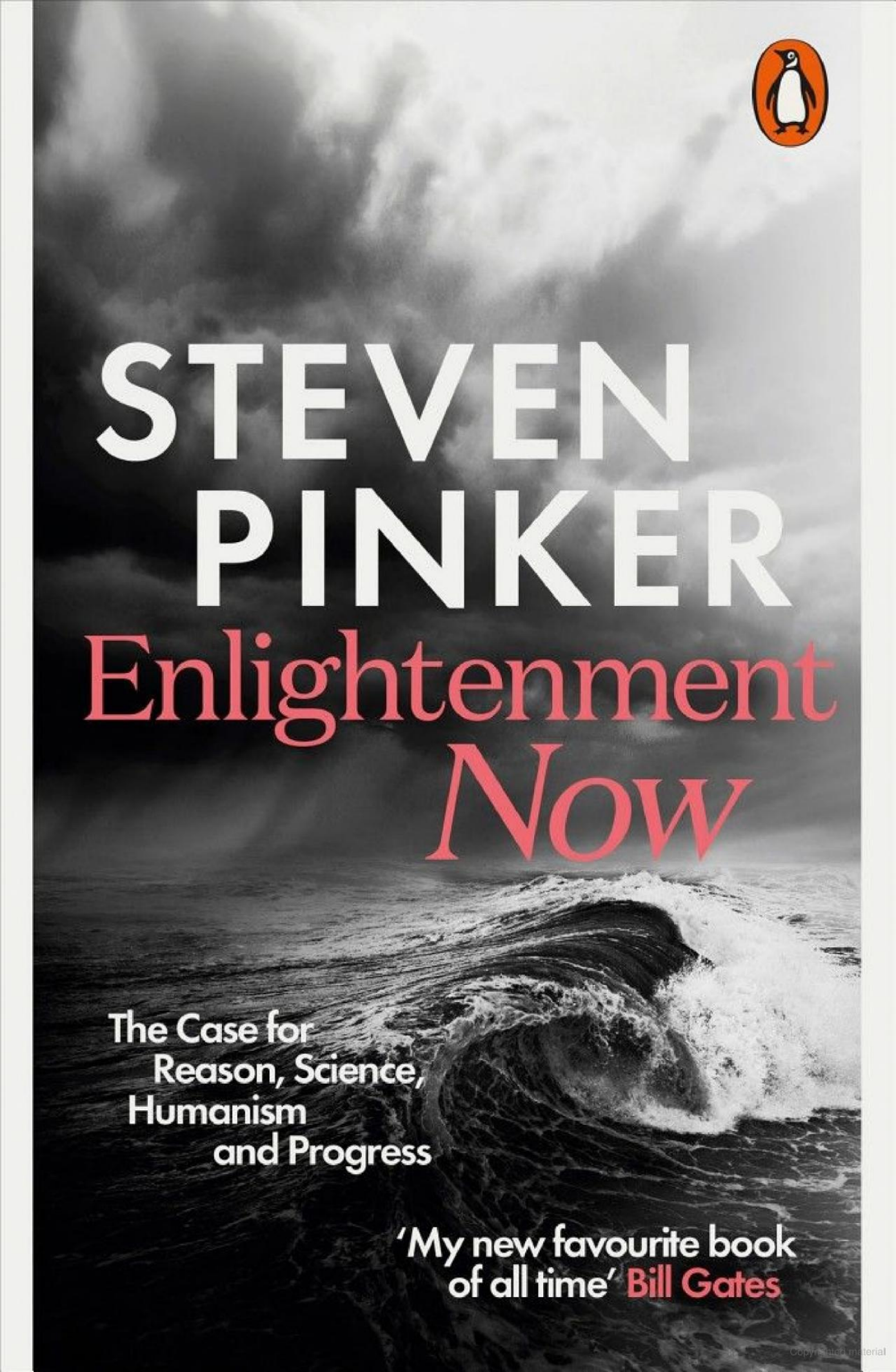

Contents

FOLLOW PENGUIN

Steven Pinker is one of the world's most influential thinkers and writers on the human condition. His popular and highly praised books include *The Better Angels of Our Nature*, *The Sense of Style*, *The Stuff of Thought*, *The Blank Slate*, *How the Mind Works*, and *The Language Instinct*. The recipient of several major awards for his teaching, books, and scientific research, Pinker is Harvard College Professor and Johnstone Family Professor of Psychology at Harvard University. He also writes frequently for *The New York Times*, the *Guardian* and other publications. He has been named Humanist of the Year, *Prospect* magazine's 'The World's Top 100 Public Intellectuals', Foreign Policy's '100 Global Thinkers', and *Time* magazine's 'The 100 Most Influential People in the World Today'.

PENGUIN BOOKS

ENLIGHTENMENT NOW

'A characteristically fluent, decisive and data-rich demonstration of why, given the chance to live at any point in human history, only a stone-cold idiot would choose any time other than the present' Sam Leith, *Spectator*

'Everyone should read this book and, just for once, be enthralled by what humankind has achieved' Iain Macwhirter, *Herald*

'An excellent book, championing a rational humanism that is – it turns out – really quite cool' Sarah Bakewell, *The New York Times Book Review*

'Brimming with surprising data and entertaining anecdotes ... a genuinely enlightening book' Jan-Werner Müller, *Financial Times*

'Today we are living healthier, wealthier lives – and it's thanks to the values of the Enlightenment ... a passionate book in praise of Enlightenment values' David Aaronovitch, *The Times*

'Pinker is a paragon of exactly the kind of intellectual honesty and courage we need' David Brooks, *The New York Times*

'A new, optimistic view of the world ... Things are not as bad as your Facebook news feed makes them seem ... a cheerful, contrarian tract for dark times' Niall Ferguson, *The Sunday Times*

'Gripping, provocative ... An important and timely book' David Wootton, *The Times Literary Supplement*

'A deep and important critic of the visceral hostility to nature and science now so sadly prevalent on the left and right, a defender of reason and the Enlightenment ... Pinker is right' Andrew Sullivan, *New York Magazine*

'Modern life has gotten much better despite ever-present complaints. Technology has reduced the need for physical labor. Mortality rates are down. IQ scores are on the rise. Wars are less frequent and less deadly ... the Enlightenment's championing of reason, science, humanism and moral progress is a model for our own times' David Lay Williams, *Washington Post*

'*Enlightenment Now* can hardly be bettered' *Boston Globe*

'A careful and deeply researched piece of work ... Pinker is bravely prepared to be the bearer of good news' Andrew Anthony, *Observer*

'The most uplifting work of science I've ever read' Michael Shermer, *Science*

'Pinker is ahead of his critics ... To accuse him of smugly sipping cocktails at the End of History café is simply to ignore his repeated calls to work for the better future that is there for the taking, but also for the losing' Julian Baggini, *Literary Review*

'Shock therapy for pessimists' Mary Ann Gwinn, *Seattle Times*

'In essence, Pinker thinks we are reaping the reward for the colossal advances we have made since the great scientific revolution of the 17th and 18th centuries. It was then, in countries including France, Holland and, above all, England and Scotland, that thinkers came up with a new way to understand our world, characterised by reason, science and individualism. Ever since, the world has been getting better. When I picked up Pinker's book, I had my doubts. But by the time I finished it, I was converted' Dominic Sandbrook, *Daily Mail*

'Remarkable, heart-warming, and long overdue' Rayyan Al-Shawaf, *Christian Science Monitor*

'Pinker is right ... Human beings today lead longer, safer, healthier, wealthier and indeed happier lives than at any point in recorded history ... Pinker surveys the stupendous advancements that the human race has made in modern times according to a dizzying range of metrics' David A. Bell, *The Nation*

'An engaging, compelling set of reasons to be cheerful ... it is a welcome antidote' Ian Goldin, *Nature*

'A substantial and wide-ranging book on the state of our world today ... In forensic detail, Pinker enumerates the myriad ways in which life is getting better ... The book is packed with statistics vaunting the gifts of progress' Paul Cullen, *Irish Times*

'After devouring all 453 pages and 75 graphs of psychologist Steven Pinker's *Enlightenment Now*, I admit defeat. The defeat of defeatism. This man has done the math. Since the 18th century things have been getting better in pretty much every dimension of human wellbeing' Jason Gots, *Big Think*

'We must read this book and absorb its message' *El País* (Colombia)

'Compelling ... At a moment when liberal Enlightenment values are under attack, from the right and the left, this is a very important contribution' Alison Gopnik, *Atlantic*

'For years, I've been saying Steven Pinker's *The Better Angels of Our Nature* was the best book I'd read in a decade. If I could recommend just one book for anyone to

pick up, that was it ... *Enlightenment Now*, is even better ... he's able to articulate his case in a way that feels fresh and new ... I'm glad we have brilliant thinkers like Steven Pinker to help us see the big picture. *Enlightenment Now* is not only the best book Pinker's ever written. It's my new favourite book of all time' Bill Gates

List of Figures

12-2: Homicide deaths, 1967–2015
12-3: Motor vehicle accident deaths, US, 1921–2015
12-4: Pedestrian deaths, US, 1927–2015
12-5: Plane crash deaths, 1970–2015
12-6: Deaths from falls, fire, drowning, and poison, US, 1903–2014
12-7: Occupational accident deaths, US, 1913–2015
12-8: Natural disaster deaths, 1900–2015
12-9: Lightning strike deaths, US, 1900–2015
13-1: Terrorism deaths, 1970–2015
14-1: Democracy versus autocracy, 1800–2015
14-2: Human rights, 1949–2014
14-3: Death penalty abolitions, 1863–2016
14-4: Executions, US, 1780–2016
15-1: Racist, sexist, and homophobic opinions, US, 1987–2012
15-2: Racist, sexist, and homophobic Web searches, US, 2004–2017
15-3: Hate crimes, US, 1996–2015
15-4: Rape and domestic violence, US, 1993–2014
15-5: Decriminalization of homosexuality, 1791–2016
15-6: Liberal values across time and generations, developed countries, 1980–2005
15-7: Liberal values across time (extrapolated), world's culture zones, 1960–2006
15-8: Victimization of children, US, 1993–2012
15-9: Child labor, 1850–2012
16-1: Literacy, 1475–2010
16-2: Basic education, 1820–2010
16-3: Years of schooling, 1870–2010
16-4: Female literacy, 1750–2014
16-5: IQ gains, 1909–2013
16-6: Global well-being, 1820–2015
17-1: Work hours, Western Europe and US, 1870–2000
17-2: Retirement, US, 1880–2010
17-3: Utilities, appliances, and housework, US, 1900–2015
17-4: Cost of light, England, 1300–2006
17-5: Spending on necessities, US, 1929–2016
17-6: Leisure time, US, 1965–2015
17-7: Cost of air travel, US, 1979–2015
17-8: International tourism, 1995–2015
18-1: Life satisfaction and income, 2006
18-2: Loneliness, US students, 1978–2011
18-3: Suicide, England, Switzerland, and US, 1860–2014
18-4: Happiness and excitement, US, 1972–2016

Preface

The second half of the second decade of the third millennium would not seem to be an auspicious time to publish a book on the historical sweep of progress and its causes. At the time of this writing, my country is led by people with a dark vision of the current moment: "mothers and children trapped in poverty ... an education system which leaves our young and beautiful students deprived of all knowledge ... and the crime, and the gangs, and the drugs that have stolen too many lives." We are in an "outright war" that is "expanding and metastasizing." The blame for this nightmare may be placed on a "global power structure" that has eroded "the underlying spiritual and moral foundations of Christianity."[1]

In the pages that follow, I will show that this bleak assessment of the state of the world is wrong. And not just a little wrong—wrong wrong, flat-earth wrong, couldn't-*be*-more-wrong. But this book is not about the forty-fifth president of the United States and his advisors. It was conceived some years before Donald Trump announced his candidacy, and I hope it will outlast his administration by many more. The ideas that prepared the ground for his election are in fact widely shared among intellectuals and laypeople, on both the left and the right. They include pessimism about the way the world is heading, cynicism about the institutions of modernity, and an inability to conceive of a higher purpose in anything other than religion. I will present a different understanding of the world, grounded in fact and inspired by the ideals of the Enlightenment: reason, science, humanism, and progress. Enlightenment ideals, I hope to show, are timeless, but they have never been more relevant than they are right now.

~

The sociologist Robert Merton identified Communalism as a cardinal scientific virtue, together with Universalism, Disinterestedness, and Organized Skepticism: CUDOS.[2] Kudos indeed goes to the many scientists who shared their data in a communal spirit and responded to my queries thoroughly and swiftly. First among these is Max Roser, proprietor of the mind-expanding *Our World in Data* Web site, whose insight and generosity were indispensable to many discussions in part II, the section on progress. I am grateful as well to Marian Tupy of *HumanProgress* and to Ola Rosling and Hans Rosling of *Gapminder,* two other invaluable resources for understanding the state of humanity. Hans was an

inspiration, and his death in 2017 a tragedy for those who are committed to reason, science, humanism, and progress.

My gratitude goes as well to the other data scientists I pestered and to the institutions that collect and maintain their data: Karlyn Bowman, Daniel Cox (PRRI), Tamar Epner (Social Progress Index), Christopher Fariss, Chelsea Follett (*HumanProgress*), Andrew Gelman, Yair Ghitza, April Ingram (Science Heroes), Jill Janocha (Bureau of Labor Statistics), Gayle Kelch (US Fire Administration/FEMA), Alaina Kolosh (National Safety Council), Kalev Leetaru (Global Database of Events, Language, and Tone), Monty Marshall (Polity Project), Bruce Meyer, Branko Milanović (World Bank), Robert Muggah (Homicide Monitor), Pippa Norris (World Values Survey), Thomas Olshanski (US Fire Administration/FEMA), Amy Pearce (Science Heroes), Mark Perry, Therese Pettersson (Uppsala Conflict Data Program), Leandro Prados de la Escosura, Steven Radelet, Auke Rijpma (OECD Clio Infra), Hannah Ritchie (*Our World in Data*), Seth Stephens-Davidowitz (Google Trends), James X. Sullivan, Sam Taub (Uppsala Conflict Data Program), Kyla Thomas, Jennifer Truman (Bureau of Justice Statistics), Jean Twenge, Bas van Leeuwen (OECD Clio Infra), Carlos Vilalta, Christian Welzel (World Values Survey), Justin Wolfers, and Billy Woodward (Science Heroes).

David Deutsch, Rebecca Newberger Goldstein, Kevin Kelly, John Mueller, Roslyn Pinker, Max Roser, and Bruce Schneier read a draft of the entire manuscript and offered invaluable advice. I also profited from comments by experts who read chapters or excerpts, including Scott Aaronson, Leda Cosmides, Jeremy England, Paul Ewald, Joshua Goldstein, A. C. Grayling, Joshua Greene, Cesar Hidalgo, Jodie Jackson, Lawrence Krauss, Branko Milanović, Robert Muggah, Jason Nemirow, Matthew Nock, Ted Nordhaus, Anthony Pagden, Robert Pinker, Susan Pinker, Steven Radelet, Peter Scoblic, Martin Seligman, Michael Shellenberger, and Christian Welzel.

Other friends and colleagues answered questions or made important suggestions, including Charleen Adams, Rosalind Arden, Andrew Balmford, Nicolas Baumard, Brian Boutwell, Stewart Brand, David Byrne, Richard Dawkins, Daniel Dennett, Gregg Easterbrook, Emily-Rose Eastop, Nils Petter Gleditsch, Jennifer Jacquet, Barry Latzer, Mark Lilla, Karen Long, Andrew Mack, Michael McCullough, Heiner Rindermann, Jim Rossi, Scott Sagan, Sally Satel, and Michael Shermer. Special thanks go to my Harvard colleagues Mahzarin Banaji, Mercè Crosas, James Engell, Daniel Gilbert, Richard McNally, Kathryn Sikkink, and Lawrence Summers.

I thank Rhea Howard and Luz Lopez for their heroic efforts in obtaining, analyzing, and plotting data, and Keehup Yong for several regression analyses. I

In the course of several decades giving public lectures on language, mind, and human nature, I have been asked some mighty strange questions. Which is the best language? Are clams and oysters conscious? When will I be able to upload my mind to the Internet? Is obesity a form of violence?

But the most arresting question I have ever fielded followed a talk in which I explained the commonplace among scientists that mental life consists of patterns of activity in the tissues of the brain. A student in the audience raised her hand and asked me:

"Why should I live?"

The student's ingenuous tone made it clear that she was neither suicidal nor sarcastic but genuinely curious about how to find meaning and purpose if traditional religious beliefs about an immortal soul are undermined by our best science. My policy is that there is no such thing as a stupid question, and to the surprise of the student, the audience, and most of all myself, I mustered a reasonably creditable answer. What I recall saying—embellished, to be sure, by the distortions of memory and *l'esprit de l'escalier,* the wit of the staircase—went something like this:

> In the very act of asking that question, you are seeking *reasons* for your convictions, and so you are committed to reason as the means to discover and justify what is important to you. And there are so many reasons to live!
>
> As a sentient being, you have the potential to *flourish.* You can refine your faculty of reason itself by learning and debating. You can seek explanations of the natural world through science, and insight into the human condition through the arts and humanities. You can make the most of your capacity for pleasure and satisfaction, which allowed your ancestors to thrive and thereby allowed you to exist. You can appreciate the beauty and richness of the natural and cultural world. As the heir to billions of years of life perpetuating itself, you can perpetuate life in turn. You have been endowed with a sense of *sympathy*—the ability to like, love, respect, help, and show kindness—and you can enjoy the gift of mutual benevolence with friends, family, and colleagues.
>
> And because reason tells you that none of this is particular to *you,* you have the responsibility to provide to others what you expect for yourself. You can foster the welfare of other sentient beings by enhancing life, health, knowledge, freedom, abundance, safety, beauty, and peace. History shows that when we sympathize with others and apply our ingenuity to improving the human condition, we can make progress in doing so, and you can help to continue that progress.

Explaining the meaning of life is not in the usual job description of a professor of cognitive science, and I would not have had the gall to take up her question if the answer depended on my arcane technical knowledge or my dubious personal

wisdom. But I knew I was channeling a body of beliefs and values that had taken shape more than two centuries before me and that are now more relevant than ever: the ideals of the Enlightenment.

The Enlightenment principle that we can apply reason and sympathy to enhance human flourishing may seem obvious, trite, old-fashioned. I wrote this book because I have come to realize that it is not. More than ever, the ideals of reason, science, humanism, and progress need a wholehearted defense. We take its gifts for granted: newborns who will live more than eight decades, markets overflowing with food, clean water that appears with a flick of a finger and waste that disappears with another, pills that erase a painful infection, sons who are not sent off to war, daughters who can walk the streets in safety, critics of the powerful who are not jailed or shot, the world's knowledge and culture available in a shirt pocket. But these are human accomplishments, not cosmic birthrights. In the memories of many readers of this book—and in the experience of those in less fortunate parts of the world—war, scarcity, disease, ignorance, and lethal menace are a natural part of existence. We know that countries can slide back into these primitive conditions, and so we ignore the achievements of the Enlightenment at our peril.

In the years since I took the young woman's question, I have often been reminded of the need to restate the ideals of the Enlightenment (also called humanism, the open society, and cosmopolitan or classical liberalism). It's not just that questions like hers regularly appear in my inbox. ("Dear Professor Pinker, What advice do you have for someone who has taken ideas in your books and science to heart, and sees himself as a collection of atoms? A machine with a limited scope of intelligence, sprung out of selfish genes, inhabiting spacetime?") It's also that an obliviousness to the scope of human progress can lead to symptoms that are worse than existential angst. It can make people cynical about the Enlightenment-inspired institutions that are securing this progress, such as liberal democracy and organizations of international cooperation, and turn them toward atavistic alternatives.

The ideals of the Enlightenment are products of human reason, but they always struggle with other strands of human nature: loyalty to tribe, deference to authority, magical thinking, the blaming of misfortune on evildoers. The second decade of the 21st century has seen the rise of political movements that depict their countries as being pulled into a hellish dystopia by malign factions that can be resisted only by a strong leader who wrenches the country backward to make it "great again." These movements have been abetted by a narrative shared by many of their fiercest opponents, in which the institutions of modernity have failed and every aspect of life is in deepening crisis—the two sides in macabre agreement that wrecking those institutions will make the

world a better place. Harder to find is a positive vision that sees the world's problems against a background of progress that it seeks to build upon by solving those problems in their turn.

If you still are unsure whether the ideals of Enlightenment humanism need a vigorous defense, consider the diagnosis of Shiraz Maher, an analyst of radical Islamist movements. "The West is shy of its values—it doesn't speak up for classical liberalism," he says. "We are unsure of them. They make us feel uneasy." Contrast that with the Islamic State, which "knows exactly what it stands for," a certainty that is "incredibly seductive"—and he should know, having once been a regional director of the jihadist group Hizb ut-Tahrir.[1]

Reflecting on liberal ideals in 1960, not long after they had withstood their greatest trial, the economist Friedrich Hayek observed, "If old truths are to retain their hold on men's minds, they must be restated in the language and concepts of successive generations" (inadvertently proving his point with the expression *men's minds*). "What at one time are their most effective expressions gradually become so worn with use that they cease to carry a definite meaning. The underlying ideas may be as valid as ever, but the words, even when they refer to problems that are still with us, no longer convey the same conviction."[2]

This book is my attempt to restate the ideals of the Enlightenment in the language and concepts of the 21st century. I will first lay out a framework for understanding the human condition informed by modern science—who we are, where we came from, what our challenges are, and how we can meet them. The bulk of the book is devoted to defending those ideals in a distinctively 21st-century way: with data. This evidence-based take on the Enlightenment project reveals that it was not a naïve hope. The Enlightenment has *worked*—perhaps the greatest story seldom told. And because this triumph is so unsung, the underlying ideals of reason, science, and humanism are unappreciated as well. Far from being an insipid consensus, these ideals are treated by today's intellectuals with indifference, skepticism, and sometimes contempt. When properly appreciated, I will suggest, the ideals of the Enlightenment are in fact stirring, inspiring, noble—a reason to live.

CHAPTER 1

Dare to Understand!

What is enlightenment? In a 1784 essay with that question as its title, Immanuel Kant answered that it consists of "humankind's emergence from its self-incurred immaturity," its "lazy and cowardly" submission to the "dogmas and formulas" of religious or political authority.[1] Enlightenment's motto, he proclaimed, is "Dare to understand!" and its foundational demand is freedom of thought and speech. "One age cannot conclude a pact that would prevent succeeding ages from extending their insights, increasing their knowledge, and purging their errors. That would be a crime against human nature, whose proper destiny lies precisely in such progress."[2]

A 21st-century statement of the same idea may be found in the physicist David Deutsch's defense of enlightenment, *The Beginning of Infinity*. Deutsch argues that if we dare to understand, progress is possible in all fields, scientific, political, and moral:

> Optimism (in the sense that I have advocated) is the theory that all failures—all evils—are due to insufficient knowledge .... Problems are inevitable, because our knowledge will always be infinitely far from complete. Some problems are hard, but it is a mistake to confuse hard problems with problems unlikely to be solved. Problems are soluble, and each particular evil is a problem that can be solved. An optimistic civilization is open and not afraid to innovate, and is based on traditions of criticism. Its institutions keep improving, and the most important knowledge that they embody is knowledge of how to detect and eliminate errors.[3]

What is *the* Enlightenment?[4] There is no official answer, because the era named by Kant's essay was never demarcated by opening and closing ceremonies like the Olympics, nor are its tenets stipulated in an oath or creed. The Enlightenment is conventionally placed in the last two-thirds of the 18th century, though it flowed out of the Scientific Revolution and the Age of Reason in the 17th century and spilled into the heyday of classical liberalism of the first half of the 19th. Provoked by challenges to conventional wisdom from science and exploration, mindful of the bloodshed of recent wars of religion, and abetted by the easy movement of ideas and people, the thinkers of the Enlightenment sought a new understanding of the human condition. The era was a cornucopia

of ideas, some of them contradictory, but four themes tie them together: reason, science, humanism, and progress.

Foremost is reason. Reason is nonnegotiable. As soon as you show up to discuss the question of what we should live for (or any other question), as long as you insist that your answers, whatever they are, are reasonable or justified or true and that therefore other people ought to believe them too, then you have committed yourself to reason, and to holding your beliefs accountable to objective standards.[5] If there's anything the Enlightenment thinkers had in common, it was an insistence that we energetically apply the standard of reason to understanding our world, and not fall back on generators of delusion like faith, dogma, revelation, authority, charisma, mysticism, divination, visions, gut feelings, or the hermeneutic parsing of sacred texts.

It was reason that led most of the Enlightenment thinkers to repudiate a belief in an anthropomorphic God who took an interest in human affairs.[6] The application of reason revealed that reports of miracles were dubious, that the authors of holy books were all too human, that natural events unfolded with no regard to human welfare, and that different cultures believed in mutually incompatible deities, none of them less likely than the others to be products of the imagination. (As Montesquieu wrote, "If triangles had a god they would give him three sides.") For all that, not all of the Enlightenment thinkers were atheists. Some were deists (as opposed to theists): they thought that God set the universe in motion and then stepped back, allowing it to unfold according to the laws of nature. Others were pantheists, who used "God" as a *synonym* for the laws of nature. But few appealed to the law-giving, miracle-conjuring, son-begetting God of scripture.

Many writers today confuse the Enlightenment endorsement of reason with the implausible claim that humans are perfectly rational agents. Nothing could be further from historical reality. Thinkers such as Kant, Baruch Spinoza, Thomas Hobbes, David Hume, and Adam Smith were inquisitive psychologists and all too aware of our irrational passions and foibles. They insisted that it was only by calling out the common sources of folly that we could hope to overcome them. The deliberate application of reason was necessary precisely because our common habits of thought are not particularly reasonable.

That leads to the second ideal, science, the refining of reason to understand the world. The Scientific Revolution was revolutionary in a way that is hard to appreciate today, now that its discoveries have become second nature to most of us. The historian David Wootton reminds us of the understanding of an educated Englishman on the eve of the Revolution in 1600:

> He believes witches can summon up storms that sink ships at sea .... He believes in werewolves, although there happen not to be any in England—he knows they are

The Enlightenment belief in progress should not be confused with the 19th-century Romantic belief in mystical forces, laws, dialectics, struggles, unfoldings, destinies, ages of man, and evolutionary forces that propel mankind ever upward toward utopia.[13] As Kant's remark about "increasing knowledge and purging errors" indicates, it was more prosaic, a combination of reason and humanism. If we keep track of how our laws and manners are doing, think up ways to improve them, try them out, and keep the ones that make people better off, we can gradually make the world a better place. Science itself creeps forward through this cycle of theory and experiment, and its ceaseless headway, superimposed on local setbacks and reversals, shows how progress is possible.

The ideal of progress also should not be confused with the 20th-century movement to re-engineer society for the convenience of technocrats and planners, which the political scientist James Scott calls Authoritarian High Modernism.[14] The movement denied the existence of human nature, with its messy needs for beauty, nature, tradition, and social intimacy.[15] Starting from a "clean tablecloth," the modernists designed urban renewal projects that replaced vibrant neighborhoods with freeways, high-rises, windswept plazas, and brutalist architecture. "Mankind will be reborn," they theorized, and "live in an ordered relation to the whole."[16] Though these developments were sometimes linked to the word *progress,* the usage was ironic: "progress" unguided by humanism is not progress.

Rather than trying to shape human nature, the Enlightenment hope for progress was concentrated on human institutions. Human-made systems like governments, laws, schools, markets, and international bodies are a natural target for the application of reason to human betterment.

In this way of thinking, government is not a divine fiat to reign, a synonym for "society," or an avatar of the national, religious, or racial soul. It is a human invention, tacitly agreed to in a social contract, designed to enhance the welfare of citizens by coordinating their behavior and discouraging selfish acts that may be tempting to every individual but leave everyone worse off. As the most famous product of the Enlightenment, the Declaration of Independence, put it, in order to secure the right to life, liberty, and the pursuit of happiness, governments are instituted among people, deriving their just powers from the consent of the governed.

Among the powers of government is meting out punishment, and writers such as Montesquieu, Cesare Beccaria, and the American founders thought afresh about the government's license to harm its citizens.[17] Criminal punishment, they argued, is not a mandate to implement cosmic justice but part of an incentive structure that discourages antisocial acts without causing more suffering than it deters. The reason the punishment should fit the crime, for example, is not to

balance some mystical scale of justice but to ensure that a wrongdoer stops at a minor crime rather than escalating to a more harmful one. Cruel punishments, whether or not they are in some sense "deserved," are no more effective at deterring harm than moderate but surer punishments, and they desensitize spectators and brutalize the society that implements them.

The Enlightenment also saw the first rational analysis of prosperity. Its starting point was not how wealth is distributed but the prior question of how wealth comes to exist in the first place.[18] Smith, building on French, Dutch, and Scottish influences, noted that an abundance of useful stuff cannot be conjured into existence by a farmer or craftsman working in isolation. It depends on a network of specialists, each of whom learns how to make something as efficiently as possible, and who combine and exchange the fruits of their ingenuity, skill, and labor. In a famous example, Smith calculated that a pin-maker working alone could make at most one pin a day, whereas in a workshop in which "one man draws out the wire, another straights it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head," each could make almost five thousand.

Specialization works only in a market that allows the specialists to exchange their goods and services, and Smith explained that economic activity was a form of mutually beneficial cooperation (a positive-sum game, in today's lingo): each gets back something that is more valuable to him than what he gives up. Through voluntary exchange, people benefit others by benefiting themselves; as he wrote, "It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love." Smith was not saying that people are ruthlessly selfish, or that they ought to be; he was one of history's keenest commentators on human sympathy. He only said that in a market, whatever tendency people have to care for their families and themselves can work to the good of all.

Exchange can make an entire society not just richer but nicer, because in an effective market it is cheaper to buy things than to steal them, and other people are more valuable to you alive than dead. (As the economist Ludwig von Mises put it centuries later, "If the tailor goes to war against the baker, he must henceforth bake his own bread.") Many Enlightenment thinkers, including Montesquieu, Kant, Voltaire, Diderot, and the Abbé de Saint-Pierre, endorsed the ideal of *doux commerce,* gentle commerce.[19] The American founders—George Washington, James Madison, and especially Alexander Hamilton—designed the institutions of the young nation to nurture it.

This brings us to another Enlightenment ideal, peace. War was so common in history that it was natural to see it as a permanent part of the human condition

and to think peace could come only in a messianic age. But now war was no longer thought of as a divine punishment to be endured and deplored, or a glorious contest to be won and celebrated, but a practical problem to be mitigated and someday solved. In "Perpetual Peace," Kant laid out measures that would discourage leaders from dragging their countries into war.[20] Together with international commerce, he recommended representative republics (what we would call democracies), mutual transparency, norms against conquest and internal interference, freedom of travel and immigration, and a federation of states that would adjudicate disputes between them.

For all the prescience of the founders, framers, and *philosophes,* this is not a book of Enlightenolatry. The Enlightenment thinkers were men and women of their age, the 18th century. Some were racists, sexists, anti-Semites, slaveholders, or duelists. Some of the questions they worried about are almost incomprehensible to us, and they came up with plenty of daffy ideas together with the brilliant ones. More to the point, they were born too soon to appreciate some of the keystones of our modern understanding of reality.

They of all people would have been the first to concede this. If you extol reason, then what matters is the integrity of the thoughts, not the personalities of the thinkers. And if you're committed to progress, you can't very well claim to have it all figured out. It takes nothing away from the Enlightenment thinkers to identify some critical ideas about the human condition and the nature of progress that we know and they didn't. Those ideas, I suggest, are entropy, evolution, and information.

CHAPTER 2

Entro, Evo, Info

The first keystone in understanding the human condition is the concept of entropy or disorder, which emerged from 19th-century physics and was defined in its current form by the physicist Ludwig Boltzmann.[1] The Second Law of Thermodynamics states that in an isolated system (one that is not interacting with its environment), entropy never decreases. (The First Law is that energy is conserved; the Third, that a temperature of absolute zero is unreachable.) Closed systems inexorably become less structured, less organized, less able to accomplish interesting and useful outcomes, until they slide into an equilibrium of gray, tepid, homogeneous monotony and stay there.

In its original formulation the Second Law referred to the process in which usable energy in the form of a difference in temperature between two bodies is inevitably dissipated as heat flows from the warmer to the cooler body. (As the musical team Flanders & Swann explained, "You can't pass heat from the cooler to the hotter; Try it if you like but you far better notter.") A cup of coffee, unless it is placed on a plugged-in hot plate, will cool down. When the coal feeding a steam engine is used up, the cooled-off steam on one side of the piston can no longer budge it because the warmed-up steam and air on the other side are pushing back just as hard.

Once it was appreciated that heat is not an invisible fluid but the energy in moving molecules, and that a difference in temperature between two bodies consists of a difference in the average speeds of those molecules, a more general, statistical version of the concept of entropy and the Second Law took shape. Now order could be characterized in terms of the set of all microscopically distinct states of a system (in the original example involving heat, the possible speeds and positions of all the molecules in the two bodies). Of all these states, the ones that we find useful from a bird's-eye view (such as one body being hotter than the other, which translates into the average speed of the molecules in one body being higher than the average speed in the other) make up a tiny fraction of the possibilities, while all the disorderly or useless states (the ones without a temperature difference, in which the average speeds in the two bodies are the same) make up the vast majority. It follows that any perturbation of the system,

whether it is a random jiggling of its parts or a whack from the outside, will, by the laws of probability, nudge the system toward disorder or uselessness—not because nature strives for disorder, but because there are so many more ways of being disorderly than of being orderly. If you walk away from a sandcastle, it won't be there tomorrow, because as the wind, waves, seagulls, and small children push the grains of sand around, they're more likely to arrange them into one of the vast number of configurations that don't look like a castle than into the tiny few that do. I'll often refer to the statistical version of the Second Law, which does not apply specifically to temperature differences evening out but to order dissipating, as the Law of Entropy.

How is entropy relevant to human affairs? Life and happiness depend on an infinitesimal sliver of orderly arrangements of matter amid the astronomical number of possibilities. Our bodies are improbable assemblies of molecules, and they maintain that order with the help of other improbabilities: the few substances that can nourish us, the few materials in the few shapes that can clothe us, shelter us, and move things around to our liking. Far more of the arrangements of matter found on Earth are of no worldly use to us, so when things change without a human agent directing the change, they are likely to change for the worse. The Law of Entropy is widely acknowledged in everyday life in sayings such as "Things fall apart," "Rust never sleeps," "Shit happens," "Whatever can go wrong will go wrong," and (from the Texas lawmaker Sam Rayburn) "Any jackass can kick down a barn, but it takes a carpenter to build one."

Scientists appreciate that the Second Law is far more than an explanation of everyday nuisances. It is a foundation of our understanding of the universe and our place in it. In 1928 the physicist Arthur Eddington wrote:

> The law that entropy always increases ... holds, I think, the supreme position among the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations—then so much the worse for Maxwell's equations. If it is found to be contradicted by observation—well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation.[2]

In his famous 1959 Rede lectures, published as *The Two Cultures and the Scientific Revolution,* the scientist and novelist C. P. Snow commented on the disdain for science among educated Britons in his day:

> A good many times I have been present at gatherings of people who, by the standards of the traditional culture, are thought highly educated and who have with considerable gusto been expressing their incredulity at the illiteracy of scientists. Once or twice I have been provoked and have asked the company how

and which was a foundation of several Enlightenment-era theories of life and mind.[7]

The ironclad requirement to suck energy out of the environment leads to one of the tragedies of living things. While plants bask in solar energy, and a few creatures of the briny deep soak up the chemical broth spewing from cracks in the ocean floor, animals are born exploiters: they live off the hard-won energy stored in the bodies of plants and other animals by eating them. So do the viruses, bacteria, and other pathogens and parasites that gnaw at bodies from the inside. With the exception of fruit, everything we call "food" is the body part or energy store of some other organism, which would just as soon keep that treasure for itself. Nature is a war, and much of what captures our attention in the natural world is an arms race. Prey animals protect themselves with shells, spines, claws, horns, venom, camouflage, flight, or self-defense; plants have thorns, rinds, bark, and irritants and poisons saturating their tissues. Animals evolve weapons to penetrate these defenses: carnivores have speed, talons, and eagle-eyed vision, while herbivores have grinding teeth and livers that detoxify natural poisons.

~

And now we come to the third keystone, information.[8] Information may be thought of as a reduction in entropy—as the ingredient that distinguishes an orderly, structured system from the vast set of random, useless ones.[9] Imagine pages of random characters tapped out by a monkey at a typewriter, or a stretch of white noise from a radio tuned between channels, or a screenful of confetti from a corrupted computer file. Each of these objects can take trillions of different forms, each as boring as the next. But now suppose that the devices are controlled by a signal that arranges the characters or sound waves or pixels into a pattern that correlates with something in the world: the Declaration of Independence, the opening bars of "Hey Jude," a cat wearing sunglasses. We say that the signal transmits *information* about the Declaration or the song or the cat.[10]

The information contained in a pattern depends on how coarsely or finely grained our view of the world is. If we cared about the *exact* sequence of characters in the monkey's output, or the precise difference between one burst of noise and another, or the particular pattern of pixels in just one of the haphazard displays, then we would have to say that each of the items contains the same amount of information as the others. Indeed, the interesting ones would contain *less* information, because when you look at one part (like the letter *q*) you can guess others (such as the following letter, *u*) without needing the signal. But more commonly we lump together the immense majority of

random-looking configurations as equivalently boring, and distinguish them all from the tiny few that correlate with something else. From that vantage point the cat photo contains more information than the confetti of pixels, because it takes a garrulous message to pinpoint a rare orderly configuration out of the vast number of equivalently disorderly ones. To say that the universe is orderly rather than random is to say that it contains information in this sense. Some physicists enshrine information as one of the basic constituents of the universe, together with matter and energy.[11]

Information is what gets accumulated in a genome in the course of evolution. The sequence of bases in a DNA molecule correlates with the sequence of amino acids in the proteins that make up the organism's body, and they got that sequence by structuring the organism's ancestors—reducing their entropy—into the improbable configurations that allowed them to capture energy and grow and reproduce.

Information is also collected by an animal's nervous system as it lives its life. When the ear transduces sound into neural firings, the two physical processes—vibrating air and diffusing ions—could not be more different. But thanks to the correlation between them, the pattern of neural activity in the animal's brain carries information about the sound in the world. From there the information can switch from electrical to chemical and back as it crosses the synapses connecting one neuron to the next; through all these physical transformations, the information is preserved.

A momentous discovery of 20th-century theoretical neuroscience is that networks of neurons not only can preserve information but can transform it in ways that allow us to explain how brains can be *intelligent*. Two input neurons can be connected to an output neuron in such a way that their firing patterns correspond to logical relations such as AND, OR, and NOT, or to a statistical decision that depends on the weight of the incoming evidence. That gives neural networks the power to engage in information processing or computation. Given a large enough network built out of these logical and statistical circuits (and with billions of neurons, the brain has room for plenty), a brain can compute complex functions, the prerequisite for intelligence. It can transform the information about the world that it receives from the sense organs in a way that mirrors the laws governing that world, which in turn allows it to make useful inferences and predictions.[12] Internal representations that reliably correlate with states of the world, and that participate in inferences that tend to derive true implications from true premises, may be called knowledge.[13] We say that someone knows what a robin is if she thinks the thought "robin" whenever she sees one, and if she can infer that it is a kind of bird which appears in the spring and pulls worms out of the ground.

Getting back to evolution, a brain wired by information in the genome to perform computations on information coming in from the senses could organize the animal's behavior in a way that allowed it to capture energy and resist entropy. It could, for example, implement the rule "If it squeaks, chase it; if it barks, flee from it."

Chasing and fleeing, though, are not just sequences of muscle contractions—they are *goal-directed.* Chasing may consist of running or climbing or leaping or ambushing, depending on the circumstances, as long as it increases the chances of snagging the prey; fleeing may include hiding or freezing or zigzagging. And that brings up another momentous 20th-century idea, sometimes called cybernetics, feedback, or control. The idea explains how a physical system can appear to be teleological, that is, directed by purposes or goals. All it needs are a way of sensing the state of itself and its environment, a representation of a goal state (what it "wants," what it's "trying for"), an ability to compute the difference between the current state and the goal state, and a repertoire of actions that are tagged with their typical effects. If the system is wired so that it triggers actions that typically reduce the difference between the current state and the goal state, it can be said to pursue goals (and when the world is sufficiently predictable, it will attain them). The principle was discovered by natural selection in the form of homeostasis, as when our bodies regulate their temperature by shivering and sweating. When it was discovered by humans, it was engineered into analog systems like thermostats and cruise control and then into digital systems like chess-playing programs and autonomous robots.

The principles of information, computation, and control bridge the chasm between the physical world of cause and effect and the mental world of knowledge, intelligence, and purpose. It's not just a rhetorical aspiration to say that ideas can change the world; it's a fact about the physical makeup of brains. The Enlightenment thinkers had an inkling that thought could consist of patterns in matter—they likened ideas to impressions in wax, vibrations in a string, or waves from a boat. And some, like Hobbes, proposed that "reasoning is but reckoning," in the original sense of *reckoning* as calculation. But before the concepts of information and computation were elucidated, it was reasonable for someone to be a mind-body dualist and attribute mental life to an immaterial soul (just as before the concept of evolution was elucidated, it was reasonable to be a creationist and attribute design in nature to a cosmic designer). That's another reason, I suspect, that so many Enlightenment thinkers were deists.

Of course it's natural to think twice about whether your cell phone truly "knows" a favorite number, your GPS is really "figuring out" the best route home, and your Roomba is genuinely "trying" to clean the floor. But as information-processing systems become more sophisticated—as their

representations of the world become richer, their goals are arranged into hierarchies of subgoals within subgoals, and their actions for attaining the goals become more diverse and less predictable—it starts to look like hominid chauvinism to insist that they don't. (Whether information and computation explain *consciousness,* in addition to knowledge, intelligence, and purpose, is a question I'll turn to in the final chapter.)

Human intelligence remains the benchmark for the artificial kind, and what makes *Homo sapiens* an unusual species is that our ancestors invested in bigger brains that collected more information about the world, reasoned about it in more sophisticated ways, and deployed a greater variety of actions to achieve their goals. They specialized in the cognitive niche, also called the cultural niche and the hunter-gatherer niche.[14] This embraced a suite of new adaptations, including the ability to manipulate mental models of the world and predict what would happen if one tried out new things; the ability to cooperate with others, which allowed teams of people to accomplish what a single person could not; and language, which allowed them to coordinate their actions and to pool the fruits of their experience into the collections of skills and norms we call cultures.[15] These investments allowed early hominids to defeat the defenses of a wide range of plants and animals and reap the bounty in energy, which stoked their expanding brains, giving them still more know-how and access to still more energy. A well-studied contemporary hunter-gatherer tribe, the Hadza of Tanzania, who live in the ecosystem where modern humans first evolved and probably preserve much of their lifestyle, extract 3,000 calories daily per person from more than 880 species.[16] They create this menu through ingenious and uniquely human ways of foraging, such as felling large animals with poison-tipped arrows, smoking bees out of their hives to steal their honey, and enhancing the nutritional value of meat and tubers by cooking them.

Energy channeled by knowledge is the elixir with which we stave off entropy, and advances in energy capture are advances in human destiny. The invention of farming around ten thousand years ago multiplied the availability of calories from cultivated plants and domesticated animals, freed a portion of the population from the demands of hunting and gathering, and eventually gave them the luxury of writing, thinking, and accumulating their ideas. Around 500 BCE, in what the philosopher Karl Jaspers called the Axial Age, several widely separated cultures pivoted from systems of ritual and sacrifice that merely warded off misfortune to systems of philosophical and religious belief that promoted selflessness and promised spiritual transcendence.[17] Taoism and Confucianism in China, Hinduism, Buddhism, and Jainism in India, Zoroastrianism in Persia, Second Temple Judaism in Judea, and classical Greek philosophy and drama emerged within a few centuries of one another.

(Confucius, Buddha, Pythagoras, Aeschylus, and the last of the Hebrew prophets walked the earth at the same time.) Recently an interdisciplinary team of scholars identified a common cause.[18] It was not an aura of spirituality that descended on the planet but something more prosaic: energy capture. The Axial Age was when agricultural and economic advances provided a burst of energy: upwards of 20,000 calories per person per day in food, fodder, fuel, and raw materials. This surge allowed the civilizations to afford larger cities, a scholarly and priestly class, and a reorientation of their priorities from short-term survival to long-term harmony. As Bertolt Brecht put it millennia later: Grub first, then ethics.[19]

When the Industrial Revolution released a gusher of usable energy from coal, oil, and falling water, it launched a Great Escape from poverty, disease, hunger, illiteracy, and premature death, first in the West and increasingly in the rest of the world (as we shall see in chapters 5–8). And the next leap in human welfare—the end of extreme poverty and spread of abundance, with all its moral benefits—will depend on technological advances that provide energy at an acceptable economic and environmental cost to the entire world (chapter 10).

~

Entro, evo, info. These concepts define the narrative of human progress: the tragedy we were born into, and our means for eking out a better existence.

The first piece of wisdom they offer is that *misfortune may be no one's fault.* A major breakthrough of the Scientific Revolution—perhaps its biggest breakthrough—was to refute the intuition that the universe is saturated with purpose. In this primitive but ubiquitous understanding, everything happens for a reason, so when bad things happen—accidents, disease, famine, poverty—some agent must have *wanted* them to happen. If a person can be fingered for the misfortune, he can be punished or squeezed for damages. If no individual can be singled out, one might blame the nearest ethnic or religious minority, who can be lynched or massacred in a pogrom. If no mortal can plausibly be indicted, one might cast about for witches, who may be burned or drowned. Failing that, one points to sadistic gods, who cannot be punished but can be placated with prayers and sacrifices. And then there are disembodied forces like karma, fate, spiritual messages, cosmic justice, and other guarantors of the intuition that "everything happens for a reason."

Galileo, Newton, and Laplace replaced this cosmic morality play with a clockwork universe in which events are caused by conditions in the present, not goals for the future.[20] *People* have goals, of course, but projecting goals onto the workings of nature is an illusion. Things can happen without anyone taking into account their effects on human happiness.

people the means to think about a variable with a value and about a cause and its effect—just the conceptual machinery one needs to frame theories and laws. They can do this not just with the elements of thought but with more complex assemblies, allowing them to think in metaphors and analogies: heat is a fluid, a message is a container, a society is a family, obligations are bonds.

The second stepladder of cognition is its combinatorial, recursive power. The mind can entertain an explosive variety of ideas by assembling basic concepts like thing, place, path, actor, cause, and goal into propositions. And it can entertain not only propositions, but propositions about the propositions, and propositions about the propositions about the propositions. Bodies contain humors; illness is an imbalance in the humors that bodies contain; I no longer believe the theory that illness is an imbalance in the humors that bodies contain.

Thanks to language, ideas are not just abstracted and combined inside the head of a single thinker but can be pooled across a community of thinkers. Thomas Jefferson explained the power of language with the help of an analogy: "He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me."[30] The potency of language as the original sharing app was multiplied by the invention of writing (and again in later epochs by the printing press, the spread of literacy, and electronic media). The networks of communicating thinkers expanded over time as populations grew, mixed, and became concentrated in cities. And the availability of energy beyond the minimum needed for survival gave more of them the luxury to think and talk.

When large and connected communities take shape, they can come up with ways of organizing their affairs that work to their members' mutual advantage. Though everyone wants to be right, as soon as people start to air their incompatible views it becomes clear that not everyone can be right about everything. Also, the desire to be right can collide with a second desire, to know the truth, which is uppermost in the minds of bystanders to an argument who are not invested in which side wins. Communities can thereby come up with rules that allow true beliefs to emerge from the rough-and-tumble of argument, such as that you have to provide reasons for your beliefs, you're allowed to point out flaws in the beliefs of others, and you're not allowed to forcibly shut people up who disagree with you. Add in the rule that you should allow the world to show you whether your beliefs are true or false, and we can call the rules science. With the right rules, a community of less than fully rational thinkers can cultivate rational thoughts.[31]

The wisdom of crowds can also elevate our moral sentiments. When a wide enough circle of people confer on how best to treat each other, the conversation is bound to go in certain directions. If my starting offer is "I get to rob, beat,

enslave, and kill you and your kind, but you don't get to rob, beat, enslave, or kill me or my kind," I can't expect you to agree to the deal or third parties to ratify it, because there's no good reason that I should get privileges just because I'm me and you're not.[32] Nor are we likely to agree to the deal "I get to rob, beat, enslave, and kill you and your kind, and you get to rob, beat, enslave, and kill me and my kind," despite its symmetry, because the advantages either of us might get in harming the other are massively outweighed by the disadvantages we would suffer in being harmed (yet another implication of the Law of Entropy: harms are easier to inflict and have larger effects than benefits). We'd be wiser to negotiate a social contract that puts us in a positive-sum game: neither gets to harm the other, and both are encouraged to help the other.

So for all the flaws in human nature, it contains the seeds of its own improvement, as long as it comes up with norms and institutions that channel parochial interests into universal benefits. Among those norms are free speech, nonviolence, cooperation, cosmopolitanism, human rights, and an acknowledgment of human fallibility, and among the institutions are science, education, media, democratic government, international organizations, and markets. Not coincidentally, these were the major brainchildren of the Enlightenment.

CHAPTER 3

Counter-Enlightenments

Who could be against reason, science, humanism, or progress? The words seem saccharine, the ideals unexceptionable. They define the missions of all the institutions of modernity—schools, hospitals, charities, news agencies, democratic governments, international organizations. Do these ideals really need a defense?

They absolutely do. Since the 1960s, trust in the institutions of modernity has sunk, and the second decade of the 21st century saw the rise of populist movements that blatantly repudiate the ideals of the Enlightenment.[1] They are tribalist rather than cosmopolitan, authoritarian rather than democratic, contemptuous of experts rather than respectful of knowledge, and nostalgic for an idyllic past rather than hopeful for a better future. But these reactions are by no means confined to 21st-century political populism (a movement we will examine in chapters 20 and 23). Far from sprouting from the grass roots or channeling the anger of know-nothings, the disdain for reason, science, humanism, and progress has a long pedigree in elite intellectual and artistic culture.

Indeed, a common criticism of the Enlightenment project—that it is a Western invention, unsuited to the world in all its diversity—is doubly wrongheaded. For one thing, all ideas have to come from somewhere, and their birthplace has no bearing on their merit. Though many Enlightenment ideas were articulated in their clearest and most influential form in 18th-century Europe and America, they are rooted in reason and human nature, so any reasoning human can engage with them. That's why Enlightenment ideals have been articulated in non-Western civilizations at many times in history.[2]

But my main reaction to the claim that the Enlightenment is the guiding ideal of the West is: If only! The Enlightenment was swiftly followed by a counter-Enlightenment, and the West has been divided ever since.[3] No sooner did people step into the light than they were advised that darkness wasn't so bad after all, that they should stop daring to understand so much, that dogmas and formulas deserved another chance, and that human nature's destiny was not progress but decline.

The Romantic movement pushed back particularly hard against Enlightenment ideals. Rousseau, Johann Herder, Friedrich Schelling, and others denied that reason could be separated from emotion, that individuals could be considered apart from their culture, that people should provide reasons for their acts, that values applied across times and places, and that peace and prosperity were desirable ends. A human is a part of an organic whole—a culture, race, nation, religion, spirit, or historical force—and people should creatively channel the transcendent unity of which they are a part. Heroic struggle, not the solving of problems, is the greatest good, and violence is inherent to nature and cannot be stifled without draining life of its vitality. "There are but three groups worthy of respect," wrote Charles Baudelaire, "the priest, the warrior, and the poet. To know, to kill, and to create."

It sounds mad, but in the 21st century those counter-Enlightenment ideals continue to be found across a surprising range of elite cultural and intellectual movements. The notion that we should apply our collective reason to enhance flourishing and reduce suffering is considered crass, naïve, wimpy, square. Let me introduce some of the popular alternatives to reason, science, humanism, and progress; they will reappear in other chapters, and in part III of the book I will confront them head on.

The most obvious is religious faith. To take something on faith means to believe it without good reason, so by definition a faith in the existence of supernatural entities clashes with reason. Religions also commonly clash with humanism whenever they elevate some moral good above the well-being of humans, such as accepting a divine savior, ratifying a sacred narrative, enforcing rituals and taboos, proselytizing other people to do the same, and punishing or demonizing those who don't. Religions can also clash with humanism by valuing *souls* above *lives,* which is not as uplifting as it sounds. Belief in an afterlife implies that health and happiness are not such a big deal, because life on earth is an infinitesimal portion of one's existence; that coercing people into accepting salvation is doing them a favor; and that martyrdom may be the best thing that can ever happen to you. As for incompatibilities with science, these are the stuff of legend and current events, from Galileo and the Scopes Monkey Trial to stem-cell research and climate change.

A second counter-Enlightenment idea is that people are the expendable cells of a superorganism—a clan, tribe, ethnic group, religion, race, class, or nation—and that the supreme good is the glory of this collectivity rather than the well-being of the people who make it up. An obvious example is nationalism, in which the superorganism is the nation-state, namely an ethnic group with a government. We see the clash between nationalism and humanism in morbid patriotic slogans like "Dulce et decorum est pro patria mori" (Sweet and right it

is to die for your country) and "Happy those who with a glowing faith in one embrace clasped death and victory."[4] Even John F. Kennedy's less gruesome "Ask not what your country can do for you; ask what you can do for your country" makes the tension clear.

Nationalism should not be confused with civic values, public spirit, social responsibility, or cultural pride. Humans are a social species, and the well-being of every individual depends on patterns of cooperation and harmony that span a community. When a "nation" is conceived as a tacit social contract among people sharing a territory, like a condominium association, it is an essential means for advancing its members' flourishing. And of course it is genuinely admirable for one individual to sacrifice his or her interests for those of many individuals. It's quite another thing when a person is forced to make the supreme sacrifice for the benefit of a charismatic leader, a square of cloth, or colors on a map. Nor is it sweet and right to clasp death in order to prevent a province from seceding, expand a sphere of influence, or carry out an irredentist crusade.

Religion and nationalism are signature causes of political conservatism, and continue to affect the fate of billions of people in the countries under their influence. Many left-wing colleagues who learned that I was writing a book on reason and humanism egged me on, relishing the prospect of an arsenal of talking points against the right. But not so long ago the left was sympathetic to nationalism when it was fused with Marxist liberation movements. And many on the left encourage identity politicians and social justice warriors who downplay individual rights in favor of equalizing the standing of races, classes, and genders, which they see as being pitted in zero-sum competition.

Religion, too, has defenders on both halves of the political spectrum. Even writers who are unwilling to defend the literal content of religious beliefs may be fiercely defensive of religion and hostile to the idea that science and reason have anything to say about morality (most of them show little awareness that humanism even exists).[5] Defenders of the faith insist that religion has the exclusive franchise for questions about what matters. Or that even if we sophisticated people don't need religion to be moral, the teeming masses do. Or that even if everyone would be better off without religious faith, it's pointless to talk about the place of religion in the world because religion is a part of human nature, which is why, mocking Enlightenment hopes, it is more tenacious than ever. In chapter 23 I will examine all these claims.

The left tends to be sympathetic to yet another movement that subordinates human interests to a transcendent entity, the ecosystem. The romantic Green movement sees the human capture of energy not as a way of resisting entropy and enhancing human flourishing but as a heinous crime against nature, which

has risen, and then multiplied that sympathy by a few hundred million, might wonder why "coming to terms with great literature" is morally superior to "raising the standard of living" as a criterion for "what at bottom we really believe"—or why the two should be seen as alternatives in the first place.)

As we shall see in chapter 22, Leavis's outlook may be found in a wide swath of the Second Culture today. Many intellectuals and critics express a disdain for science as anything but a fix for mundane problems. They write as if the consumption of elite art is the ultimate moral good. Their methodology for seeking the truth consists not in framing hypotheses and citing evidence but in issuing pronouncements that draw on their breadth of erudition and lifetime habits of reading. Intellectual magazines regularly denounce "scientism," the intrusion of science into the territory of the humanities such as politics and the arts. In many colleges and universities, science is presented not as the pursuit of true explanations but as just another narrative or myth. Science is commonly blamed for racism, imperialism, world wars, and the Holocaust. And it is accused of robbing life of its enchantment and stripping humans of freedom and dignity.

Enlightenment humanism, then, is far from being a crowd-pleaser. The idea that the ultimate good is to use knowledge to enhance human welfare leaves people cold. Deep explanations of the universe, the planet, life, the brain? Unless they use magic, we don't want to believe them! Saving the lives of billions, eradicating disease, feeding the hungry? *Bo*-ring. People extending their compassion to all of humankind? Not good enough—we want *the laws of physics* to care about us! Longevity, health, understanding, beauty, freedom, love? There's got to be more to life than that!

But it's the idea of progress that sticks most firmly in the craw. Even people who think it is a fine idea in theory to use knowledge to improve well-being insist it will never work in practice. And the daily news offers plenty of support for their cynicism: the world is depicted as a vale of tears, a tale of woe, a slough of despond. Since any defense of reason, science, and humanism would count for nothing if, two hundred and fifty years after the Enlightenment, we're no better off than our ancestors in the Dark Ages, an appraisal of human progress is where the case must begin.

Part II

PROGRESS

If you had to choose a moment in history to be born, and you did not know ahead of time who you would be—you didn't know whether you were going to be born into a wealthy family or a poor family, what country you'd be born in, whether you were going to be a man or a woman—if you had to choose blindly what moment you'd want to be born, you'd choose now.

—Barack Obama, 2016

CHAPTER 4

Progressophobia

Intellectuals hate progress. Intellectuals who call themselves "progressive" *really* hate progress. It's not that they hate the *fruits* of progress, mind you: most pundits, critics, and their *bien-pensant* readers use computers rather than quills and inkwells, and they prefer to have their surgery with anesthesia rather than without it. It's the *idea* of progress that rankles the chattering class—the Enlightenment belief that by understanding the world we can improve the human condition.

An entire lexicon of abuse has grown up to express their scorn. If you think knowledge can help solve problems, then you have a "blind faith" and a "quasi-religious belief" in the "outmoded superstition" and "false promise" of the "myth" of the "onward march" of "inevitable progress." You are a "cheerleader" for "vulgar American can-doism" with the "rah-rah" spirit of "boardroom ideology," "Silicon Valley," and the "Chamber of Commerce." You are a practitioner of "Whig history," a "naïve optimist," a "Pollyanna," and of course a "Pangloss," a modern-day version of the philosopher in Voltaire's *Candide* who asserts that "all is for the best in the best of all possible worlds."

Professor Pangloss, as it happens, is what we would now call a pessimist. A modern optimist believes that the world can be *much, much* better than it is today. Voltaire was satirizing not the Enlightenment hope for progress but its opposite, the religious rationalization for suffering called theodicy, according to which God had no choice but to allow epidemics and massacres because a world without them is metaphysically impossible.

Epithets aside, the idea that the world is better than it was and can get better still fell out of fashion among the clerisy long ago. In *The Idea of Decline in Western History,* Arthur Herman shows that prophets of doom are the all-stars of the liberal arts curriculum, including Nietzsche, Arthur Schopenhauer, Martin Heidegger, Theodor Adorno, Walter Benjamin, Herbert Marcuse, Jean-Paul Sartre, Frantz Fanon, Michel Foucault, Edward Said, Cornel West, and a chorus of eco-pessimists.[1] Surveying the intellectual landscape at the end of the 20th century, Herman lamented a "grand recessional" of "the luminous exponents" of Enlightenment humanism, the ones who believed that "since people generate

conflicts and problems in society, they can also resolve them." In *History of the Idea of Progress,* the sociologist Robert Nisbet agreed: "The skepticism regarding Western progress that was once confined to a very small number of intellectuals in the nineteenth century has grown and spread to not merely the large majority of intellectuals in this final quarter of the century, but to many millions of other people in the West."[2]

Yes, it's not just those who intellectualize for a living who think the world is going to hell in a handcart. It's ordinary people when they switch into intellectualizing mode. Psychologists have long known that people tend to see their own lives through rose-colored glasses: they think they're less likely than the average person to become the victim of a divorce, layoff, accident, illness, or crime. But change the question from the people's *lives* to their *society,* and they transform from Pollyanna to Eeyore.

Public opinion researchers call it the Optimism Gap.[3] For more than two decades, through good times and bad, when Europeans were asked by pollsters whether their *own* economic situation would get better or worse in the coming year, more of them said it would get better, but when they were asked about their *country's* economic situation, more of them said it would get worse.[4] A large majority of Britons think that immigration, teen pregnancy, litter, unemployment, crime, vandalism, and drugs are a problem in the United Kingdom as a whole, while few think they are problems in their area.[5] Environmental quality, too, is judged in most nations to be worse in the nation than in the community, and worse in the world than in the nation.[6] In almost every year from 1992 through 2015, an era in which the rate of violent crime plummeted, a majority of Americans told pollsters that crime was rising.[7] In late 2015, large majorities in eleven developed countries said that "the world is getting worse," and in most of the last forty years a solid majority of Americans have said that the country is "heading in the wrong direction."[8]

Are they right? Is pessimism correct? Could the state of the world, like the stripes on a barbershop pole, keep sinking lower and lower? It's easy to see why people feel that way: every day the news is filled with stories about war, terrorism, crime, pollution, inequality, drug abuse, and oppression. And it's not just the headlines we're talking about; it's the op-eds and long-form stories as well. Magazine covers warn us of coming anarchies, plagues, epidemics, collapses, and so many "crises" (farm, health, retirement, welfare, energy, deficit) that copywriters have had to escalate to the redundant "serious crisis."

Whether or not the world really is getting worse, the nature of news will interact with the nature of cognition to make us think that it is. News is about things that happen, not things that don't happen. We never see a journalist saying to the camera, "I'm reporting live from a country where a war has not

broken out"—or a city that has not been bombed, or a school that has not been shot up. As long as bad things have not vanished from the face of the earth, there will always be enough incidents to fill the news, especially when billions of smartphones turn most of the world's population into crime reporters and war correspondents.

And among the things that do happen, the positive and negative ones unfold on different time lines. The news, far from being a "first draft of history," is closer to play-by-play sports commentary. It focuses on discrete events, generally those that took place since the last edition (in earlier times, the day before; now, seconds before).[9] Bad things can happen quickly, but good things aren't built in a day, and as they unfold, they will be out of sync with the news cycle. The peace researcher Johan Galtung pointed out that if a newspaper came out once every fifty years, it would not report half a century of celebrity gossip and political scandals. It would report momentous global changes such as the increase in life expectancy.[10]

The nature of news is likely to distort people's view of the world because of a mental bug that the psychologists Amos Tversky and Daniel Kahneman called the Availability heuristic: people estimate the probability of an event or the frequency of a kind of thing by the ease with which instances come to mind.[11] In many walks of life this is a serviceable rule of thumb. Frequent events leave stronger memory traces, so stronger memories generally indicate more-frequent events: you really are on solid ground in guessing that pigeons are more common in cities than orioles, even though you're drawing on your memory of encountering them rather than on a bird census. But whenever a memory turns up high in the result list of the mind's search engine for reasons other than frequency—because it is recent, vivid, gory, distinctive, or upsetting—people will overestimate how likely it is in the world. Which are more numerous in the English language, words that begin with *k* or words with *k* in the third position? Most people say the former. In fact, there are three times as many words with *k* in the third position (*ankle, ask, awkward, bake, cake, make, take* ...), but we retrieve words by their initial sounds, so *keep, kind, kill, kid,* and *king* are likelier to pop into mind on demand.

Availability errors are a common source of folly in human reasoning. First-year medical students interpret every rash as a symptom of an exotic disease, and vacationers stay out of the water after they have read about a shark attack or if they have just seen *Jaws.*[12] Plane crashes always make the news, but car crashes, which kill far more people, almost never do. Not surprisingly, many people have a fear of flying, but almost no one has a fear of driving. People rank tornadoes (which kill about fifty Americans a year) as a more common cause of

always be monotonic because solutions to problems create new problems.[18] But progress can resume when the new problems are solved in their turn.

By the way, the nonmonotonicity of social data provides an easy formula for news outlets to accentuate the negative. If you ignore all the years in which an indicator of some problem declines, and report every uptick (since, after all, it's "news"), readers will come away with the impression that life is getting worse and worse even as it gets better and better. In the first six months of 2016 the *New York Times* pulled this trick three times, with figures for suicide, longevity, and automobile fatalities.

Well, if levels of violence don't always go down, that means they're cyclical, so even if they're low right now it's only a matter of time before they go back up.

No, changes over time may be *statistical,* with unpredictable fluctuations, without being *cyclical,* namely oscillating like a pendulum between two extremes. That is, even if a reversal is possible at any time, that does not mean it becomes more likely as time passes. (Many investors have lost their shirts betting on a misnamed "business cycle" that in fact consists of unpredictable swings.) Progress can take place when the reversals in a positive trend become less frequent, become less severe, or, in some cases, cease altogether.

How can you say that violence has decreased? Didn't you read about the school shooting (or terrorist bombing, or artillery shelling, or soccer riot, or barroom stabbing) in the news this morning?

A decline is not the same thing as a disappearance. (The statement "$x > y$" is different from the statement "$y = 0$.") Something can decrease a lot without vanishing altogether. That means that the level of violence today is *completely irrelevant* to the question of whether violence has declined over the course of history. The only way to answer that question is to compare the level of violence now with the level of violence in the past. And whenever you look at the level of violence in the past, you find a lot of it, even if it isn't as fresh in memory as the morning's headlines.

All your fancy statistics about violence going down don't mean anything if you're one of the victims.

True, but they do mean that you're less likely to *be* a victim. For that reason they mean the world to the millions of people who are not victims but would have been if rates of violence had stayed the same.

So you're saying that we can all sit back and relax, that violence will just take care of itself.

Illogical, Captain. If you see that a pile of laundry has gone down, it does not mean the clothes washed themselves; it means someone washed the clothes. If a type of violence has gone down, then some change in the social, cultural, or material milieu has caused it to go down. If the conditions persist, violence could

remain low or decline even further; if they don't, it won't. That makes it important to find out what the causes are, so we can try to intensify them and apply them more widely to ensure that the decline of violence continues.

To say that violence has gone down is to be naïve, sentimental, idealistic, romantic, starry-eyed, Whiggish, utopian, a Pollyanna, a Pangloss.

No, to look at data showing that violence has gone down and say "Violence has gone down" is to describe a fact. To look at data showing that violence has gone down and say "Violence has gone up" is to be delusional. To ignore data on violence and say "Violence has gone up" is to be a know-nothing.

As for accusations of romanticism, I can reply with some confidence. I am also the author of the staunchly unromantic, anti-utopian *The Blank Slate: The Modern Denial of Human Nature,* in which I argued that human beings are fitted by evolution with a number of destructive motives such as greed, lust, dominance, vengeance, and self-deception. But I believe that people are also fitted with a sense of sympathy, an ability to reflect on their predicament, and faculties to think up and share new ideas—the better angels of our nature, in the words of Abraham Lincoln. Only by looking at the facts can we tell to what extent our better angels have prevailed over our inner demons at a given time and place.

How can you predict that violence will keep going down? Your theory could be refuted by a war breaking out tomorrow.

A statement that some measure of violence has gone down is not a "theory" but an observation of a fact. And yes, the fact that a measure has changed over time is not the same as a prediction that it will continue to change in that way at all times forever. As the investment ads are required to say, past performance is no guarantee of future results.

In that case, what good are all those graphs and analyses? Isn't a scientific theory supposed to make testable predictions?

A scientific theory makes predictions in *experiments* in which the causal influences are controlled. No theory can make a prediction about the world at large, with its seven billion people spreading viral ideas in global networks and interacting with chaotic cycles of weather and resources. To declare what the future holds in an uncontrollable world, and without an explanation of why events unfold as they do, is not prediction but *prophecy,* and as David Deutsch observes, "The most important of all limitations on knowledge-creation is that we cannot prophesy: we cannot predict the content of ideas yet to be created, or their effects. This limitation is not only consistent with the unlimited growth of knowledge, it is entailed by it."[19]

Our inability to prophesy is not, of course, a license to ignore the facts. An improvement in some measure of human well-being suggests that, overall, more things have pushed in the right direction than in the wrong direction. Whether

we should expect progress to continue depends on whether we know what those forces are and how long they will remain in place. That will vary from trend to trend. Some may turn out to be like Moore's Law (the number of transistors per computer chip doubles every two years) and give grounds for confidence (though not certainty) that the fruits of human ingenuity will accumulate and progress will continue. Some may be like the stock market and foretell short-term fluctuations but long-term gains. Some of these may reel in a statistical distribution with a "thick tail," in which extreme events, even if less likely, cannot be ruled out.[20] Still others may be cyclical or chaotic. In chapters 19 and 21 we will examine rational forecasting in an uncertain world. For now we should keep in mind that a positive trend suggests (but does not prove) that we have been doing something right, and that we should seek to identify what it is and do more of it.

When all these objections are exhausted, I often see people racking their brains to find *some* way in which the news cannot be as good as the data suggest. In desperation, they turn to semantics.

Isn't Internet trolling a form of violence? Isn't strip-mining a form of violence? Isn't inequality a form of violence? Isn't pollution a form of violence? Isn't poverty a form of violence? Isn't consumerism a form of violence? Isn't divorce a form of violence? Isn't advertising a form of violence? Isn't keeping statistics on violence a form of violence?

As wonderful as metaphor is as a rhetorical device, it is a poor way to assess the state of humanity. Moral reasoning requires proportionality. It may be upsetting when someone says mean things on Twitter, but it is not the same as the slave trade or the Holocaust. It also requires distinguishing rhetoric from reality. Marching into a rape crisis center and demanding to know what they have done about the rape of the environment does nothing for rape victims and nothing for the environment. Finally, improving the world requires an understanding of cause and effect. Though primitive moral intuitions tend to lump bad things together and find a villain to blame them on, there is no coherent phenomenon of "bad things" that we can seek to understand and eliminate. (Entropy and evolution will generate them in profusion.) War, crime, pollution, poverty, disease, and incivility are evils that may have little in common, and if we want to reduce them, we can't play word games that make it impossible even to discuss them individually.

~

I have run through these objections to prepare the way for my presentation of other measures of human progress. The incredulous reaction to *Better Angels* convinced me that it isn't just the Availability heuristic that makes people fatalistic about progress. Nor can the media's fondness for bad news be blamed

entirely on a cynical chase for eyeballs and clicks. No, the psychological roots of progressophobia run deeper.

The deepest is a bias that has been summarized in the slogan "Bad is stronger than good."[21] The idea can be captured in a set of thought experiments suggested by Tversky.[22] How much better can you imagine yourself feeling than you are feeling right now? How much *worse* can you imagine yourself feeling? In answering the first hypothetical, most of us can imagine a bit more of a spring in our step or a twinkle in our eye, but the answer to the second one is: it's bottomless. This asymmetry in mood can be explained by an asymmetry in life (a corollary of the Law of Entropy). How many things could happen to you today that would leave you much better off? How many things could happen that would leave you much *worse* off? Once again, to answer the first question, we can all come up with the odd windfall or stroke of good luck, but the answer to the second one is: it's endless. But we needn't rely on our imaginations. The psychological literature confirms that people dread losses more than they look forward to gains, that they dwell on setbacks more than they savor good fortune, and that they are more stung by criticism than they are heartened by praise. (As a psycholinguist I am compelled to add that the English language has far more words for negative emotions than for positive ones.)[23]

One exception to the Negativity bias is found in autobiographical memory. Though we tend to remember bad events as well as we remember good ones, the negative coloring of the misfortunes fades with time, particularly the ones that happened to us.[24] We are wired for nostalgia: in human memory, time heals most wounds. Two other illusions mislead us into thinking that things ain't what they used to be: we mistake the growing burdens of maturity and parenthood for a less innocent world, and we mistake a decline in our own faculties for a decline in the times.[25] As the columnist Franklin Pierce Adams pointed out, "Nothing is more responsible for the good old days than a bad memory."

Intellectual culture should strive to counteract our cognitive biases, but all too often it reinforces them. The cure for the Availability bias is quantitative thinking, but the literary scholar Steven Connor has noted that "there is in the arts and humanities an exceptionless consensus about the encroaching horror of the domain of number."[26] This "ideological rather than accidental innumeracy" leads writers to notice, for example, that wars take place today and wars took place in the past and to conclude that "nothing has changed"—failing to acknowledge the difference between an era with a handful of wars that collectively kill in the thousands and an era with dozens of wars that collectively killed in the millions. And it leaves them unappreciative of systemic processes that eke out incremental improvements over the long term.

Nor is intellectual culture equipped to treat the Negativity bias. Indeed, our vigilance for bad things around us opens up a market for professional curmudgeons who call our attention to bad things we may have missed. Experiments have shown that a critic who pans a book is perceived as more competent than a critic who praises it, and the same may be true of critics of society.[27] "Always predict the worst, and you'll be hailed as a prophet," the musical humorist Tom Lehrer once advised. At least since the time of the Hebrew prophets, who blended their social criticism with forewarnings of disaster, pessimism has been equated with moral seriousness. Journalists believe that by accentuating the negative they are discharging their duty as watchdogs, muckrakers, whistleblowers, and afflicters of the comfortable. And intellectuals know they can attain instant gravitas by pointing to an unsolved problem and theorizing that it is a symptom of a sick society.

The converse is true as well. The financial writer Morgan Housel has observed that while pessimists sound like they're trying to help you, optimists sound like they're trying to sell you something.[28] Whenever someone offers a solution to a problem, critics will be quick to point out that it is not a panacea, a silver bullet, a magic bullet, or a one-size-fits-all solution; it's just a Band-Aid or a quick technological fix that fails to get at the root causes and will blow back with side effects and unintended consequences. Of course, since nothing is a panacea and everything has side effects (you can't do just one thing), these common tropes are little more than a refusal to entertain the possibility that anything can ever be improved.[29]

Pessimism among the intelligentsia can also be a form of one-upmanship. A modern society is a league of political, industrial, financial, technological, military, and intellectual elites, all competing for prestige and influence, and with differing responsibilities for making the society run. Complaining about modern society can be a backhanded way of putting down one's rivals—for academics to feel superior to businesspeople, businesspeople to feel superior to politicians, and so on. As Thomas Hobbes noted in 1651, "Competition of praise inclineth to a reverence of antiquity. For men contend with the living, not with the dead."

Pessimism, to be sure, has a bright side. The expanding circle of sympathy makes us concerned about harms that would have passed unnoticed in more callous times. Today we recognize the Syrian civil war as a humanitarian tragedy. The wars of earlier decades, such as the Chinese Civil War, the partition of India, and the Korean War, are seldom remembered that way, though they killed and displaced more people. When I grew up, bullying was considered a natural part of boyhood. It would have strained belief to think that someday the president of the United States would deliver a speech about its evils, as Barack

position to turn your nose up at these values—or to deny that other people should share your good fortune.

As it happens, the world does agree on these values. In the year 2000, all 189 members of the United Nations, together with two dozen international organizations, agreed on eight Millennium Development Goals for the year 2015 that blend right into this list.[31]

And here is a shocker: *The world has made spectacular progress in every single measure of human well-being.* Here is a second shocker: *Almost no one knows about it.*

Information about human progress, though absent from major news outlets and intellectual forums, is easy enough to find. The data are not entombed in dry reports but are displayed in gorgeous Web sites, particularly Max Roser's *Our World in Data,* Marian Tupy's *HumanProgress,* and Hans Rosling's *Gapminder.* (Rosling learned that not even swallowing a sword during a 2007 TED talk was enough to get the world's attention.) The case has been made in beautifully written books, some by Nobel laureates, which flaunt the news in their titles —*Progress, The Progress Paradox, Infinite Progress, The Infinite Resource, The Rational Optimist, The Case for Rational Optimism, Utopia for Realists, Mass Flourishing, Abundance, The Improving State of the World, Getting Better, The End of Doom, The Moral Arc, The Big Ratchet, The Great Escape, The Great Surge, The Great Convergence.*[32] (None was recognized with a major prize, but over the period in which they appeared, Pulitzers in nonfiction were given to four books on genocide, three on terrorism, two on cancer, two on racism, and one on extinction.) And for those whose reading habits tend toward listicles, recent years have offered "Five Amazing Pieces of Good News Nobody Is Reporting," "Five Reasons Why 2013 Was the Best Year in Human History," "Seven Reasons the World Looks Worse Than It Really Is," "26 Charts and Maps That Show the World Is Getting Much, Much Better," "40 Ways the World Is Getting Better," and my favorite, "50 Reasons We're Living Through the Greatest Period in World History." Let's look at some of those reasons.

CHAPTER 5

Life

The struggle to stay alive is the primal urge of animate beings, and humans deploy their ingenuity and conscious resolve to stave off death as long as possible. "Choose life, so that you and your children may live," commanded the God of the Hebrew Bible; "Rage, rage against the dying of the light," adjured Dylan Thomas. A long life is the ultimate blessing.

How long do you think an average person in the world can be expected to live today? Bear in mind that the global average is dragged down by the premature deaths from hunger and disease in the populous countries in the developing world, particularly by the deaths of infants, who mix a lot of zeroes into the average.

The answer for 2015 is 71.4 years.[1] How close is that to your guess? In a recent survey Hans Rosling found that less than one in four Swedes guessed that it was that high, a finding consistent with the results of other multinational surveys of opinions on longevity, literacy, and poverty in what Rosling dubbed the Ignorance Project. The logo of the project is a chimpanzee, because, as Rosling explained, "If for each question I wrote the alternatives on bananas, and asked chimpanzees in the zoo to pick the right answers, they'd have done better than the respondents." The respondents, including students and professors of global health, were not so much ignorant as fallaciously pessimistic.[2]

Figure 5-1, a plot from Max Roser of life expectancy over the centuries, displays a general pattern in world history. At the time when the lines begin, in the mid-18th century, life expectancy in Europe and the Americas was around 35, where it had been parked for the 225 previous years for which we have data.[3] Life expectancy for the world as a whole was 29. These numbers are in the range of expected life spans for most of human history. The life expectancy of hunter-gatherers is around 32.5, and it probably decreased among the peoples who first took up farming because of their starchy diet and the diseases they caught from their livestock and each other. It returned to the low 30s by the Bronze Age, where it stayed put for thousands of years, with small fluctuations across centuries and regions.[4] This period in human history may be called the Malthusian Era, when any advance in agriculture or health was quickly canceled

by the resulting bulge in population, though "era" is an odd term for 99.9 percent of our species' existence.

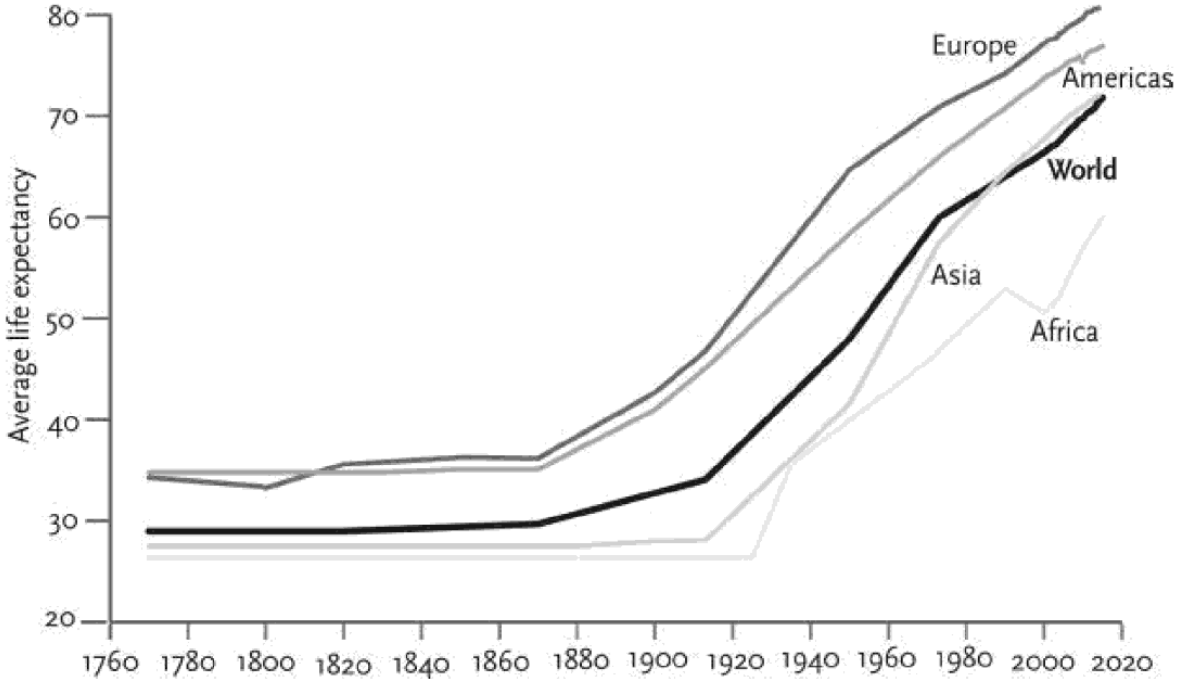

Figure 5-1: Life expectancy, 1771–2015

Sources: *Our World in Data*, Roser 2016n, based on data from Riley 2005 for the years before 2000 and from the World Health Organization and the World Bank for the subsequent years. Updated with data provided by Max Roser.

But starting in the 19th century, the world embarked on the Great Escape, the economist Angus Deaton's term for humanity's release from its patrimony of poverty, disease, and early death. Life expectancy began to rise, picked up speed in the 20th century, and shows no signs of slowing down. As the economic historian Johan Norberg points out, we tend to think that "we approach death by one year for every year we age, but during the twentieth century, the average person approached death by just seven months for every year they aged." Thrillingly, the gift of longevity is spreading to all of humankind, including the world's poorest countries, and at a much faster pace than it did in the rich ones. "Life expectancy in Kenya increased by almost ten years between 2003 and 2013," Norberg writes. "After having lived, loved and struggled for a whole decade, the average person in Kenya had not lost a single year of their remaining lifetime. Everyone got ten years older, yet death had not come a step closer."[5]

As a result, inequality in life expectancy, which opened up during the Great Escape when a few fortunate countries broke away from the pack, is shrinking as the rest catch up. In 1800, no country in the world had a life expectancy above 40. By 1950, it had grown to around 60 in Europe and the Americas, leaving Africa and Asia far behind. But since then Asia has shot up at twice the European rate, and Africa at one and a half times the rate. An African born today can

expect to live as long as a person born in the Americas in 1950 or in Europe in the 1930s. The average would have been longer still were it not for the calamity of AIDS, which caused the terrible trough in the 1990s before antiretroviral drugs started to bring it under control.

The African AIDS dip is a reminder that progress is not an escalator that inexorably raises the well-being of every human everywhere all the time. That would be magic, and progress is an outcome not of magic but of problem-solving. Problems are inevitable, and at times particular sectors of humanity have suffered terrible setbacks. In addition to the African AIDS epidemic, longevity went into reverse for young adults worldwide during the Spanish flu pandemic of 1918–19 and for middle-aged, non-college-educated, non-Hispanic white Americans in the early 21st century.[6] But problems are solvable, and the fact that longevity continues to increase in every other Western demographic means that solutions to the problems facing this one exist as well.

Average life spans are stretched the most by decreases in infant and child mortality, both because children are fragile and because the death of a child brings down the average more than the death of a 60-year-old. Figure 5-2 shows what has happened to child mortality since the Age of Enlightenment in five countries that are more or less representative of their continents.

Look at the numbers on the vertical axis: they refer to the percentage of children who die before reaching the age of 5. Yes, well into the 19th century, in Sweden, one of the world's wealthiest countries, between *a quarter and a third* of all children died before their fifth birthday, and in some years the death toll was close to half. This appears to be typical in human history: a fifth of hunter-gatherer children die in their first year, and almost half before they reach adulthood.[7] The spikiness in the curve before the 20th century reflects not just noise in the data but the parlous nature of life: an epidemic, war, or famine could bring death to one's door at any time. Even the well-to-do could be struck by tragedy: Charles Darwin lost two children in infancy and his beloved daughter Annie at the age of 10.

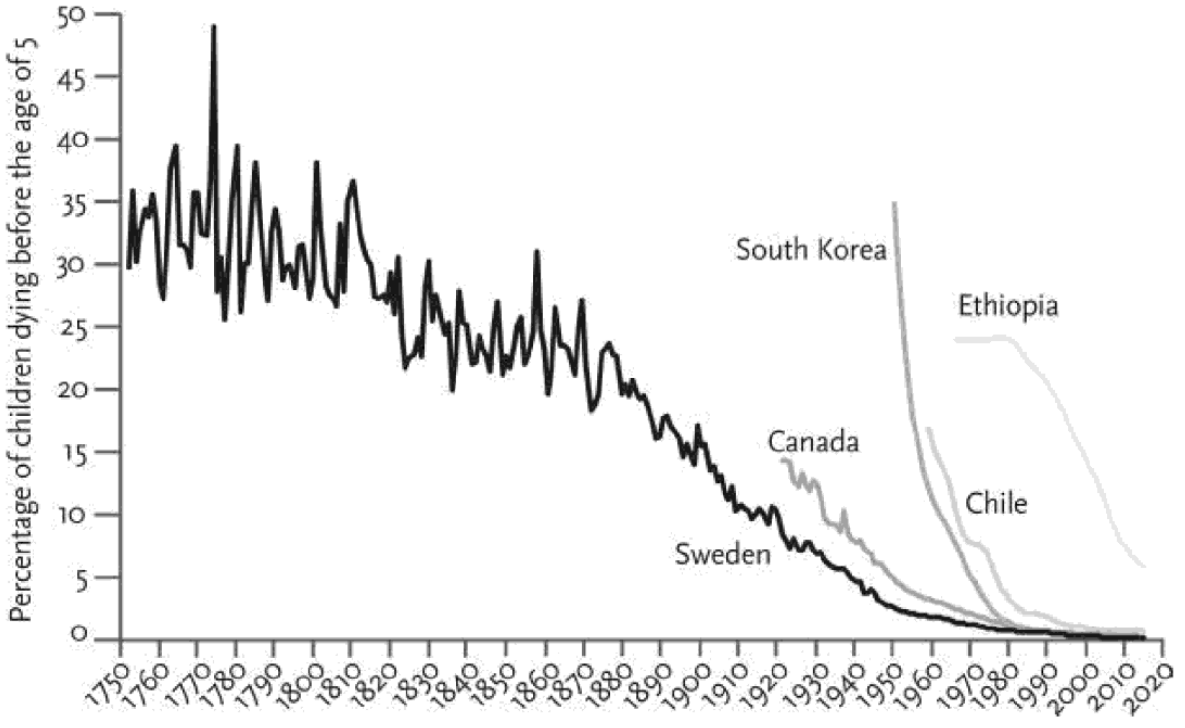

Figure 5-2: Child mortality, 1751–2013

Sources: *Our World in Data,* Roser 2016a, based on data from the UN Child Mortality estimates, http://www.childmortality.org/, and the *Human Mortality Database*, http://www.mortality.org/.

Then a remarkable thing happened. The rate of child mortality plunged a hundredfold, to a fraction of a percentage point in developed countries, and the plunge went global. As Deaton observed in 2013, "There is not a single country in the world where infant or child mortality today is not lower than it was in 1950."[8] In sub-Saharan Africa, the child mortality rate has fallen from around one in four in the 1960s to less than one in ten in 2015, and the global rate has fallen from 18 to 4 percent—still too high, but sure to come down if the current thrust to improve global health continues.

Remember two facts behind the numbers. One is demographic: when fewer children die, parents have fewer children, since they no longer have to hedge their bets against losing their entire families. So contrary to the worry that saving children's lives would only set off a "population bomb" (a major eco-panic of the 1960s and 1970s, which led to calls for reducing health care in the developing world), the decline in child mortality has defused it.[9]

The other is personal. The loss of a child is among the most devastating experiences. Imagine the tragedy; then try to imagine it another million times. That's a quarter of the number of children who did not die *last year alone* who would have died had they been born fifteen years earlier. Now repeat, two hundred times or so, for the years since the decline in child mortality began. Graphs like figure 5-2 display a triumph of human well-being whose magnitude the mind cannot begin to comprehend.

Similar trends, though with lower numbers (so far), have occurred in every part of the world. For example, a 10-year-old Ethiopian in 1950 could expect to live to 44; a 10-year-old Ethiopian today can expect to live to 61. The economist Steven Radelet has pointed out that "the improvements in health among the global poor in the last few decades are so large and widespread that they rank among the greatest achievements in human history. Rarely has the basic well-being of so many people around the world improved so substantially, so quickly. Yet few people are even aware that it is happening."[13]

And no, the extra years of life will not be spent senile in a rocking chair. Of course the longer you live, the more of those years you'll live as an older person, with its inevitable aches and pains. But bodies that are better at resisting a mortal blow are also better at resisting the lesser assaults of disease, injury, and wear. As the life span is stretched, our run of vigor is stretched out as well, even if not by the same number of years. A heroic project called the Global Burden of Disease has tried to measure this improvement by tallying not just the number of people who drop dead of each of 291 diseases and disabilities, but how many years of healthy life they lose, weighted by the degree to which each condition compromises the quality of their lives. For the world in 1990, the project estimated that 56.8 of the 64.5 years of life that an average person could be expected to live were years of *healthy* life. And at least in developed countries, where estimates are available for 2010 as well, we know that out of the 4.7 years of additional expected life we gained in those two decades, 3.8 were healthy years.[14] Numbers like these show that people today live far more years in the pink of health than their ancestors lived altogether, healthy and infirm years combined. For many people the greatest fear raised by the prospect of a longer life is dementia, but another pleasant surprise has come to light: between 2000 and 2012, the rate among Americans over 65 fell by a quarter, and the average age at diagnosis rose from 80.7 to 82.4 years.[15]

There is still more good news. The curves in figure 5-4 are not tapestries of your life that have been drawn out and measured by two of the Fates and will someday be cut by the third. Rather, they are projections from today's vital statistics, based on the assumption that medical knowledge will be frozen at its current state. It's not that anyone believes that assumption, but in the absence of clairvoyance about future medical advances we have no other choice. That means you will almost certainly live longer—perhaps much longer—than the numbers you read off the vertical axis.

People will complain about anything, and in 2001 George W. Bush appointed a President's Council on Bioethics to deal with the looming threat of biomedical advances that promise longer and healthier lives.[16] Its chairman, the physician and public intellectual Leon Kass, decreed that "the desire to prolong

youthfulness is an expression of a childish and narcissistic wish incompatible with a devotion to posterity," and that the years that would be added to other people's lives were not worth living ("Would professional tennis players really enjoy playing 25 percent more games of tennis?" he asks). Most people would rather decide that for themselves, and even if he is right that "mortality makes life matter," longevity is not the same as immortality.[17] But the fact that experts' assertions about maximum possible life expectancy have repeatedly been shattered (on average five years after they were published) raises the question of whether longevity will increase indefinitely and someday slip the surly bonds of mortality entirely.[18] Should we worry about a world of stodgy multicentenarians who will resist the innovations of ninety-something upstarts and perhaps ban the begetting of pesky children altogether?

A number of Silicon Valley visionaries are trying to bring that world closer.[19] They have funded research institutes which aim not to chip away at mortality one disease at a time but to reverse-engineer the aging process itself and upgrade our cellular hardware to a version without that bug. The result, they hope, will be an increase in the human life span of fifty, a hundred, even a thousand years. In his 2005 bestseller *The Singularity Is Near,* the inventor Ray Kurzweil forecasts that those of us who make it to 2045 will live forever, thanks to advances in genetics, nanotechnology (such as nanobots that will course through our bloodstream and repair our bodies from the inside), and artificial intelligence, which will not just figure out how to do all this but recursively improve its own intelligence without limit.

To readers of medical newsletters and other hypochondriacs, the prospects for immortality look rather different. We certainly find incremental improvements to celebrate, such as a decline in the death rate from cancer over the past twenty-five years of around a percentage point a year, saving a million lives in the United States alone.[20] But we also are regularly disappointed by miracle drugs that work no better than the placebo, treatments with side effects worse than the disease, and trumpeted benefits that wash out in the meta-analysis. Medical progress today is more Sisyphus than Singularity.

Lacking the gift of prophecy, no one can say whether scientists will ever find a cure for mortality. But evolution and entropy make it unlikely. Senescence is baked into our genome at every level of organization, because natural selection favors genes that make us vigorous when we are young over those that make us live as long as possible. That bias is built in because of the asymmetry of time: there is a nonzero probability at any moment that we will be felled by an unpreventable accident like a lightning strike or landslide, making the advantage of any costly longevity gene moot. Biologists would have to

reprogram thousands of genes or molecular pathways, each with a small and uncertain effect on longevity, to launch the leap to immortality.[21]

And even if we were fitted with perfectly tuned biological hardware, the march of entropy would degrade it. As the physicist Peter Hoffman points out, "Life pits biology against physics in mortal combat." Violently thrashing molecules constantly collide with the machinery of our cells, including the very machinery that staves off entropy by correcting errors and repairing damage. As damage to the various damage-control systems accumulates, the risk of collapse increases exponentially, sooner or later swamping whatever protections biomedical science has given us against constant risks like cancer and organ failure.[22]

In my view the best projection of the outcome of our multicentury war on death is Stein's Law—"Things that can't go on forever don't"—as amended by Davies's Corollary—"Things that can't go on forever can go on much longer than you think."

CHAPTER 6

Health

How do we explain the gift of life that has been granted to more and more of our species since the end of the 18th century? The timing offers a clue. In *The Great Escape,* Deaton writes, "Ever since people rebelled against authority in the Enlightenment, and set about using the force of reason to make their lives better, they have found a way to do so, and there is little doubt that they will continue to win victories against the forces of death."[1] The gains in longevity celebrated in the previous chapter are the spoils of victory against several of those forces—disease, starvation, war, homicide, accidents—and in this chapter and subsequent ones I will tell the story of each.

For most of human history, the strongest force of death was infectious disease, the nasty feature of evolution in which small, rapidly reproducing organisms make their living at our expense and hitch a ride from body to body in bugs, worms, and bodily effluvia. Epidemics killed by the millions, wiping out entire civilizations, and visited sudden misery on local populations. To take just one example, yellow fever, a viral disease transmitted by mosquitoes, was so named because its victims turned that color before dying in agony. According to an account of an 1878 Memphis epidemic, the sick had "crawled into holes twisted out of shape, their bodies discovered later only by the stench of their decaying flesh .... [A mother was found dead] with her body sprawled across the bed ... black vomit like coffee grounds spattered all over ... the children rolling on the floor, groaning."[2]

The rich were not spared: in 1836, the wealthiest man in the world, Nathan Mayer Rothschild, died of an infected abscess. Nor the powerful: various British monarchs were cut down by dysentery, smallpox, pneumonia, typhoid, tuberculosis, and malaria. American presidents, too, were vulnerable: William Henry Harrison fell ill shortly after his inauguration in 1841 and died of septic shock thirty-one days later, and James Polk succumbed to cholera three months after leaving office in 1849. As recently as 1924, the sixteen-year-old son of a sitting president, Calvin Coolidge Jr., died of an infected blister he got while playing tennis.

Ever-creative *Homo sapiens* had long fought back against disease with quackery such as prayer, sacrifice, bloodletting, cupping, toxic metals, homeopathy, and squeezing a hen to death against an infected body part. But starting in the late 18th century with the invention of vaccination, and accelerating in the 19th with acceptance of the germ theory of disease, the tide of battle began to turn. Handwashing, midwifery, mosquito control, and especially the protection of drinking water by public sewerage and chlorinated tap water would come to save billions of lives. Before the 20th century, cities were piled high in excrement, their rivers and lakes viscous with waste, and their residents drinking and washing their clothes in putrid brown liquid.[3] Epidemics were blamed on miasmas—foul-smelling air—until John Snow (1813–1858), the first epidemiologist, determined that cholera-stricken Londoners got their water from an intake pipe that was downstream from an outflow of sewage. Doctors themselves used to be a major health hazard as they went from autopsy to examining room in black coats encrusted with dried blood and pus, probed their patients' wounds with unwashed hands, and sewed them up with sutures they kept in their buttonholes, until Ignaz Semmelweis (1818–1865) and Joseph Lister (1827–1912) got them to sterilize their hands and equipment. Antisepsis, anesthesia, and blood transfusions allowed surgery to cure rather than torture and mutilate, and antibiotics, antitoxins, and countless other medical advances further beat back the assault of pestilence.

The sin of ingratitude may not have made the Top Seven, but according to Dante it consigns the sinners to the ninth circle of Hell, and that's where post-1960s intellectual culture may find itself because of its amnesia for the conquerors of disease. It wasn't always that way. When I was a boy, a popular literary genre for children was the heroic biography of a medical pioneer such as Edward Jenner, Louis Pasteur, Joseph Lister, Frederick Banting, Charles Best, William Osler, or Alexander Fleming. On April 12, 1955, a team of scientists announced that Jonas Salk's vaccine against polio—the disease that had killed thousands a year, paralyzed Franklin Roosevelt, and sent many children into iron lungs—was proven safe. According to Richard Carter's history of the discovery, on that day "people observed moments of silence, rang bells, honked horns, blew factory whistles, fired salutes, ... took the rest of the day off, closed their schools or convoked fervid assemblies therein, drank toasts, hugged children, attended church, smiled at strangers, and forgave enemies."[4] The city of New York offered to honor Salk with a ticker-tape parade, which he politely declined.

And how much thought have you given lately to Karl Landsteiner? Karl who? He only saved *a billion lives* by his discovery of blood groups. Or how about these other heroes?

between 2000 and 2013 the world also saw massive reductions in the number of children dying from the five most lethal infectious diseases. In all, the control of infectious disease since 1990 has saved the lives of more than a hundred million children.[14]

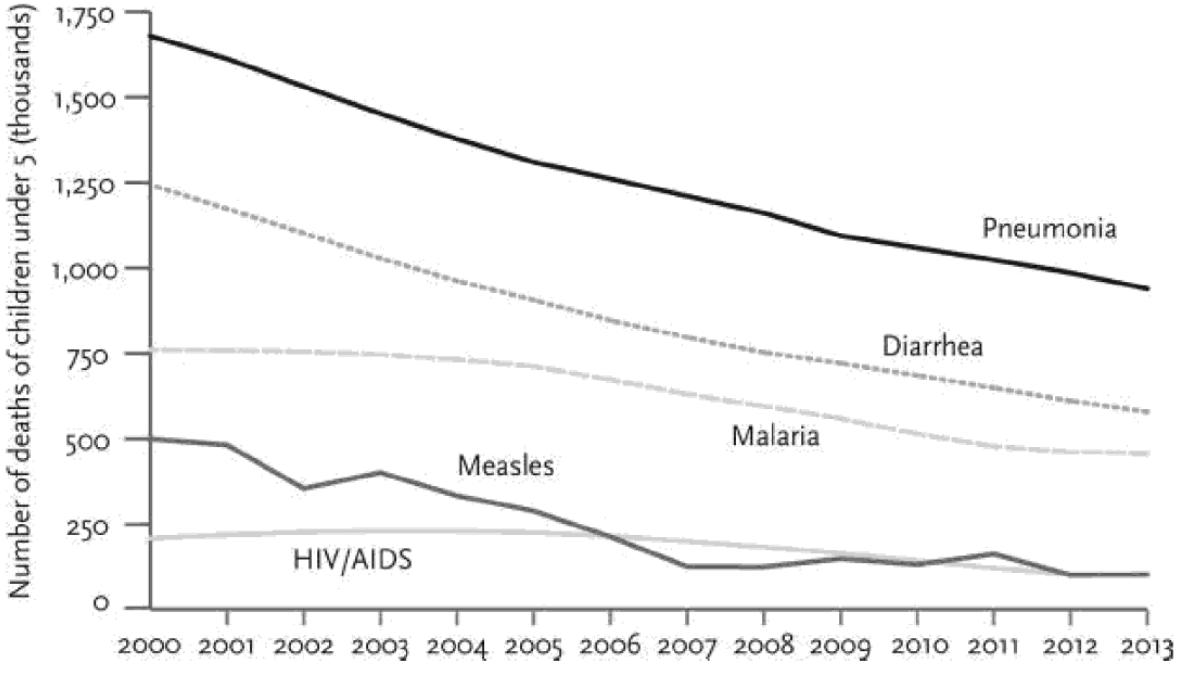

Figure 6-1: Childhood deaths from infectious disease, 2000–2013

Source: Child Health Epidemiology Reference Group of the World Health Organization, Liu et al. 2014, supplementary appendix.

And in the most ambitious plan of all, a team of global health experts led by the economists Dean Jamison and Lawrence Summers have laid out a roadmap for "a grand convergence in global health" by 2035, when infectious, maternal, and child deaths everywhere in the world could be reduced to the levels found in the healthiest middle-income countries today.[15]

As impressive as the conquest of infectious disease in Europe and America was, the ongoing progress among the global poor is even more astonishing. Part of the explanation lies in economic development (chapter 8), because a richer world is a healthier world. Part lies in the expanding circle of sympathy, which inspired global leaders such as Bill Gates, Jimmy Carter, and Bill Clinton to make their legacy the health of the poor in distant continents rather than glittering buildings close to home. George W. Bush, for his part, has been praised by even his harshest critics for his policy on African AIDS relief, which saved millions of lives.

But the most powerful contributor was science. "It is knowledge that is the key," Deaton argues. "Income—although important both in and of itself and as a component of wellbeing ...—is not the ultimate cause of wellbeing."[16] The fruits

of science are not just high-tech pharmaceuticals such as vaccines, antibiotics, antiretrovirals, and deworming pills. They also comprise *ideas*—ideas that may be cheap to implement and obvious in retrospect, but which save millions of lives. Examples include boiling, filtering, or adding bleach to water; washing hands; giving iodine supplements to pregnant women; breast-feeding and cuddling infants; defecating in latrines rather than in fields, streets, and waterways; protecting sleeping children with insecticide-impregnated bed nets; and treating diarrhea with a solution of salt and sugar in clean water. Conversely, progress can be reversed by bad ideas, such as the conspiracy theory spread by the Taliban and Boko Haram that vaccines sterilize Muslim girls, or the one spread by affluent American activists that vaccines cause autism. Deaton notes that even the idea that lies at the core of the Enlightenment—knowledge can make us better off—may come as a revelation in the parts of the world where people are resigned to their poor health, never dreaming that changes to their institutions and norms could improve it.[17]

CHAPTER 7

Sustenance

Together with senescence, childbirth, and pathogens, another mean trick has been played on us by evolution and entropy: our ceaseless need for energy. Famine has long been part of the human condition. The Hebrew Bible tells of seven lean years in Egypt; the Christian Bible has Famine as one of the four horsemen of the apocalypse. Well into the 19th century a crop failure could bring sudden misery even to privileged parts of the world. Johan Norberg quotes the childhood reminiscence of a contemporary of one of his ancestors in Sweden in the winter of 1868:

> We often saw mother weeping to herself, and it was hard on a mother, not having any food to put on the table for her hungry children. Emaciated, starving children were often seen going from farm to farm, begging for a few crumbs of bread. One day three children came to us, crying and begging for something to still the pangs of hunger. Sadly, her eyes brimming with tears, our mother was forced to tell them that we had nothing but a few crumbs of bread which we ourselves needed. When we children saw the anguish in the unknown children's supplicatory eyes, we burst into tears and begged mother to share with them what crumbs we had. Hesitantly she acceded to our request, and the unknown children wolfed down the food before going on to the next farm, which was a good way off from our home. The following day all three were found dead between our farm and the next.[1]

The historian Fernand Braudel has documented that premodern Europe suffered from famines every few decades.[2] Desperate peasants would harvest grain before it was ripe, eat grass or human flesh, and pour into cities to beg. Even in good times, many would get the bulk of their calories from bread or gruel, and not many at that: in *The Escape from Hunger and Premature Death, 1700–2100,* the economist Robert Fogel noted that "the energy value of the typical diet in France at the start of the eighteenth century was as low as that of Rwanda in 1965, the most malnourished nation for that year."[3] Many of those who were not starving were too weak to work, which locked them into poverty. Hungry Europeans titillated themselves with food pornography, such as tales of Cockaigne, a country where pancakes grew on trees, the streets were paved with pastry, roasted pigs wandered around with knives in their backs for easy carving, and cooked fish jumped out of the water and landed at one's feet.

Today we live in Cockaigne, and our problem is not too few calories but too many. As the comedian Chris Rock observed, "This is the first society in history where the poor people are fat." With the usual first-world ingratitude, modern social critics rail against the obesity epidemic with a level of outrage that might be appropriate for a famine (that is, when they are not railing at fat-shaming, slender fashion models, or eating disorders). Though obesity surely is a public health problem, by the standards of history it's a good problem to have.

What about the rest of the world? The hunger that many Westerners associate with Africa and Asia is by no means a modern phenomenon. India and China have always been vulnerable to famine, because millions of people subsisted on rice that was watered by erratic monsoons or fragile irrigation systems and had to be transported across great distances. Braudel recounts the testimony of a Dutch merchant who was in India during a famine in 1630–31:

> "Men abandoned towns and villages and wandered helplessly. It was easy to recognize their condition: eyes sunk deep in the head, lips pale and covered with slime, the skin hard, with the bones showing through, the belly nothing but a pouch hanging down empty .... One would cry and howl for hunger, while another lay stretched on the ground dying in misery." The familiar human dramas followed: wives and children abandoned, children sold by parents, who either abandoned them or sold themselves in order to survive, collective suicides .... Then came the stage when the starving split open the stomachs of the dead or dying and "drew at the entrails to fill their own bellies." "Many hundred thousands of men died of hunger, so that the whole country was covered with corpses lying unburied, which caused such a stench that the whole air was filled and infected with it .... In the village of Susuntra ... human flesh was sold in open market."[4]

But in recent times the world has been blessed with another remarkable and little-noticed advance: in spite of burgeoning numbers, the developing world is feeding itself. This is most obvious in China, whose 1.3 billion people now have access to an average of 3,100 calories per person per day, which, according to US government guidelines, is the number needed by a highly active young man.[5] India's billion people get an average of 2,400 calories a day, the number recommended for a highly active young woman or an active middle-aged man. The figure for the continent of Africa comes in between the two at 2,600.[6] Figure 7-1, which plots available calories for a representative sample of developed and developing nations and for the world as a whole, shows a pattern familiar from earlier graphs: hardship everywhere before the 19th century, rapid improvement in Europe and the United States over the next two centuries, and, in recent decades, the developing world catching up.

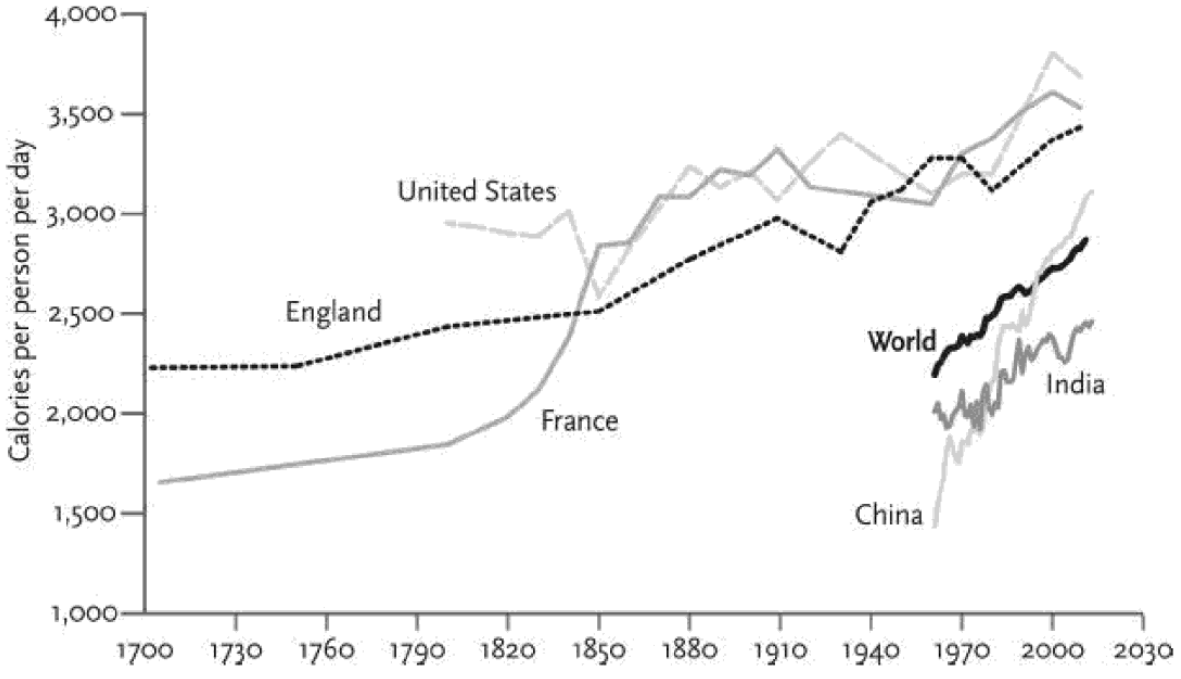

Figure 7-1: Calories, 1700–2013

Sources: United States, England, and France: *Our World in Data*, Roser 2016d, based on data from Fogel 2004. **China, India, and the World:** Food and Agriculture Organization of the United Nations, http://www.fao.org/faostat/en/#data.

The numbers plotted in figure 7-1 are averages, and they would be a misleading index of well-being if they were just lifted by rich people scarfing down more calories (if no one was getting fat except Mama Cass). Fortunately, the numbers reflect an increase in the availability of calories throughout the range, including the bottom. When children are underfed, their growth is stunted, and throughout their lives they have a higher risk of getting sick and dying. Figure 7-2 shows the proportion of children who are stunted in a representative sample of countries which have data for the longest spans of time. Though the proportion of stunted children in poor countries like Kenya and Bangladesh is deplorable, we see that in just two decades the rate of stunting has been cut in half. Countries like Colombia and China also had high rates of stunting not long ago and have managed to bring them even lower.