accident, as fatal as it was, we would have kept building larger and larger ocean liners and the next disaster would have been even more tragic. So the people who perished were sacrificed for the greater good; they unarguably saved more lives than were lost. The story of the *Titanic* illustrates the difference between gains for the system and harm to some of its individual parts.

The same can be said of the debacle of Fukushima: one can safely say that it made us aware of the problem with nuclear reactors (and small probabilities) and prevented larger catastrophes. (Note that the errors of naive stress testing and reliance on risk models were quite obvious at the time; as with the economic

crisis, nobody wanted to listen.)

Every plane crash brings us closer to safety, improves the system, and makes the next flight safer—those who perish contribute to the overall safety of others. Swiss flight 111, TWA flight 800, and Air France flight 447 allowed the improvement of the system. But these systems learn because they are antifragile and set up to exploit small errors; the same cannot be said of economic crashes, since the economic system is not antifragile the way it is presently built. Why? There are hundreds of thousands of plane flights every year, and a crash in one plane does not involve others, so errors remain confined and highly epistemic—whereas globalized economic systems operate as one: errors spread and compound.

Again, crucially, we are talking of partial, not general, mistakes, small, not severe and terminal ones. This creates a separation between good and bad systems. Good systems such as airlines are set up to have small errors, independent from each other—or, in effect, negatively correlated to each other, since mistakes lower the odds of future mistakes. This is one way to see how one environment can be antifragile (aviation) and the other fragile (modern economic life with "earth is flat" style interconnectedness).

If every plane crash makes the next one less likely, every bank crash makes the next one more likely. We need to eliminate the second type of error—the one that produces contagion—in our construction of an ideal socioeconomic system. Let us examine Mother Nature once again.

The natural was built from nonsystemic mistake to nonsystemic mistake: my errors lifting stones, when I am well calibrated, translate into small injuries that guide me the next time, as I try to avoid pain—after all, that's the purpose of pain. Leopards, who move like a true symphony of nature, are not instructed by personal trainers on the "proper form" to lift a deer up a tree. Human advice might work with artificial sports, like, say, tennis, bowling, or gun shooting, not with natural movements.

Some businesses love their *own* mistakes. Reinsurance companies, who focus on insuring catastrophic risks (and are used by insurance companies to "re-insure" such non-diversifiable risks), manage to do well *after* a calamity or tail event that causes them to take a hit. If they are still in business and "have their powder dry" (few manage to have plans for such contingency), they make it up by disproportionately raising premia—customers overreact and pay up for insurance. They claim to have no idea about fair value, that is, proper pricing, for reinsurance, but they certainly know that it is overpriced at times of stress, which

is sufficient to them to make a long-term shekel. All they need is to keep their mistakes small enough so they can survive them.

How to Become Mother Teresa

Variability causes mistakes and adaptations; it also allows you to know who your friends are. Both your failures and your successes will give you information. But, and this is one of the good things in life, sometimes you only know about someone's character after you harm them with an error for which you are solely responsible—I have been astonished at the generosity of some persons in the way they forgave me for my mistakes.

And of course you learn from the errors of others. You may never know what type of person someone is unless they are given opportunities to violate moral or ethical codes. I remember a classmate, a girl in high school who seemed nice and honest and part of my childhood group of anti-materialistic utopists. I learned that against my expectations (and her innocent looks) she didn't turn out to be Mother Teresa or Rosa Luxemburg, as she dumped her first (rich) husband for another, richer person, whom she dumped upon his first financial difficulties for yet another richer and more powerful (and generous) lover. In a nonvolatile environment I (and most probably she, too) would have mistaken her for a utopist and a saint. Some members of society—those who did not marry her—got valuable information while others, her victims, paid the price.

Further, my characterization of a loser is someone who, after making a mistake, doesn't introspect, doesn't exploit it, feels embarrassed and defensive rather than enriched with a new piece of information, and tries to explain why he made the mistake rather than moving on. These types often consider themselves the "victims" of some large plot, a bad boss, or bad weather.

Finally, a thought. He who has never sinned is less reliable than he who has only sinned once. And someone who has made plenty of errors—though never the same error more than once—is more reliable than someone who has never made any.

WHY THE AGGREGATE HATES THE INDIVIDUAL

We saw that antifragility in biology works thanks to layers. This rivalry between suborganisms contributes to evolution: cells within our bodies compete; within the cells, proteins compete, all the way through. Let us translate the point into human endeavors. The economy has an equivalent layering: individuals, artisans, small firms, departments within corporations, corporations, industries, the regional economy, and, finally, on top, the general economy—one can even have thinner slicing with a larger number of layers.

For the economy to be antifragile and undergo what is called evolution, every single individual business must *necessarily* be fragile, exposed to breaking—evolution needs organisms (or their genes) to die when supplanted by others, in order to achieve improvement, or to avoid reproduction when they are not as fit as someone else. Accordingly, the antifragility of the higher level may require the fragility—and sacrifice—of the lower one. Every time you use a coffeemaker for your morning cappuccino, you are benefiting from the fragility of the coffeemaking entrepreneur who failed. He failed in order to help put the superior merchandise on your kitchen counter.

Also consider traditional societies. There, too, we have a similar layering: individuals, immediate families, extended families, tribes, people using the same dialects, ethnicities, groups.

While sacrifice as a modus is obvious in the case of ant colonies, I am certain that individual businessmen are not overly interested in hara-kiri for the greater good of the economy; they are therefore necessarily concerned in seeking antifragility or at least some level of robustness for themselves. That's not necessarily compatible with the interest of the collective—that is, the economy. So there is a problem in which the property of the sum (the aggregate) varies from that of each one of the parts—in fact, it wants harm to the parts.

It is painful to think about ruthlessness as an engine of improvement.

Now what is the solution? There is none, alas, that can please everyone—but there are ways to mitigate the harm to the very weak.

The problem is graver than you think. People go to business school to learn how to do well while ensuring their survival—but what the economy, as a collective, wants them to do is to *not* survive, rather to take a lot, a lot of imprudent risks themselves and be blinded by the odds. Their respective industries improve from failure to failure. Natural and naturelike systems want

some overconfidence on the part of individual economic agents, i.e., the overestimation of their chances of success and underestimation of the risks of failure in their businesses, provided their failure does not impact others. In other words, they want local, but not global, overconfidence.

We saw that the restaurant business is wonderfully efficient precisely because restaurants, being vulnerable, go bankrupt every minute, and entrepreneurs ignore such a possibility, as they think that they will beat the odds. In other words, some class of rash, even suicidal, risk taking is healthy for the economy —under the condition that not all people take the same risks and that these risks remain small and localized.

Now, by disrupting the model, as we will see, with bailouts, governments typically favor a certain class of firms that are large enough to require being saved in order to avoid contagion to other business. This is the opposite of healthy risk-taking; it is *transferring fragility from the collective to the unfit*. People have difficulty realizing that the solution is building a system in which nobody's fall can drag others down—for continuous failures work to preserve the system. Paradoxically, many government interventions and social policies end up hurting the weak and consolidating the established.

WHAT DOES NOT KILL ME KILLS OTHERS

Time to debunk a myth.

As an advocate of antifragility I need to warn about the illusion of seeing it when it is not really there. We can mistake the antifragility of the system for that of the individual, when in fact it takes place *at the expense* of the individual (the difference between hormesis and selection).

Nietzsche's famous expression "what does not kill me makes me stronger" can be easily misinterpreted as meaning Mithridatization or hormesis. It may be one of these two phenomena, very possible, but it could as well mean "what did not kill me *did not* make me stronger, but spared me *because* I am stronger than others; but it killed others and the average population is now stronger because the weak are gone." In other words, I passed an exit exam. I've discussed the problem in earlier writings of the false illusion of causality, with a newspaper article saying that the new mafia members, former Soviet exiles, had been "hardened by a visit to the Gulag" (the Soviet concentration camps). Since the sojourn in the Gulag killed the weakest, one had the illusion of strengthening. Sometimes we see people having survived trials and imagine, given that the surviving population is sturdier than the original one, that these trials are good for them. In other words, the trial can just be a ruthless exam that kills those who fail. All we may be witnessing is that transfer of fragility (rather, antifragility) from the individual to the system that I discussed earlier. Let me present it in a different way. The surviving cohort, clearly, is stronger than the initial one—but not quite the individuals, since the weaker ones died.

Someone paid a price for the system to improve.

Me and Us

This visible tension between individual and collective interests is new in history: in the past it was dealt with by the near irrelevance of individuals. Sacrifice for the sake of the group is behind the notion of heroism: it is good for the tribe, bad for those who perish under the fever of war. This instinct for heroism and the fading of individual interests in favor of the communal has become aberrant with suicide bombers. These pre-death terrorists get into a mood similar to an ecstatic trance in which their emotions drive them to become indifferent to their own mortality. It is a fallacy that suicide bombers are driven by the promise of a

reward of some Islamic paradise with virgins and other entertainment, for, as the anthropologist Scott Atran has pointed out, the first suicide bombers in the Levant were revolutionaries of Greek Orthodox background—my tribe—not Islamists.

There is something like a switch in us that kills the individual in favor of the collective when people engage in communal dances, mass riots, or war. Your mood is now that of the herd. You are part of what Elias Canetti calls the *rhythmic and throbbing crowd*. You can also feel a different variety of crowd experience during your next street riot, when fear of authorities vanishes completely under group fever.

Let us now generalize the point. Looking at the world from a certain distance, I see a total tension between man and nature—a tension in the trade-off of fragilities. We saw how nature wants herself, the aggregate, to survive—not every species—just as, in turn, every single species wants its individuals to be fragile (particularly after reproduction), for evolutionary selection to take place. We saw how such transfer of fragility from individuals to species is necessary for its overall survival: species are potentially antifragile, given that DNA is information, but members of the species are perishable, hence ready to sacrifice and in reality designed to do so for the benefit of the collective.

Antifragility shmantifragility. Some of the ideas about fitness and selection here are not very comfortable to this author, which makes the writing of some sections rather painful—I detest the ruthlessness of selection, the inexorable disloyalty of Mother Nature. I detest the notion of improvement thanks to harm to others. As a humanist, I stand against the antifragility of systems at the expense of individuals, for if you follow the reasoning, this makes us humans individually irrelevant.

The great benefit of the Enlightenment has been to bring the individual to the fore, with his rights, his freedom, his independence, his “pursuit of happiness” (whatever that “happiness” means), and, most of all, his privacy. In spite of its denial of antifragility, the Enlightenment and the political systems that emerged from it freed us (somewhat) from the domination of society, the tribe, and the family that had prevailed throughout history.

The unit in traditional cultures is the collective; and it could be perceived to be harmed by the behavior of an individual—the honor of the family is sullied when, say, a daughter becomes pregnant, or a member of the family engages in large-scale financial swindles and Ponzi schemes, or, worst, may even teach a college course in the charlatanic subject of financial economics. And these

mores persist. Even as recently as the late nineteenth century or early twentieth, it was common in, say, rural France for someone to spend all his savings to erase the debts of a remote cousin (a practice called *passer l'éponge*, literally, to use a sponge to erase the liability from the chalkboard), and to do so in order to preserve the dignity and good name of the extended family. It was perceived as a duty. (I confess having done some of that myself in the twenty-first century!)

Clearly the system needs to be there for the individual to survive. So one needs to be careful in glorifying one interest against others in the presence of interdependence and complexity.[4]

In the Cosa Nostra, the Sicilian mafia, the designation "man of honor" (*uomo d'onore*) implies that the person caught by the police would remain silent and not rat on his friends, regardless of benefits, and that life in prison is preferable to a plea that entails hurting other members. The tribe (Cosa Nostra) comes before the individual. And what broke the back of the mafia was the recent generation of plea bargainers. (Note that "honor" in the mafia is limited to such in-group solidarity—they otherwise lie, and there is nothing honorable about them in other domains. And they kill people from behind, something that on the east side of the Mediterranean is considered the purest form of cowardice.)

Likewise, we humans may have to be self-centered at the expense of other species, at the risk of ecological fragility, if it insures our survival. Our interests —as a human race—prevail over those of nature; and we can tolerate some inefficiency, some fragility, in order to protect individuals, although sacrificing nature too much may eventually hurt ourselves.

We saw the trade-off between the interests of the collective and those of the individual. An economy cannot survive without breaking individual eggs; protection is harmful, and constraining the forces of evolution to benefit individuals does not seem required. But we can shield individuals from starvation, provide some social protection. And give them respect. Or more, as we see next.

National Entrepreneur Day

Meanwhile, if as a utopist (indeed), I hate what I am figuring out, I think that there is hope.

Heroism and the respect it commands is a form of compensation by society for those who take risks for others. And entrepreneurship is a risky and heroic activity, necessary for growth or even the mere survival of the economy.

It is also necessarily collective on epistemological grounds—to facilitate the development of expertise. Someone who did *not* find something is providing others with knowledge, the best knowledge, that of *absence* (what does not work)—yet he gets little or no credit for it. He is a central part of the process with incentives going to others and, what is worse, gets no respect.[5]

I am an ingrate toward the man whose overconfidence caused him to open a restaurant and fail, enjoying my nice meal while he is probably eating canned tuna.

In order to progress, modern society should be treating ruined entrepreneurs in the same way we honor dead soldiers, perhaps not with as much honor, but using exactly the same logic (the entrepreneur is still alive, though perhaps morally broken and socially stigmatized, particularly if he lives in Japan). For there is no such thing as a failed soldier, dead or alive (unless he acted in a cowardly manner)—likewise, there is no such thing as a failed entrepreneur or failed scientific researcher, any more than there is a successful babbler, philosophaster, commentator, consultant, lobbyist, or business school professor who does not take personal risks. (Sorry.)

Psychologists label "overconfidence" a disease, blinding people to the odds of success when engaging in ventures. But there is a difference between the benign, heroic type of risk taking that is beneficial to others, in the antifragile case, and the nastier modern type related to negative Black Swans, such as the overconfidence of "scientists" computing the risks of harm from the Fukushima reactor. In the case of the former, what they call overconfidence is a good thing, not something to medicate.

And compare entrepreneurs to the beancounting managers of companies who climb the ladder of hierarchy with hardly ever any real downside. Their cohort is rarely at risk.

What Erasmus called *ingratitudo vulgi*, the ingratitude of the masses, is increasing in the age of globalization and the Internet.

My dream—the solution—is that we would have a National Entrepreneur Day, with the following message:

> Most of you will fail, disrespected, impoverished, but we are grateful for the risks you are taking and the sacrifices you are making for the sake of the economic growth of the planet and pulling others out of poverty. *You are at the source of our antifragility*. Our nation thanks you.

[1] A technical comment on why the adaptability criterion is innocent of probability (the nontechnical reader should skip the rest of this note). The property in a stochastic process of not seeing at any time period *t* what would happen in time after *t*, that is, any period higher than *t*, hence reacting with a lag, an incompressible lag, is called *nonanticipative strategy*, a requirement of stochastic integration. The incompressibility of the lag is central and unavoidable. Organisms can only have nonanticipative strategies—hence nature can only be nonpredictive. This point is not trivial at all, and has even confused probabilists such as the Russian School represented by Stratonovich and the users of his method of integration, who fell into the common mental distortion of thinking that the future sends some signal detectable by us. We wish.

[2] Strong antifragility is when the love of volatility knows no bound—the gains have a remote limit or are truly unlimited—the sky is the limit. These can only exist in artificial, man-made life such as economic contracts and cultural products, not really in natural processes. More in the Appendix.

[3] He and his co-authors published in the journal *Genes* a paper on the idea of antifragility in biological systems. Interestingly, the article was in response to a draft of this book; in turn this book was modified in response to Danchin's article.

[4] Many people think at first that their own death is the worst Black Swan scenario. It is not. Unless they've studied too much modern economics, they would agree explicitly that their death *plus* the death of their loved ones *plus* the termination of humanity would be a vastly worse outcome than their own death. Recall my comment on complex systems. We are a mere part of a large chain, and we are worried about both ourselves and the system, as well as the preservation of parts of that large chain.

[5] A correspondent, Jean-Louis Rheault, wrote, "I have noticed that the more people glorify the entrepreneur as an abstraction, the more they will scorn an actual one they meet."

BOOK II

Modernity and the Denial of Antifragility

As in Baudelaire's sad poem about the albatross, what is made to fly will not do well trapped on the ground, where it is forced to traipse. And it is quite fitting that "volatility" comes from *volare,* "to fly" in Latin. Depriving political (and other) systems of volatility harms them, causing eventually greater volatility of the cascading type.

This section, Book II, deals with the fragility that comes from the denial of hormesis, the natural antifragility of organisms, and how we hurt systems with the very best of intentions by playing conductor. We are fragilizing social and economic systems by denying them stressors and randomness, putting them in the Procrustean bed of cushy and comfortable—but ultimately harmful—modernity.

Procrustes was an inn-keeper in Greek mythology who, in order to make the travelers fit in his bed, cut the limbs of those who were too tall and stretched those who were too short. But he had the bed fitting the visitor with total perfection.

As we saw in Chapter 3, treating an organism like a simple machine is a kind of simplification or approximation or reduction that is exactly like a Procrustean bed. It is often with the most noble intentions that we do so, as we are pressured to "fix" things, so we often blow them up with our fear of randomness and love of smoothness.[1]

Book II will also discuss the competition between man and natural forces, the craving of volatility by some antifragile systems, and how we make social, political (and other) systems vulnerable to Black Swans when we overstabilize them.

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[1] Where simplifications fail, causing the most damage, is when something nonlinear is simplified with the

linear as a substitute. That is the most common Procrustean bed.

CHAPTER 5

The Souk and the Office Building

The Reds and the Whites all go to Zurich—War is not a prison—The turkey's thwarted projects—Remember we are in Extremistan

TWO TYPES OF PROFESSIONS

Consider the fate of Ioannis (John) and Georgios (George), two identical twin brothers, born in Cyprus (both of them), currently both living in the Greater London area. John has been employed for twenty-five years as a clerk in the personnel department of a large bank, dealing with the relocation of employees around the globe. George is a taxi driver.

John has a perfectly predictable income (or so he thinks), with benefits, four weeks' annual vacation, and a gold watch every twenty-five years of employment. Every month, £3,082 is deposited in his local Nat West checking account. He spends a portion of it for the mortgage on his house west of London, the utilities, and feta cheese, and has a bit left for his savings. He used to wake up on Saturday morning, the day when people stretch and linger in bed, anxiety free, telling himself "life is good"—until the banking crisis, when he realized that his job could be "made redundant." Unemployment would seriously hit him hard. As a personnel expert, he has seen the implosions of long careers, with persons who, laid off at the age of fifty, never recovered.

George, who lives on the same street as his brother, drives a black taxi—meaning he has a license for which he spent three years expanding his frontal lobes by memorizing streets and itineraries in Greater London, which gives him the right to pick up clients in the streets. His income is extremely variable. Some days are "good," and he earns several hundred pounds; some are worse, when he does not even cover his costs; but, year after year, he averages about the same as his brother. To date, he has only had a single day in his twenty-five-year career without a fare. Because of the variability of his income, he keeps moaning that he does not have the job security of his brother—but in fact this is an illusion, for he has a bit more.

This is the central illusion in life: that randomness is risky, that it is a bad thing—and that eliminating randomness is done by eliminating randomness.

Artisans, say, taxi drivers, prostitutes (a very, very old profession), carpenters, plumbers, tailors, and dentists, have some volatility in their income but they are rather robust to a minor professional Black Swan, one that would bring their income to a complete halt. Their risks are visible. Not so with employees, who have no volatility, but can be surprised to see their income going to zero after a phone call from the personnel department. Employees' risks are hidden.

Thanks to variability, these artisanal careers harbor a bit of antifragility: small

variations make them adapt and change continuously by learning from the environment and being, sort of, continuously under pressure to be fit. Remember that stressors are information; these careers face a continuous supply of these stressors that make them adjust opportunistically. In addition, they are open to gifts and positive surprises, free options—the hallmark of antifragility, as we will see in Book IV. George was used to having, once in a while, a crazy request, one he was free to decline: during the Icelandic volcano scare, when U.K. air traffic was shut down, he was asked by a rich old lady to drive her to a wedding in the South of France—a two-thousand-mile round-trip journey. Likewise, a prostitute faces the small probability of seeing a severely infatuated rich client give her a very expensive diamond, or even an offer of matrimony, in what can be expected to be a short transitional period before her widowhood.

And George has the freedom to continue until he drops (many people continue to drive cabs into their eighties, mostly to kill time), since he is his own boss, compared to his brother, who is completely unhireable in his fifties.

The difference between the two volatilities in income applies to political systems—and, as we will see in the next two chapters, to about everything in life. Man-made smoothing of randomness produces the equivalent of John's income: smooth, steady, but fragile. Such income is more vulnerable to large shocks that can make it go to zero (plus some unemployment benefits if he resides in one of the few welfare states). Natural randomness presents itself more like George's income: smaller role for very large shocks, but daily variability. Further, such variability helps improve the system (hence the antifragility). A week with declining earnings for a taxi driver or a prostitute provides information concerning the environment and intimates the need to find a new part of town where clients hang around; a month or so without earnings drives them to revise their skills.

Further, for a self-employed person, a small (nonterminal) mistake is information, valuable information, one that directs him in his adaptive approach; for someone employed like John, a mistake is something that goes into his permanent record, filed in the personnel department. Yogi Berra once said: "We made the wrong mistake"—and for John all mistakes are wrong mistakes. Nature loves small errors (without which genetic variations are impossible), humans don't—hence when you rely on human judgment you are at the mercy of a mental bias that disfavors antifragility.

So, alas, we humans are afraid of the second type of variability and naively fragilize systems—or prevent their antifragility—by protecting them. In other

words, a point worth repeating every time it applies, this avoidance of small mistakes makes the large ones more severe.

The centralized state resembles the income of John; the city-state model that of George. John has one large employer, George many small ones—so he can select the ones that fit him the best and hence has, at any point in time, "more options." One has the illusion of stability, but is fragile; the other one the illusion of variability, but is robust and even antifragile.

The more variability you observe in a system, the less Black Swan–prone it is. Let us now examine how this applies to political systems with the story of Switzerland.

Lenin in Zurich

I was recently in a café-turned-expensive-restaurant in Zurich poring over the overpriced menu, with prices at least triple of those in a place of equivalent quality in the United States. The world's recent crisis had made Switzerland even more of a safe haven than it had ever been, causing its currency to rise dramatically—Switzerland is the most antifragile place on the planet; it benefits from shocks that take place in the rest of the world. The friend, a writer, pointed out to me that Lenin, who lived in town, used to play chess in the café with the Dadaist poet Tristan Tzara. Yes, the Russian revolutionary Vladimir Ilyich Ulyanov, later known as Lenin, spent some time in Switzerland concocting his project of the great top-down modernist state and largest human experiment in centralized state control. It hit me that there was something eerie in Lenin's presence there, for, a few days before, I had been at a conference in Montreux, on Lake Geneva, that took place in the same lakefront hotel where Vladimir Nabokov, the émigré Russian aristocrat and victim of Lenin, spent the last couple of decades of his life.

It seemed interesting to me that sheltering the reds and the whites, both the Bolsheviks and the aristocratic White Russians they later displaced, seems to be part of the primary business of the Helvetic Confederation. The main cities such as Zurich, Geneva, or Lausanne bear traces of the political refugees who went there for shelter: émigrés, from the Iranian royals thrown out by the Islamists to the latest African potentate executing "plan B." Even Voltaire spent some time hiding in the place, in Ferney, a French suburb of Geneva near the Swiss border (before it even joined the confederation). Voltaire, the perfectly protected gadfly, would rush to Ferney after insulting the king of France, the Catholic Church, or

some other authority—what people don't usually know about him is that he also had an incentive to seek protection there for financial reasons. Voltaire was a self-made man, a wealthy merchant, investor, and speculative dealer. Much of his wealth came from the antifragility of stressors, as he started building his fortune during his early exile.

So, like Voltaire, there are refugees of other types: financial refugees coming from places of turmoil, recognizable by their expensive and boring clothes, bland vocabulary, contrived decorum, and expensive (shiny) watches—in other words, non-Voltaires. Like many rich people, they feel entitled to laugh at their own jokes. These (dull) people are not looking for personal shelter: it is their assets that are seeking refuge. While some political persons might prefer to hide from the risks of their national regime in France or England, more exciting places on Saturday night, it is most certainly in Switzerland that their checking account wants to be. It is economically the most robust place on the planet—and has been so for quite a few centuries.

This great variety of people and their wallets are there, in Switzerland, for its shelter, safety, and stability. But all these refugees don't notice the obvious: the most stable country in the world *does not have* a government. And it is not stable in spite of not having a government; it is stable *because* it does not have one. Ask random Swiss citizens to name their president, and count the proportion of people who can do so—they can usually name the presidents of France or the United States but not their own. Its currency works best (at the time of writing it proved to be the safest), yet its central bank is tiny, even relative to its size.

Do these politicians biding their time before (they hope) returning to power notice such absence of government, accept that they are in Switzerland because of such absence of government, and adapt their ideas on nation-states and political systems accordingly? Not at all.

It is not quite true that the Swiss do not have a government. What they do not have is a large *central* government, or what the common discourse describes as "the" government—what governs them is entirely bottom-up, municipal of sorts, regional entities called cantons, near-sovereign mini-states united in a confederation. There is plenty of volatility, with enmities between residents that stay at the level of fights over water fountains or other such uninspiring debates. This is not necessarily pleasant, since neighbors are transformed into busybodies—this is a dictatorship from the bottom, not from the top, but a dictatorship nevertheless. But this bottom-up form of dictatorship provides protection against the romanticism of utopias, since no big ideas can be generated in such an

unintellectual atmosphere—it suffices to spend some time in cafés in the old section of Geneva, particularly on a Sunday afternoon, to understand that the process is highly unintellectual, devoid of any sense of the grandiose, even downright puny (there is a famous quip about how the greatest accomplishment of the Swiss was inventing the cuckoo clock while other nations produced great works—nice story except that the Swiss did not invent the cuckoo clock). But the system produces stability—boring stability—at every possible level.

Also note that the hideously glitzy scenes one encounters in Switzerland, in all of Geneva, in some parts of Zurich (the center), and particularly in the ski resorts such as Gstaadt and San Moritz are not the direct product of the country nor part of its mission, but the result of its success, as Switzerland acts as a magnet for the ugly rich and tax refugees.

Note for now that this is the last major country that is not a nation-state, but rather a collection of small municipalities left to their own devices.

BOTTOM-UP VARIATIONS

What I call bottom-up variations—or noise—is the type of political volatility that takes place within a municipality, the petty fights and frictions in the running of regular affairs. It is not scalable (or what is called *invariant* under scale transformation): in other words, if you increase the size, say, multiply the number of people in a community by a hundred, you will have markedly different dynamics. A large state does not behave at all like a gigantic municipality, much as a baby human does not resemble a smaller adult. The difference is qualitative: the increase in the number of persons in a given community alters the quality of the relationship between parties. Recall the nonlinearity description from the Prologue. If you multiply by ten the number of persons in a given entity, you do not preserve the properties: there is a transformation. Here conversations switch from the mundane—but effective—to abstract numbers, more interesting, more academic perhaps, but, alas, less effective.

A cluster of municipalities with charming provincial enmities, their own internal fights, and people out to get one another aggregates to a quite benign and stable state. Switzerland is similar to the income of the second brother, stable because of the variations and noise at the local level. Just as the income of the cab driver shows instability on a daily basis but annual stability, likewise Switzerland shows stability at the aggregate level, as the ensemble of cantons produces a solid system.

The way people handle local affairs is vastly different from the way they handle large, abstract public expenditures: we have traditionally lived in small units and tribes and managed rather well in small units.[1]

Further, biology plays a role in a municipal environment, not in a larger system. An administration is shielded from having to feel the sting of shame (with flushing in his face), a biological reaction to overspending and other failures such as killing people in Vietnam. Eye contact with one’s peers changes one’s behavior. But for a desk-grounded office leech, a number is a just a number. Someone you see in church Sunday morning would feel uncomfortable for his mistakes—and more responsible for them. On the small, local scale, his body and biological response would direct him to avoid causing harm to others. On a large scale, others are abstract items; given the lack of social contact with the people concerned, the civil servant’s brain leads rather than his emotions—

with numbers, spreadsheets, statistics, more spreadsheets, and theories.

When I expressed this idea to my co-author Mark Blyth, he blurted out the obvious: “Stalin could not have existed in a municipality.”

Small is beautiful in so many other ways. Take for now that the small (in the aggregate, that is, a collection of small units) is more antifragile than the large—in fact the large is doomed to breaking, a mathematical property we will explain later, that, sadly, seems universal as it applies to large corporations, very large mammals, and large administrations.[2]

There is another issue with the abstract state, a psychological one. We humans scorn what is not concrete. We are more easily swayed by a crying baby than by thousands of people dying elsewhere that do not make it to our living room through the TV set. The one case is a tragedy, the other a statistic. Our emotional energy is blind to probability. The media make things worse as they play on our infatuation with anecdotes, our thirst for the sensational, and they cause a great deal of unfairness that way. At the present time, one person is dying of diabetes every seven seconds, but the news can only talk about victims of hurricanes with houses flying in the air.

The problem is that by creating bureaucracies, we put civil servants in a position to make decisions based on abstract and theoretical matters, with the illusion that they will be making them in a rational, accountable way.

Also consider that lobbyists—this annoying race of lobbyists—cannot exist in a municipality or small region. The Europeans, thanks to the centralization of (some) power with the European Commission in Brussels, are quickly discovering the existence of these mutants coming to manipulate democracy for the sake of some large corporation. By influencing one single decision or regulation in Brussels, a single lobbyist gets a large bang. It is a much larger payoff (at low cost) than with municipalities, which would require armies of lobbyists trying to convince people while embedded in their communities.[3]

Consider, too, the other effect of scale: small corporations are less likely to have lobbyists.

The same bottom-up effect applies to law. The Italian political and legal philosopher Bruno Leoni has argued in favor of the robustness of judge-based law (owing to its diversity) as compared to explicit and rigid codifications. True, the choice of a court could be a lottery—but it helps prevent large-scale mistakes.

I use the example of Switzerland to show the natural antifragility of political systems and how stability is achieved by managing noise, having a mechanism

for letting it run its natural course, not by minimizing it.

Note another element of Switzerland: it is perhaps the most successful country in history, yet it has traditionally had a very low level of university education compared to the rest of the rich nations. Its system, even in banking during my days, was based on apprenticeship models, nearly vocational rather than the theoretical ones. In other words, on *techne* (crafts and know how), not *episteme* (book knowledge, know what).

AWAY FROM EXTREMISTAN

Let us now examine the technical aspects of the process, a more statistical view of the effect of human intervention on the volatility of affairs. There is a certain mathematical property to this bottom-up volatility, and to the volatility of natural systems. It generates the kind of randomness I call Mediocristan—plenty of variations that might be scary, but tend to cancel out in the aggregate (over time, or over the collection of municipalities that constitute the larger confederation or entity)—rather than the unruly one called Extremistan, in which you have mostly stability and occasionally large chaos—errors there have large consequences. One fluctuates, the other jumps. One has a lot of small variations, the other varies in lumps. Just like the income of the driver compared to that of bank employee. The two types of randomness are qualitatively distinct.

Mediocristan has a lot of variations, not a single one of which is extreme; Extremistan has few variations, but those that take place are extreme.

Another way to understand the difference: your caloric intake is from Mediocristan. If you add the calories you consume in a year, even without adjusting for your lies, not a single day will represent much of the total (say, more than 0.5 percent of the total, five thousand calories when you may consume eight hundred thousand in a year). So the exception, the rare event, plays an inconsequential role in the aggregate and the long-term. You cannot double your weight in a single day, not even a month, not possibly in a year—but you can double your net worth or lose half of it in a single moment.

By comparison, if you take the sale of novels, more than half of sales (and perhaps 90 percent of profits) tends to come from the top 0.1 percent, so the exception, the one-in-a-thousand event, is dominant there. So financial matters—and other economic matters—tend to be from Extremistan, just like history, which moves by discontinuities and jumps from one state to another.[4]

FIGURE 3. Municipal noise, distributed variations in the souks (first) compared to that of centralized or human-managed systems (second)—or, equivalently, the income of a taxi driver (first) and that of an employee (second). The second graph shows moves taking place from cascade to cascade, or Black Swan to Black Swan. Human overintervention to smooth or control processes causes a switch from one kind of system, Mediocristan, into another, Extremistan. This effect applies to all manner of systems with constrained volatility—health, politics, economics, even someone's mood with and without Prozac. Or the difference between the entrepreneur-driven Silicon Valley (first) and the banking system (second).

Figure 3 illustrates how antifragile systems are hurt when they are deprived of their natural variations (mostly thanks to naive intervention). Beyond municipal noise, the same logic applies to: the child who, after spending time in a sterilized environment, is left out in the open; a system with dictated political stability from the top; the effects of price controls; the advantages of size for a

corporation; *etc.* We switch from a system that produces steady but controllable volatility (Mediocristan), closer to the statistical "bell curve" (from the benign family of the Gaussian or Normal Distribution), into one that is highly unpredictable and moves mostly by jumps, called "fat tails." Fat tails—a synonym for Extremistan—mean that remote events, those in what is called the "tails," play a disproportionate role. One (first graph) is volatile; it fluctuates but does not sink. The other (second graph) sinks without significant fluctuations outside of episodes of turmoil. In the long run the second system will be far more volatile—but volatility comes in lumps. When we constrain the first system we tend to get the second outcome.

Note also that in Extremistan predictability is very low. In the second, pseudo-smooth kind of randomness, mistakes appear to be rare, but they will be large, often devastating when they occur. Actually, an argument we develop in Book IV, anything locked into planning tends to fail precisely because of these attributes—it is quite a myth that planning helps corporations: in fact we saw that the world is too random and unpredictable to base a policy on visibility of the future. What survives comes from the interplay of some fitness and environmental conditions.

The Great Turkey Problem

Let me now move back from the technical jargon and graphs of Fat Tails and Extremistan to colloquial Lebanese. In Extremistan, one is prone to be fooled by the properties of the past and get the story exactly backwards. It is easy, looking at what is happening in the second graph of Figure 3, before the big jump down, to believe that the system is now safe, particularly when the system has made a progressive switch from the "scary" type of visibly volatile randomness at left to the apparently safe right. It looks like a drop in volatility—and it is not.

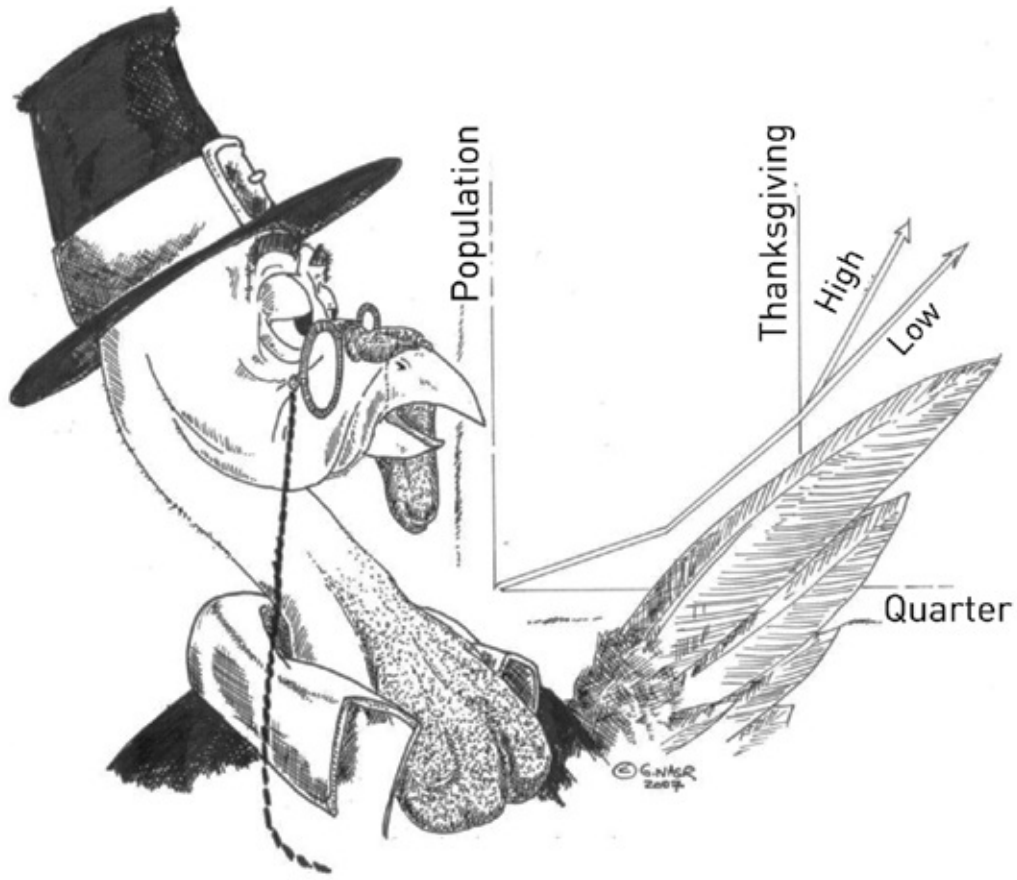

FIGURE 4. A turkey using "evidence"; unaware of Thanksgiving, it is making "rigorous" future projections based on the past. Credit: George Nasr

A turkey is fed for a thousand days by a butcher; every day confirms to its staff of analysts that butchers love turkeys "with increased statistical confidence." The butcher will keep feeding the turkey until a few days before Thanksgiving. Then comes that day when it is really not a very good idea to be a turkey. So with the butcher surprising it, the turkey will have a revision of belief —right when its confidence in the statement that *the butcher loves turkeys* is maximal and "it is very quiet" and soothingly predictable in the life of the turkey. This example builds on an adaptation of a metaphor by Bertrand Russell. The key here is that such a surprise will be a Black Swan event; but just for the turkey, not for the butcher.

We can also see from the turkey story the mother of all harmful mistakes: mistaking absence of evidence (of harm) for evidence of absence, a mistake that we will see tends to prevail in intellectual circles and one that is grounded in the social sciences.

So our mission in life becomes simply "how not to be a turkey," or, if

possible, how to be a turkey in reverse—antifragile, that is. “Not being a turkey” starts with figuring out the difference between true and manufactured stability.

The reader can easily imagine what happens when constrained, volatility-choked systems explode. We have a fitting example: the removal of the Baath Party, with the abrupt toppling of Saddam Hussein and his regime in 2003 by the United States. More than a hundred thousand persons died, and ten years later, the place is still a mess.

TWELVE THOUSAND YEARS

We started the discussion of the state with the example of Switzerland. Now let us go a little bit farther east.

The northern Levant, roughly today's northern part of Syria and Lebanon, stayed perhaps the most prosperous province in the history of mankind, over the long, very long stretch of time from the pre-pottery Neolithic until very modern history, the middle of the twentieth century. That's twelve thousand years—compared to, say, England, which has been prosperous for about five hundred years, or Scandinavia, now only prosperous for less than three hundred years. Few areas on the planet have managed to thrive with so much continuity over any protracted stretch of time, what historians call *longue durée*. Other cities came and went; Aleppo, Emesa (today Homs), and Laodicea (Lattakia) stayed relatively affluent.

The northern Levant was since ancient times dominated by traders, largely owing to its position as a central spot on the Silk Road, and by agricultural lords, as the province supplied wheat to much of the Mediterranean world, particularly Rome. The area supplied a few Roman emperors, a few Catholic popes before the schisms, and more than thirty Greek language writers and philosophers (which includes many of the heads of Plato's academy), in addition to the ancestors of the American visionary and computer entrepreneur Steve Jobs, who brought us the Apple computer, on one of which I am recopying these lines (and the iPad tablet, on which you may be reading them). We know of the autonomy of the province from the records during Roman days, as it was then managed by the local elites, a decentralized method of ruling through locals that the Ottoman retained. Cities minted their own coins.

Then two events took place. First, after the Great War, one part of the northern Levant was integrated into the newly created nation of Syria, separated from its other section, now part of Lebanon. The entire area had been until then part of the Ottoman Empire, but functioned as somewhat autonomous regions—Ottomans, like the Romans before them, let local elites run the place so long as sufficient tax was paid, while they focused on their business of war. The Ottoman type of imperial peace, the *pax Ottomana*, like its predecessor the *pax Romana*, was good for commerce. Contracts were enforced, and that is what governments are needed for the most. In the recent nostalgic book *Levant*, Philip Mansel documents how the cities of the Eastern Mediterranean operated as city-

states separated from the hinterland.

Then, a few decades into the life of Syria, the modernist Baath Party came to further enforce utopias. As soon as the Baathists centralized the place and enforced their statist laws, Aleppo and Emesa went into instant decline.

What the Baath Party did, in its "modernization" program, was to remove the archaic mess of the souks and replace them with the crisp modernism of the office building.

The effect was immediately visible: overnight the trading families moved to places such as New York and New Jersey (for the Jews), California (for the Armenians), and Beirut (for the Christians). Beirut offered a commerce-friendly atmosphere, and Lebanon was a benign, smaller, disorganized state without any real central government. Lebanon was small enough to be a municipality on its own: it was smaller than a medium-size metropolitan area.

War, Prison, or Both

But while Lebanon had all the right qualities, the state was *too* loose, and by allowing the various Palestinian factions and the Christian militias to own weapons, it caused an arms race between the communities while placidly watching the entire buildup. There was also an imbalance between communities, with the Christians trying to impose their identity on the place. Disorganized is invigorating; but the Lebanese state was one step too disorganized. It would be like allowing each of the New York mafia bosses to have a larger army than the Joint Chiefs of Staff (just imagine John Gotti with missiles). So in 1975 a raging civil war started in Lebanon.

A sentence that still shocks me when I think about it was voiced by one of my grandfather's friends, a wealthy Aleppine merchant who fled the Baath regime. When my grandfather asked his friend during the Lebanese war why he did not go back to Aleppo, his answer was categorical: "We people of Aleppo prefer war to prison." I thought that he meant that they were going to put him in jail, but then I realized that by "prison" he meant the loss of political and economic freedoms.

Economic life, too, seems to prefer war to prison. Lebanon and Northern Syria had very similar wealth per individual (what economists call Gross Domestic Product) about a century ago—and had identical cultures, language, ethnicities, food, and even jokes. Everything was the same except for the rule of the "modernizing" Baath Party in Syria compared to the totally benign state in

Lebanon. In spite of a civil war that decimated the population, causing an acute brain drain and setting wealth back by several decades, in addition to every possible form of chaos that rocked the place, today Lebanon has a considerably higher standard of living—between three and six times the wealth of Syria.

Nor did the point escape Machiavelli. Jean-Jacques Rousseau wrote, citing him: “It seemed, wrote Machiavelli, that in the midst of murders and civil wars, our republic became stronger [and] its citizens infused with virtues.… A little bit of agitation gives resources to souls and what makes the species prosper isn’t peace, but freedom.”

Pax Romana

The centralized nation-state is not exactly new in history. In fact, it existed in a nearly identical form in ancient Egypt. But this was an isolated event in history, and it did not survive there for long: the Egyptian high state started collapsing upon contact with the crazy unruly barbaric disorganized harassing invaders coming from Asia Minor with their assault chariots, literally a killer app.

The dynasties of ancient Egypt did not run the place like an empire but like an integrated state, which is markedly different—as we saw, it produces different types of variations. Nation-states rely on centralized bureaucracy, whereas empires, such as the Roman empire and Ottoman dynasties, have relied on local elites, in fact allowing the city-states to prosper and conserve some effective autonomy—and, what was great for peace, such autonomy was commercial, not military. In reality, the Ottomans did these vassals and suzerains a favor by preventing them from involvement in warfare—this took away militaristic temptations and helped them thrive; regardless of how iniquitous the system seemed to be on the surface, it allowed locals to focus on commerce rather than war. It protected them from themselves. This is the argument brought by David Hume in his *History of England* in favor of small states, as large states get tempted by warfare.

Clearly neither the Romans nor the Ottomans were allowing local autonomy out of love of freedom on the part of others; they just did it for convenience. A combination of empire (for some affairs) and semi-independent regions (left alone for their own business) provides more stability than the middle: the centralized nation-state with flags and discrete borders.

But the states, even when centralized, as in Egypt or China, were, in practice, not too different from the Roman and Ottoman ones—except for the

centralization of intellect with the scribes and the mandarinate system establishing a monopoly of knowledge. Some of us may remember that there were days with no Internet, no electronic monitoring of wire transfers to supervise tax receipts. And before modernity's communication networks, with the telegraph, the train, and, later, the telephone, states had to rely on messenger services. So a local provincial ruler was king for a large number of matters, even though he was not so nominally. Until recent history, the central state represented about 5 percent of the economy—compared to about ten times that share in modern Europe. And, further, governments were sufficiently distracted by war to leave economic affairs to businessmen.[5]

War or No War

Let us take a look at Europe before the creations of the nation-states of Germany and Italy (marketed as "re-unification," as if these nations had been crisp units in some romantic past). There was, until the creation of these romantic entities, a fissiparous and amorphous mass of small statelings and city-states in constant tension—but shifting alliances. In most of their history, Genoa and Venice were competing for the Eastern and Southern Mediterranean like two hookers battling for a sidewalk. And here is something comforting about statelings at war: mediocrity cannot handle more than one enemy, so war here turns into an alliance there. Tension was always present somewhere but without large consequences, like precipitation in the British Isles; mild rain and no floods are vastly more manageable than the opposite: long droughts followed by intense rainfall. In other words, Mediocristan.

Then of course the contagious creation of nation-states in the late nineteenth century led to what we saw with the two world wars and their sequels: more than sixty million (and possibly eighty million) victims. The difference between war and *no war* became huge, with marked discontinuity. This is no different from a switch to "winner take all" effects in industry, the domination of rare events. A collection of statelings is similar to the restaurant business we discussed earlier: volatile, but you never have a generalized restaurant crisis—unlike, say, the banking business. Why? Because it is composed of a lot of independent and competing small units that do not individually threaten the system and make it jump from one state to another. Randomness is distributed rather than concentrated.

Some people have fallen for the naive turkey-style belief that the world is

getting safer and safer, and of course they naively attribute it to the holy "state" (though bottom-up Switzerland has about the lowest rate of violence of any place on the planet). It is exactly like saying that nuclear bombs are safer because they explode less often. The world is subjected to fewer and fewer acts of violence, while wars have the potential to be more criminal. We were very close to the mother of all catastrophes in the 1960s when the United States was about to pull the nuclear trigger on the Soviet Union. Very close. When we look at risks in Extremistan, we don't look at evidence (evidence comes too late), we look at potential damage: never has the world been more prone to more damage; never.[6] It is hard to explain to naive data-driven people that risk is in the future, not in the past.

The messy multi-ethnic empire, the so-called Austro-Hungarian Empire, vanished after the great war, along with its Ottoman neighbor and rival (and, to a large extent, sibling—don't tell them), to be replaced with crisp, clean nation-states. The Ottoman Empire with its messy nationalities—or, rather, what was left of it—became the state of Turkey, modeled after Switzerland, with nobody noticing the inconsistency. Vienna became trapped in Austria, with whom it shared very little outside the formal language. Imagine moving New York City to central Texas and still calling it New York. Stefan Zweig, the Viennese Jewish novelist, then considered the most influential author in the world, expressed his pain in the poignant memoir *The World of Yesterday*. Vienna joined the league of multicultural cities such as Alexandria, Smyrna, Aleppo, Prague, Thessaloniki, Constantinople (now Istanbul), and Trieste, now squeezed into the Procrustean bed of the nation-state, with its citizens left in the grip of intergenerational nostalgia. Unable to handle the loss and integrate elsewhere, Zweig later committed suicide in Brazil. I first read his account as I was put in a similar situation of physical and cultural exile when my Levantine Christian world was shattered by the Lebanese war, and I wondered whether he might have stayed alive had he gone to New York instead.

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[1] I bypass here the economic argument as to whether autonomous city-states were invigorated with economic energy (as Henri Pirenne or Max Weber advocated, in a sort of romantic way); my (mathematical) point is that a collection of small units with semi-independent variations produces vastly different risk characteristics than a single large unit.

[2] It is quite distressing to hear debates about political systems that make comparisons between countries when the size of the entities is not the same—say, comparing Singapore to Malaysia. The size of the unit may matter more than the system.

[3] Thankfully, the European Union is legally protected from overcentralization thanks to the principle of

subsidiarity: things should be handled by the smallest possible unit that can manage them with efficacy. The idea was inherited from the Catholic Church: philosophically, a unit doesn't need to be very large (the state) nor very small (the individual), but somewhere in between. This is a powerful philosophical statement, particularly in light of both the transfers of fragility we saw in Chapter 4 and the notion that size fragilizes, much on which later.

4 When randomness gets distributed across a large number of small units, along with small recurrent political disorder, we get the first type, the benign Mediocristan. When randomness concentrates, we get the second type, the sneaky Extremistan.

5 Note that people invoke an expression, "Balkanization," about the mess created by fragmented states, as if fragmentation was a bad thing, and as if there was an alternative in the Balkans—but nobody uses "Helvetization" to describe its successes.

6 A more rigorous reading of the data—with appropriate adjustment for the unseen—shows that a war that would decimate the planet would be completely consistent with the statistics, and would not even be an "outlier." As we will see, Ben Bernanke was similarly fooled with his *Great Moderation*, a turkey problem; one can be confused by the properties of any process with compressed volatility from the top. Some people, like Steven Pinker, misread the nature of the statistical process and hold such a thesis, similar to the "great moderation" in finance.

CHAPTER 6

Tell Them I Love (Some) Randomness

Maxwell in Extremistan—Complicated mechanisms to feed a donkey—Virgil said to do it, and do it now

The point of the previous chapter was that the risk properties of the first brother (the fragile bank employee) are vastly different from those of the second one (the comparatively antifragile artisan taxi driver). Likewise, the risk characteristic of a centralized system is different from that of a messy municipally-led confederation. The second type is stable in the long run *because* of *some* dose of volatility.

A scientific argument showing how tight controls backfire and cause blowups was made by James Clerk Maxwell of electromagnetic theory fame. "Governors" are contraptions meant to control the speed of steam engines by compensating for abrupt variations. They aimed at stabilizing the engines, and they apparently did, but they paradoxically sometimes brought about capricious behavior and crashes. Light control works; close control leads to overreaction, sometimes causing the machinery to break into pieces. In a famous paper "On Governors," published in 1867, Maxwell modeled the behavior and showed mathematically that tightly controlling the speed of engines leads to instability.

It is remarkable how Maxwell's neat mathematical derivations and the dangers of tight control can be generalized across domains and help debunk pseudo-stabilization and hidden long-term fragility.[1] In the markets, fixing prices, or, equivalently, eliminating speculators, the so-called "noise traders"—and the moderate volatility that they bring—provide an illusion of stability, with periods of calm punctuated with large jumps. Because players are unused to volatility, the slightest price variation will then be attributed to insider information, or to changes in the state of the system, and will cause panics.

When a currency never varies, a slight, very slight move makes people believe that the world is ending. Injecting some confusion stabilizes the system.

Indeed, confusing people a little bit is beneficial—it is good for you and good for them. For an application of the point in daily life, imagine someone extremely punctual and predictable who comes home at exactly six o'clock every day for fifteen years. You can use his arrival to set your watch. The fellow will cause his family anxiety if he is barely a few minutes late. Someone with a slightly more volatile—hence unpredictable—schedule, with, say, a half-hour variation, won't do so.

Variations also act as purges. Small forest fires periodically cleanse the system of the most flammable material, so this does not have the opportunity to accumulate. Systematically preventing forest fires from taking place "to be safe" makes the big one much worse. For similar reasons, stability is not good for the economy: firms become very weak during long periods of steady prosperity devoid of setbacks, and hidden vulnerabilities accumulate silently under the surface—so delaying crises is not a very good idea. Likewise, absence of fluctuations in the market causes hidden risks to accumulate with impunity. The longer one goes without a market trauma, the worse the damage when commotion occurs.

This adverse effect of stability is straightforward to model scientifically, but when I became a trader, I was told of a heuristic used by veterans, and only old seasoned veterans: when a market reaches a "new low," that is, drops to a level not seen in a long time, there is "a lot of blood" to come, with people rushing to the exit. Some people unused to losing shekels will be experiencing a large loss and will incur distress. If such a low market level has not been seen in years, say two years, it will be called "a two-year low" and will cause more damage than a one-year low. Tellingly, they call it a "cleanup," getting the "weak hands" out of the way. A "weak hand" is clearly someone who is fragile but doesn't know it and is lulled by a false sense of security. When many such weak hands rush to the door, they collectively cause crashes. A volatile market doesn't let people go such a long time without a "cleanup" of risks, thereby preventing such market collapses.

Fluctuat nec mergitur (fluctuates, or floats, but does not sink) goes the Latin saying.

HUNGRY DONKEYS

So far we have argued that preventing randomness in an antifragile system is not always a good idea. Let us now look at the situation in which *adding* randomness has been a standard operating method, as the needed fuel for an antifragile system permanently hungry for it.

A donkey equally famished and thirsty caught at an equal distance between food and water would unavoidably die of hunger or thirst. But he can be saved thanks to a random nudge one way or the other. This metaphor is named Buridan's Donkey, after the medieval philosopher Jean de Buridan, who—among other, very complicated things—introduced the thought experiment. When some systems are stuck in a dangerous impasse, randomness and only randomness can unlock them and set them free. You can see here that absence of randomness equals guaranteed death.

The idea of injecting random noise into a system to improve its functioning has been applied across fields. By a mechanism called *stochastic resonance*, adding random noise to the background makes you hear the sounds (say, music) with more accuracy. We saw earlier that the psychological effect of overcompensation helps us get signals in the midst of noise; here it is not psychological but a physical property of the system. Weak SOS signals, too weak to get picked up by remote receptors, can become audible in the presence of background noise and random interference. By adding to the signal, random hiss allows it to rise sufficiently above the threshold of detection to become audible—nothing in that situation does better than randomness, which comes for free.

Consider the method of annealing in metallurgy, a technique used to make metal stronger and more homogeneous. It involves the heating and controlled cooling of a material, to increase the size of the crystals and reduce their defects. Just as with Buridan's donkey, the heat causes the atoms to become unstuck from their initial positions and wander randomly through states of higher energy; the cooling gives them more chances of finding new, better configurations.

As a child I was exposed to a version of this annealing effect by watching my father, who was a man of habits, tap a wooden barometer every day upon coming home. He would gently strike the barometer, then get a reading for his homemade weather forecast. The stress on the barometer got the needle unstuck and allowed it to find its true equilibrium position. That's a local brand of

antifragility. Inspired by the metallurgical technique, mathematicians use a method of computer simulation called *simulated annealing* to bring more general optimal solutions to problems and situations, solutions that only randomness can deliver.

Randomness works well in search—sometimes better than humans. Nathan Myhrvold brought to my attention a controversial 1975 paper published in *Science* showing that random drilling was superior to whatever search method was being employed at the time.

And, ironically, the so-called chaotic systems, those experiencing a brand of variations called *chaos,* can be stabilized by adding randomness to them. I watched an eerie demonstration of the effects, presented by a doctoral student who first got balls to jump chaotically on a table in response to steady vibrations on the surface. These steady shocks made the balls jump in a jumbled and inelegant manner. Then, as by magic, he moved a switch and the jumps became orderly and smooth. The magic is that such change of regime, from chaos to order, did not take place by removing chaos, but by adding random, completely random but low-intensity shocks. I came out of the beautiful experiment with so much enthusiasm that I wanted to inform strangers on the street, "I love randomness!"

Political Annealing

It has been hard to explain to real people that stressors and uncertainty have their role in life—so you can imagine what it would be like to explain it to politicians. Yet this is where a certain dose of randomness is needed the most.

I was once shown the script of a film based on a parable of a city completely ruled by randomness—very Borgesian. At set intervals, the ruler randomly assigns to the denizens a new role in the city. Say the butcher would now become a baker, and the baker a prisoner, *etc.* At the end, people end up rebelling against the ruler, asking for stability as their inalienable right.

I immediately thought that perhaps the opposite parable should be written: instead of having the rulers randomize the jobs of citizens, we should have citizens randomize the jobs of rulers, naming them by raffles and removing them at random as well. That is similar to simulated annealing—and it happens to be no less effective. It turned out that the ancients—again, those ancients!—were aware of it: the members of the Athenian assemblies were chosen by lot, a method meant to protect the system from degeneracy. Luckily, this effect has

been investigated with modern political systems. In a computer simulation, Alessandro Pluchino and his colleagues showed how adding a certain number of randomly selected politicians to the process can improve the functioning of the parliamentary system.

Or sometimes the system benefits from a different type of stressor. For Voltaire, the best form of government was the one tempered with political assassination. Regicide is sort of the equivalent of tapping on the barometer to make it work better. That, too, creates some often-needed reshuffling, and one that would never have been done voluntarily. The void created at the top allows the annealing effect, causing the new leader to emerge. The secular drop in premature deaths in society has deprived us of a naturalistic managerial turnover. Murder is the standard procedure for succession in the mafia (the last publicized annealing was when John Gotti murdered his predecessor in front of a New York steakhouse to become the capo of the family). Outside the mafia, bosses and board members now stay longer, a fact that impedes many domains: CEOs, tenured academics, politicians, journalists—and we need to offset this condition with random lotteries.

Unfortunately, you cannot randomize a political party out of existence. What is plaguing us in the United States is not the two-party system, but being stuck with the *same* two parties. Parties don't have organic built-in expiration dates.

Finally the ancients perfected the method of random draw in more or less difficult situations—and integrated it into divinations. These draws were really meant to pick a random exit without having to make a decision, so one would not have to live with the burden of the consequences later. You went with what the gods told you to do, so you would not have to second-guess yourself later. One of the methods, called *sortes virgilianae* (fate as decided by the epic poet Virgil), involved opening Virgil's *Aeneid* at random and interpreting the line that presented itself as direction for the course of action. You should use such method for every sticky business decision. I will repeat until I get hoarse: the ancients evolved hidden and sophisticated ways and tricks to exploit randomness. For instance, I actually practice such randomizing heuristic in restaurants. Given the lengthening and complication of menus, subjecting me to what psychologists call the *tyranny of choice*, with the stinging feeling after my decision that I should have ordered something else, I blindly and systematically duplicate the selection by the most overweight male at the table; and when no such person is present, I randomly pick from the menu without reading the name of the item, under the peace of mind that Baal made the choice for me.

THAT TIME BOMB CALLED STABILITY

We saw that absence of fire lets highly flammable material accumulate. People are shocked and outraged when I tell them that absence of political instability, even war, lets explosive material and tendencies accumulate under the surface.

The Second Step: Do (Small) Wars Save Lives?

The anti-Enlightenment political philosopher Joseph de Maistre remarked that conflicts strengthen countries. This is highly debatable—war is not a good thing, and, as the victim of a brutal civil war, I can attest to its horrors. But what I find interesting—and elegant—in his reasoning is his pointing out the mistake of analyzing losses from a given event and ignoring the rest of the story. It is also interesting that people tend to grasp the opposite more easily, that is, spot the error of analyzing immediate gains without taking into account the long-term side effects. For we look at casualties as losses without taking into account the second step, what happens later—unlike gardeners, who understand rather well that pruning trees strengthens them.

Likewise peace—some kind of forced, constrained, non-natural peace—may be costly in lives: just consider the great complacency that led to the Great War after almost a century of relative peace in Europe, coupled with the rise of the heavily armed nation-state.

Again, we all love peace and we all love economic and emotional stability—but do not want to be suckers in the long term. We seek vaccination at every new school year (injecting ourselves with a bit of harm to build immunity) but fail to transfer the mechanism to political and economic domains.

What to Tell the Foreign Policy Makers

To summarize, the problem with artificially suppressed volatility is not just that the system tends to become extremely fragile; it is that, at the same time, it exhibits no *visible* risks. Also remember that volatility is information. In fact, these systems tend to be too calm and exhibit minimal variability as silent risks accumulate beneath the surface. Although the stated intention of political leaders and economic policy makers is to stabilize the system by inhibiting fluctuations, the result tends to be the opposite. These artificially constrained systems become prone to Black Swans. Such environments eventually experience massive

blowups, of the type seen in Figure 3, catching everyone off guard and undoing years of stability or, in almost all cases, ending up far worse than they were in their initial volatile state. Indeed, the longer it takes for the blowup to occur, the worse the resulting harm to both economic and political systems.

Seeking stability by achieving stability (and forgetting the second step) has been a great sucker game for economic and foreign policies. The list is depressingly long. Take rotten governments like the one in Egypt before the riots of 2011, supported by the United States for four decades in order "to avoid chaos," with the side effect of a coterie of privileged pillagers using superpowers as a backstop—identical to bankers using their "too big to fail" status to scam taxpayers and pay themselves high bonuses.

Saudi Arabia is the country that at present worries and offends me the most; it is a standard case of top-down stability enforced by a superpower at the expense of every single possible moral and ethical metric—and, of course, at the expense of stability itself.

So a place "allied" to the United States is a total monarchy, devoid of a constitution. But that is not what is morally shocking. A group of between seven and fifteen thousand members of the royal family runs the place, leading a lavish, hedonistic lifestyle in open contradiction with the purist ideas that got them there. Look at the contradiction: the stern desert tribes whose legitimacy is derived from Amish-like austerity can, thanks to a superpower, turn to hedonistic uninhibited pleasure seeking—the king openly travels for pleasure with a retinue that fills four Jumbo jets. Quite a departure from his ancestors. The family members amassed a fortune now largely in Western safes. Without the United States, the country would have had its revolution, a regional breakup, some turmoil, then perhaps—by now—some stability. But preventing noise makes the problem worse in the long run.

Clearly the "alliance" between the Saudi royal family and the United States was meant to provide stability. What stability? How long can one confuse the system? Actually "how long" is irrelevant: this stability is similar to a loan one has to eventually pay back. And there are ethical issues I leave to Chapter 24, particularly casuistry, when someone finds a justification "for the sake of" to violate an otherwise inflexible moral rule.[2] Few people are aware of the fact that the bitterness of Iranians toward the United States comes from the fact that the United States—a democracy—installed a monarch, the repressive Shah of Iran, who pillaged the place but gave the United States the "stability" of access to the Persian Gulf. The theocratic regime in Iran today is largely the result of such

repression. We need to learn to think in second steps, chains of consequences, and side effects.

More worrisome, U.S. policy toward the Middle East has historically, and especially since September 11, 2001, been unduly focused on the repression of any and all political fluctuations in the name of preventing "Islamic fundamentalism"—a trope that almost every regime has used. Aside from the fact that killing Islamists compounds their numbers, the West and its autocratic Arab allies have strengthened Islamic fundamentalists by forcing them underground.

Time for American policy makers to understand that the more they intervene in other countries for the sake of stability, the more they bring instability (except for emergency-room-style cases). Or perhaps time to reduce the role of policy makers in policy affairs.

One of life's packages: no stability without volatility.

WHAT DO WE CALL HERE MODERNITY?

My definition of modernity is humans' large-scale domination of the environment, the systematic smoothing of the world's jaggedness, and the stifling of volatility and stressors.

Modernity corresponds to the systematic extraction of humans from their randomness-laden ecology—physical and social, even epistemological. Modernity is not just the postmedieval, postagrarian, and postfeudal historical period as defined in sociology textbooks. It is rather the spirit of an age marked by rationalization (naive rationalism), the idea that society is understandable, hence must be designed, by humans. With it was born statistical theory, hence the beastly bell curve. So was linear science. So was the notion of "efficiency"—or optimization.

Modernity is a Procrustean bed, good or bad—a reduction of humans to what appears to be efficient and useful. Some aspects of it work: Procrustean beds are not all negative reductions. Some may be beneficial, though these are rare.

Consider the life of the lion in the comfort and predictability of the Bronx Zoo (with Sunday afternoon visitors flocking to look at him in a combination of curiosity, awe, and pity) compared to that of his cousins in freedom. We, at some point, had free-range humans and free-range children before the advent of the golden period of the soccer mom.

We are moving into a phase of modernity marked by the lobbyist, the very, very limited liability corporation, the MBA, sucker problems, secularization (or rather reinvention of new sacred values like flags to replace altars), the tax man, fear of the boss, spending the weekend in interesting places and the workweek in a putatively less interesting one, the separation of "work" and "leisure" (though the two would look identical to someone from a wiser era), the retirement plan, argumentative intellectuals who would disagree with this definition of modernity, literal thinking, inductive inference, philosophy of science, the invention of social science, smooth surfaces, and egocentric architects. Violence is transferred from individuals to states. So is financial indiscipline. At the center of all this is the denial of antifragility.

There is a dependence on narratives, an intellectualization of actions and ventures. Public enterprises and functionaries—even employees of large corporations—can only do things that seem to fit some narrative, unlike businesses that can just follow profits, with or without a good-sounding story.

Remember that you need a name for the color blue when you build a narrative, but not in action—the thinker lacking a word for "blue" is handicapped; not the doer. (I've had a hard time conveying to intellectuals the *intellectual* superiority of practice.)

Modernity widened the difference between the sensational and the relevant—in a natural environment the sensational is, well, sensational for a reason; today we depend on the press for such essentially human things as gossip and anecdotes and we care about the private lives of people in very remote places.

Indeed, in the past, when we were not fully aware of antifragility and self-organization and spontaneous healing, we managed to respect these properties by constructing beliefs that served the purpose of managing and surviving uncertainty. We imparted improvements to the agency of god(s). We may have denied that things can take care of themselves without some agency. But it was the gods that were the agents, not Harvard-educated captains of the ship.

So the emergence of the nation-state falls squarely into this pro-gression—the transfer of agency to mere humans. The story of the nation-state is that of the concentration and magnification of human errors. Modernity starts with the state monopoly on violence, and ends with the state's monopoly on fiscal irresponsibility.

We will discuss next two central elements at the core of modernity. Primo, in Chapter 7, naive interventionism, with the costs associated with fixing things that one should leave alone. Secundo, in Chapter 8 and as a transition to Book III, this idea of replacing God and the gods running future events with something even more religiously fundamentalist: the unconditional belief in the idea of scientific prediction regardless of the domain, the aim to squeeze the future into numerical reductions whether reliable or unreliable. For we have managed to transfer religious belief into gullibility for whatever can masquerade as science.

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[1] The financier George Cooper has revived the argument in *The Origin of Financial Crises*—the argument is so crisp that an old trader friend, Peter Nielsen, has distributed it to every person he knows.

[2] Note these double standards on the part of Western governments. As a Christian, parts of Saudi Arabia are off-limits to me, as I would violate the purity of the place. But no public part of the United States or Western Europe is off-limits to Saudi citizens.

CHAPTER 7

Naive Intervention

A tonsillectomy to kill time—Never do today what can be left to tomorrow—Let's predict revolutions after they happen—Lessons in blackjack

Consider this need to "do something" through an illustrative example. In the 1930s, 389 children were presented to New York City doctors; 174 of them were recommended tonsillectomies. The remaining 215 children were again presented to doctors, and 99 were said to need the surgery. When the remaining 116 children were shown to yet a third set of doctors, 52 were recommended the surgery. Note that there is morbidity in 2 to 4 percent of the cases (today, not then, as the risks of surgery were very bad at the time) and that a death occurs in about every 15,000 such operations and you get an idea about the break-even point between medical gains and detriment.

This story allows us to witness probabilistic homicide at work. Every child who undergoes an unnecessary operation has a shortening of her life expectancy. This example not only gives us an idea of harm done by those who intervene, but, worse, it illustrates the lack of awareness of the need to look for a break-even point between benefits and harm.

Let us call this urge to help "naive interventionism." Next we examine its costs.

INTERVENTION AND IATROGENICS

In the case of tonsillectomies, the harm to the children undergoing unnecessary treatment is coupled with the trumpeted gain for *some* others. The name for such net loss, the (usually hidden or delayed) damage from treatment in excess of the benefits, is *iatrogenics*, literally, "caused by the healer," *iatros* being a healer in Greek. We will posit in Chapter 21 that every time you visit a doctor and get a treatment, you incur risks of such medical harm, which should be analyzed the way we analyze other trade-offs: probabilistic benefits minus probabilistic costs.

For a classic example of iatrogenics, consider the death of George Washington in December 1799: we have enough evidence that his doctors greatly helped, or at least hastened, his death, thanks to the then standard treatment that included bloodletting (between five and nine pounds of blood).

Now these risks of harm by the healer can be so overlooked that, depending on how you account for it, until penicillin, medicine had a largely negative balance sheet—going to the doctor increased your chance of death. But it is quite telling that medical iatrogenics seems to have increased over time, along with knowledge, to peak sometime late in the nineteenth century. Thank you, modernity: it was "scientific progress," the birth of the clinic and its substitution for home remedies, that caused death rates to shoot up, mostly from what was then called "hospital fever"—Leibniz had called these hospitals *seminaria mortis*, seedbeds of death. The evidence of increase in death rates is about as strong as they come, since all the victims were now gathered in one place: people were dying in these institutions who would have survived outside them. The famously mistreated Austro-Hungarian doctor Ignaz Semmelweis had observed that more women died giving birth in hospitals than giving birth on the street. He called the establishment doctors a bunch of criminals—which they were: the doctors who kept killing patients could not accept his facts or act on them since he "had no theory" for his observations. Semmelweis entered a state of depression, helpless to stop what he saw as murders, disgusted at the attitude of the establishment. He ended up in an asylum, where he died, ironically, from the same hospital fever he had been warning against.

Semmelweis's story is sad: a man who was punished, humiliated, and even killed for shouting the truth in order to save others. The worst punishment was his state of helplessness in the face of risks and unfairness. But the story is also a happy one—the truth came out eventually, and his mission ended up paying off,

with some delay. And the final lesson is that one should not expect laurels for bringing the truth.

Medicine is comparatively the good news, perhaps the only good news, in the field of iatrogenics. We see the problem there because things are starting to be brought under control today; it is now just what we call the cost of doing business, although medical error still currently kills between three times (as accepted by doctors) and ten times as many people as car accidents in the United States. It is generally accepted that harm from doctors—not including risks from hospital germs—accounts for more deaths than any single cancer. The methodology used by the medical establishment for decision making is still innocent of proper risk-management principles, but medicine is getting better. We have to worry about the incitation to overtreatment on the part of pharmaceutical companies, lobbies, and special interest groups and the production of harm that is not immediately salient and not accounted for as an "error." Pharma plays the game of concealed and distributed iatrogenics, and it has been growing. It is easy to assess iatrogenics when the surgeon amputates the wrong leg or operates on the wrong kidney, or when the patient dies of a drug reaction. But when you medicate a child for an imagined or invented psychiatric disease, say, ADHD or depression, instead of letting him out of the cage, the long-term harm is largely unaccounted for. Iatrogenics is compounded by the "agency problem" or "principal-agent problem," which emerges when one party (the agent) has personal interests that are divorced from those of the one using his services (the principal). An agency problem, for instance, is present with the stockbroker and medical doctor, whose ultimate interest is their own checking account, not your financial and medical health, respectively, and who give you advice that is geared to benefit themselves. Or with politicians working on their career.

First, Do No Harm

Medicine has known about iatrogenics since at least the fourth century before our era—*primum non nocere* ("first do no harm") is a first principle attributed to Hippocrates and integrated in the so-called Hippocratic Oath taken by every medical doctor on his commencement day. It just took medicine about twenty-four centuries to properly execute the brilliant idea. In spite of the recitations of *non nocere* through the ages, the term "iatrogenics" only appeared in frequent use very, very late, a few decades ago—after so much damage had been done. I

for myself did not know the exact word until the writer Bryan Appleyard introduced me to it (I had used “harmful unintended side effects”). So let us leave medicine (to return to it in a dozen chapters or so), and apply this idea born in medicine to other domains of life. Since no intervention implies no iatrogenics, the source of harm lies in the denial of antifragility, and to the impression that we humans are so necessary to making things function.

Enforcing consciousness of generalized iatrogenics is a tall order. The very notion of iatrogenics is quite absent from the discourse outside medicine (which, to repeat, has been a rather slow learner). But just as with the color blue, having a word for something helps spread awareness of it. We will push the idea of iatrogenics into political science, economics, urban planning, education, and more domains. Not one of the consultants and academics in these fields with whom I tried discussing it knew what I was talking about—or thought that they could possibly be the source of any damage. In fact, when you approach the players with such skepticism, they tend to say that you are “against scientific progress.”

But the concept can be found in some religious texts. The Koran mentions “those who are wrongful while thinking of themselves that they are righteous.”

To sum up, anything in which there is naive interventionism, nay, even just intervention, will have iatrogenics.

The Opposite of Iatrogenics

While we now have a word for causing harm while trying to help, we don’t have a designation for the opposite situation, that of someone who ends up helping while trying to cause harm. Just remember that attacking the antifragile will backfire. For instance, hackers make systems stronger. Or as in the case of Ayn Rand, obsessive and intense critics help a book spread.

Incompetence is double-sided. In the Mel Brooks movie *The Producers*, two New York theater fellows get in trouble by finding success instead of the intended failure. They had sold the same shares to multiple investors in a Broadway play, reasoning that should the play fail, they would keep the excess funds—their scheme would not be discovered if the investors got no return on their money. The problem was that they tried so hard to have a bad play—called *Springtime for Hitler*—and they were so bad at it that it turned out to be a huge hit. Uninhibited by their common prejudices, they managed to produce interesting work. I also saw similar irony in trading: a fellow was so upset with

his year-end bonus that he started making huge bets with his employer's portfolio—and ended up making them considerable sums of money, more than if he had tried to do so on purpose.

Perhaps the idea behind capitalism is an inverse-iatrogenic effect, the unintended-but-not-so-unintended consequences: the system facilitates the conversion of selfish aims (or, to be correct, not necessarily benevolent ones) at the individual level into beneficial results for the collective.

Iatrogenics in High Places

Two areas have been particularly infected with absence of awareness of iatrogenics: socioeconomic life and (as we just saw in the story of Semmelweis) the human body, matters in which we have historically combined a low degree of competence with a high rate of intervention and a disrespect for spontaneous operation and healing—let alone growth and improvement.

As we saw in Chapter 3, there is a distinction between organisms (biological or nonbiological) and machines. People with an engineering-oriented mind will tend to look at everything around as an engineering problem. This is a very good thing in engineering, but when dealing with cats, it is a much better idea to hire veterinarians than circuits engineers—or even better, let your animal heal by itself.

Table 3 provides a glimpse of these attempts to "improve matters" across domains and their effects. Note the obvious: in all cases they correspond to the denial of antifragility.

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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 U.S. supporting rotten regimes "for the sake of stability"	Informational opacity Chaos after a revolution
Economics	"No More Boom and Bust" (Greenspan (US), Labor (UK)), Great Moderation (Bernanke) State interventionism Optimization Illusion of pricing rare events, value-at-risk methodologies, illusion of economies of scale, ignorance of second-order effects	Fragility Deeper crises when they happen Support for established, state-friendly corporations; stifling of entrepreneurs 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

Can a Whale Fly Like an Eagle?

Social scientists and economists have no built-in consciousness of iatrogenics, and of course no name for it—when I decided to teach a class on model error in economics and finance, nobody took me or the idea seriously, and the few who did tried to block me, asking for "a theory" (as in Semmelweis's story) and not realizing that it was precisely the errors of theory that I was addressing and cataloguing, as well as the very idea of using a theory without considering the impact of the possible errors from theory.

For a theory is a very dangerous thing to have.

And of course one can rigorously do science without it. What scientists call phenomenology is the observation of an empirical regularity without a visible theory for it. In the Triad, I put theories in the fragile category, phenomenology in the robust one. Theories are superfragile; they come and go, then come and go, then come and go again; phenomenologies stay, and I can't believe people don't realize that phenomenology is "robust" and usable, and theories, while overhyped, are unreliable for decision making—outside physics.

Physics is privileged; it is the exception, which makes its imitation by other disciplines similar to attempts to make a whale fly like an eagle. Errors in physics get smaller from theory to theory—so saying "Newton was wrong" is attention grabbing, good for lurid science journalism, but ultimately mendacious; it would be far more honest to say "Newton's theory is imprecise in some specific cases." Predictions made by Newtonian mechanics are of astonishing precision except for items traveling close to the speed of light, something you don't expect to do on your next vacation. We also read nonsense-with-headlines to the effect that Einstein was "wrong" about that speed of light—and the tools used to prove him wrong are of such complication and such precision that they've demonstrated how inconsequential such a point will be for you and me in the near and far future.

On the other hand, social science seems to diverge from theory to theory. During the cold war, the University of Chicago was promoting laissez-faire theories, while the University of Moscow taught the exact opposite—but their respective physics departments were in convergence, if not total agreement. This

is the reason I put social science theories in the left column of the Triad, as something superfragile for real-world decisions and unusable for risk analyses. The very designation "theory" is even upsetting. In social science we should call these constructs "chimeras" rather than theories.

We will have to construct a methodology to deal with these defects. We cannot afford to wait an additional twenty-four centuries. Unlike with medicine, where iatrogenics is distributed across the population (hence with Mediocristan effects), because of concentration of power, social science and policy iatrogenics can blow us up (hence, Extremistan).

Not Doing Nothing

A main source of the economic crisis that started in 2007 lies in the iatrogenics of the attempt by Überfragilista Alan Greenspan—certainly the top economic iatrogenist of all time—to iron out the "boom-bust cycle" which caused risks to go hide under the carpet and accumulate there until they blew up the economy. The most depressing part of the Greenspan story is that the fellow was a libertarian and seemingly convinced of the idea of leaving systems to their own devices; people can fool themselves endlessly. The same naive interventionism was also applied by the U.K. government of Fragilista Gordon Brown, a student of the Enlightenment whose overt grand mission was to "eliminate" the business cycle. Fragilista Prime Minister Brown, a master iatrogenist though not nearly in the same league as Greenspan, is now trying to lecture the world on "ethics" and "sustainable" finance—but his policy of centralizing information technology (leading to massive cost overruns and delays in implementation) instead of having decentralized small units has proven difficult to reverse. Indeed, the U.K. health service was operating under the principle that a pin falling somewhere in some remote hospital should be heard in Whitehall (the street in London where the government buildings are centralized). The technical argument about the dangers of concentration is provided in Chapter 18.

These attempts to eliminate the business cycle lead to the mother of all fragilities. Just as a little bit of fire here and there gets rid of the flammable material in a forest, a little bit of harm here and there in an economy weeds out the vulnerable firms early enough to allow them to "fail early" (so they can start again) and minimize the long-term damage to the system.

An ethical problem arises when someone is put in charge. Greenspan's actions were harmful, but even if he knew that, it would have taken a bit of heroic

courage to justify inaction in a democracy where the incentive is to always promise a better outcome than the other guy, regardless of the actual, delayed cost.

Ingenuous interventionism is very pervasive across professions. Just as with the tonsillectomy, if you supply a typical copy editor with a text, he will propose a certain number of edits, say about five changes per page. Now accept his "corrections" and give this text to another copy editor who tends to have the same average rate of intervention (editors vary in interventionism), and you will see that he will suggest an equivalent number of edits, sometimes reversing changes made by the previous editor. Find a third editor, same.

Incidentally, those who do too much somewhere do too little elsewhere—and editing provides a quite fitting example. Over my writing career I've noticed that those who overedit tend to miss the real typos (and vice versa). I once pulled an op-ed from *The Washington Post* owing to the abundance of completely unnecessary edits, as if every word had been replaced by a synonym from the thesaurus. I gave the article to the *Financial Times* instead. The editor there made one single correction: 1989 became 1990. *The Washington Post* had tried so hard that they missed the only relevant mistake. As we will see, interventionism depletes mental and economic resources; it is rarely available when it is needed the most. (Beware what you wish for: small government might in the end be more effective at whatever it needs to do. Reduction in size and scope may make it even more intrusive than large government.)

Non-Naive Interventionism

Let me warn against misinterpreting the message here. The argument is not against the notion of intervention; in fact I showed above that I am equally worried about underintervention when it is truly necessary. I am just warning against *naive* intervention and lack of awareness and acceptance of harm done by it.

It is certain that the message will be misinterpreted, for a while. When I wrote *Fooled by Randomness*, which argues—a relative of this message—that we have a tendency to underestimate the role of randomness in human affairs, summarized as "it is more random than you think," the message in the media became "it's all random" or "it's all dumb luck," an illustration of the Procrustean bed that changes by reducing. During a radio interview, when I tried explaining to the journalist the nuance and the difference between the two

statements I was told that I was “too complicated”; so I simply walked out of the studio, leaving them in the lurch. The depressing part is that those people who were committing such mistakes were educated journalists entrusted to represent the world to us lay persons. Here, all I am saying is that we need to avoid being blind to the natural antifragility of systems, their ability to take care of themselves, and fight our tendency to harm and fragilize them by not giving them a chance to do so.

As we saw with the overzealous editor, over-intervention comes with underintervention. Indeed, as in medicine, we tend to over-intervene in areas with minimal benefits (and large risks) while underintervening in areas in which intervention is necessary, like emergencies. So the message here is in favor of staunch intervention in some areas, such as ecology or to limit the economic distortions and moral hazard caused by large corporations.

What should we control? As a rule, intervening to limit size (of companies, airports, or sources of pollution), concentration, and speed are beneficial in reducing Black Swan risks. These actions may be devoid of iatrogenics—but it is hard to get governments to limit the size of government. For instance, it has been argued since the 1970s that limiting speed on the highway (and enforcing it) leads to an extremely effective increase in safety. This can be plausible because risks of accidents increase disproportionally (that is, *nonlinearly*) with speed, and humans are not ancestrally equipped with such intuition. Someone recklessly driving a huge vehicle on the highway is endangering your safety and needs to be stopped before he hits your convertible Mini—or put in a situation in which he is the one exiting the gene pool, not you. Speed is from modernity, and I am always suspicious of hidden fragilities coming from the post-natural—we will further show a technical proof in Chapters 18 and 19.

But I also buy the opposite argument that regulating street signs does not seem to reduce risks; drivers become more placid. Experiments show that alertness is weakened when one relinquishes control to the system (again, lack of overcompensation). Motorists need the stressors and tension coming from the feeling of danger to feed their attention and risk controls, rather than some external regulator—fewer pedestrians die jaywalking than using regulated crossings. Some libertarians use the example of Drachten, a town in the Netherlands, in which a dream experiment was conducted. All street signs were removed. The deregulation led to an increase in safety, confirming the antifragility of attention at work, how it is whetted by a sense of danger and responsibility. As a result, many German and Dutch towns have reduced the

number of street signs. We saw a version of the Drachten effect in Chapter 2 in the discussion of the automation of planes, which produces the exact opposite effect than what is intended by making pilots lose alertness. But one needs to be careful not to overgeneralize the Drachten effect, as it does not imply the effectiveness of removing all rules from society. As I said earlier, speed on the highway responds to a different dynamic and its risks are different.

Alas, it has been hard for me to fit these ideas about fragility and antifragility within the current U.S. political discourse—that beastly two-fossil system. Most of the time, the Democratic side of the U.S. spectrum favors hyper-intervention, unconditional regulation, and large government, while the Republican side loves large corporations, unconditional deregulation, and militarism—both are the same to me here. They are even more the same when it comes to debt, as both sides have tended to encourage indebtedness on the part of citizens, corporations, and government (which brings fragility and kills antifragility). I believe that both markets and governments are unintelligent when it comes to Black Swan events—though, again, not Mother Nature, thanks to her construction, or more ancient types of markets (like the souks), unlike the ones we have now.

Let me simplify my take on intervention. To me it is mostly about having a systematic protocol to determine when to intervene and when to leave systems alone. And we may need to intervene to control the iatrogenics of modernity—particularly the large-scale harm to the environment and the concentration of potential (though not yet manifested) damage, the kind of thing we only notice when it is too late. The ideas advanced here are not political, but risk-management based. I do not have a political affiliation or allegiance to a specific party; rather, I am introducing the idea of harm and fragility into the vocabulary so we can formulate appropriate policies to ensure we don’t end up blowing up the planet and ourselves.

IN PRAISE OF PROCRASTINATION—THE FABIAN KIND

There is an element of deceit associated with interventionism, accelerating in a professionalized society. It's much easier to sell "Look what I did for you" than "Look what I avoided for you." Of course a bonus system based on "performance" exacerbates the problem. I've looked in history for heroes who became heroes for what they did *not* do, but it is hard to observe *nonaction;* I could not easily find any. The doctor who refrains from operating on a back (a very expensive surgery), instead giving it a chance to heal itself, will not be rewarded and judged as favorably as the doctor who makes the surgery look indispensable, then brings relief to the patient while exposing him to operating risks, while accruing great financial rewards to himself. The latter will be driving the pink Rolls-Royce. The corporate manager who avoids a loss will not often be rewarded. The true hero in the Black Swan world is someone who prevents a calamity and, naturally, because the calamity did not take place, does not get recognition—or a bonus—for it. I will be taking the concept deeper in Book VII, on ethics, about the unfairness of a bonus system and how such unfairness is magnified by complexity.

However, as always, the elders seem to have far more wisdom than we moderns—and much, much simpler wisdom; the Romans revered someone who, at the least, resisted and delayed intervention. One general, Fabius Maximus was nicknamed Cunctator, "the Procrastinator." He drove Hannibal, who had an obvious military superiority, crazy by avoiding and delaying engagement. And it is quite fitting to consider Hannibal's militarism as a form of interventionism (à la George W. Bush, except that Hannibal was actually in battle himself, not in the comfort of an office) and compare it to the Cunctator's wisdom.

A very intelligent group of revolutionary fellows in the United Kingdom created a political movement called the Fabian Society, named after the Cunctator, based on opportunistically delaying the revolution. The society included George Bernard Shaw, H. G. Wells, Leonard and Virginia Woolf, Ramsay MacDonald, and even Bertrand Russell for a moment. In retrospect, it turned out to be a very effective strategy, not so much as a way to achieve their objectives, but rather to accommodate the fact that these objectives are moving targets. Procrastination turned out to be a way to let events take their course and give the activists the chance to change their minds before committing to irreversible policies. And of course members *did* change their minds after seeing