

SLOWDOWN

S
N
L
i

ALSO BY THE AUTHOR AND HIS COLLEAGUES

Geography

Inequality and the 1%

The Atlas of the Real World

Injustice: Why Social Inequality Persists

The Equality Effect: Improving Life for Everyone

Finntopia: What We Can Learn from the World's Happiest Country

Population 10 Billion: The Coming Demographic Crisis and How to Survive It

SLOWDOWN

**the end of the great acceleration—
and why it's good for the planet,
the economy, and our lives**

danny dorling

illustrations by kirsten mcclure

Yale UNIVERSITY PRESS/NEW HAVEN & LONDON

—S
—N
—L
iii

Copyright © 2020 by Danny Dorling.
All rights reserved.

This book may not be reproduced, in whole or in part, including illustrations, in any form (beyond that copying permitted by Sections 107 and 108 of the U.S. Copyright Law and except by reviewers for the public press), without written permission from the publishers.

Yale University Press books may be purchased in quantity for educational, business, or promotional use. For information, please e-mail sales.press@yale.edu (U.S. office) or sales@yaleup.co.uk (U.K. office).

Set in Minion type by Newgen North America.

Printed in the United States of America.

Illustrations by Kirsten McClure.

Library of Congress Control Number: 2019952311

ISBN 978-0-300-24340-6 (hardcover : alk. paper)

A catalogue record for this book is available from the British Library.

This paper meets the requirements of ANSI/NISO Z39.48-1992
(Permanence of Paper).

10 9 8 7 6 5 4 3 2 1

S
N
L
iv

**To Bob Hughes (1947–2019): activist, academic, friend, and
one of the five co-signatories of the 2003
No One Is Illegal Manifesto**

—S
—N
—L
v

S
N
L
vi

CONTENTS

ACKNOWLEDGMENTS	IX
CHAPTER 1	1
To Worry: Imaginatively	
CHAPTER 2	16
The Slowing Down: Of Almost Everything	
CHAPTER 3	37
Debt: A Decelerating Sign of the Slowdown	
CHAPTER 4	64
Data: The Deluge of Less and Less That Is New	
CHAPTER 5	89
Climate: Industry, War, Carbon, and Chaos	
CHAPTER 6	120
Temperature: The Catastrophic Exception	
CHAPTER 7	140
Demographics: Hitting the Population Brakes	
CHAPTER 8	180
Fertility: The Greatest Slowdown of All Time	
CHAPTER 9	230
Economics: Stabilizing Standards of Living	

CONTENTS	viii
CHAPTER 10	262
Geopolitics: In an Age of Slowdown	
CHAPTER 11	287
Life: After the Great Acceleration	
CHAPTER 12	314
People: Cognition and Catfish	
APPENDIX	333
How to Read and Draw a Timeline	
NOTES	339
LIST OF FIGURES AND TABLES	371
INDEX	375

ACKNOWLEDGMENTS

With thanks to my father, David Dorling, who is now very happy spending most of his days sweeping the leaves and feeding the birds in his woodland garden, who kindly corrected and revised the first, second, and third drafts of this book. And to my mother, Bronwen Dorling, who always told me I could do anything I put my mind to, and that whatever I did would be okay. Alison Dorling has been more realistic as to my limitations, but always enthusiastically sure that this project was worthwhile. Robbie, Izzy, and Sol Dorling tolerated a particular obsession that lasted from when the oldest was just a teenager to when the youngest achieved that status and the oldest became an adult and got his first proper job.

My thanks especially to Anthony Caira-Carnell in Australia who, despite the severe effects of his hemophilia, suffering the legacy of the NHS infected blood products scandal, and being sixteen thousand kilometers away, very kindly offered to read all the final drafts, commented in brilliant detail on where I was going round in circles, and still kept a clear head. My heartfelt thanks are also owed to Karen Shook and Claire Hann, both of whom read and improved every draft chapter after I had amalgamated so many other people's thoughts and edits and did so to a standard beyond that which I could ever do. Susan Laity then smoothly took over production of a complex book with many illustrations and introduced me to Robin DuBlanc, the most thoughtful and courteous copyeditor I have ever had the pleasure to (electronically) meet. Books like this are the product of a large team of people, not of individual minds, despite being marketed as such.

I am also especially grateful to Kirsten McClure, who designed the style of converting the timelines in the book to the graphics you see here and redrew all of them from my crude Excel sheets. So many others also helped and commented. I am grateful to Qiuji Shi and Tomoki Nakaya for help on statistics on China and Japan, respectively; and again to Qiuji for all her work producing a huge number of additional timelines using many different data sets that are now all on this book's website (and available to

ACKNOWLEDGMENTS x

all for free). And I thank Lorenza Antonucci, Ben Ayre, Aniko Horvath, Carl Lee, John McKeown, Khadija Rouf, Simon Ryde, Craig Twyford, Tara van Dijk, and others (I should have kept a list), who kindly commented on earlier versions of various chapters, as I slowly tried to untangle a mass of thoughts, opinion, and bits and pieces of evidence into this book and became somewhat tiresomely obsessed to find that almost every subject I looked into was showing some evidence of slowdown.

I am very grateful for the thoughts of the undergraduate science students of the University of Cambridge, who first heard me present these ideas in February 2019; to the postgraduate students at the London School of Economics, who commented on the first drafts of the timelines in March of that year; to all those who commented after I gave my first public lecture on this topic at the Oxford Martin School in May 2019; and to the London Universities Economic and Social Research Council–funded PhD students for their views, given in June 2019.

Finally, I must thank above all Joe Calamia, my editor at Yale University Press, without whom this book would probably have proceeded a great deal more slowly, and very possibly not at all. He is patient, calm, and very kind. I think he'll fit in well to the new future.

SLOWDOWN

S
N
L
xi

S
N
L
xii

1

to worry imaginatively

The country's fertility rate—the number of expected babies per woman—fell to 0.98 in 2018, according to the latest government data released on Wednesday.

—*Song Jung-a in Seoul, South Korea, 28 August 2019*

Over the past 160 years our numbers have doubled and doubled and almost doubled again. Never before have we seen such a huge rise in human population in so few generations. Never again will we. Today our population growth is slowing down. In 1859 Charles Darwin wrote of “the numerous recorded cases of the astonishingly rapid increase of various animals in a state of nature, when circumstances have been favorable to them during two or three following seasons.”¹ Using examples ranging from minuscule seedlings to giant elephants, he discussed the very rare cases in nature when exponential population growth occurred in a species. In fact, the best example he could have picked would have been that of his own species, humans, who at that time were just beginning their own unprecedented, exponential, worldwide increase in numbers.

Today slowdown (a word first used in the 1890s, meaning to go forward more slowly) affects far more than our rate of population growth. It affects almost every aspect of our lives. Our current slowdown represents a huge challenge to the expectation of acceleration, and a step into the unknown. To what extent are our current belief systems (economic, political, and otherwise) built on assumptions of rapid future technological change and perpetual economic growth? Accepting that a slowdown is upon us

SLOWDOWN 2

will require us to shift our fundamental view of change, innovation, and discovery as unalloyed benefits. Will we be able to accept that we should stop expecting ceaseless technological revolutions? The possibility that we might not sensibly be able to do so is itself frightening. What mistakes will we make if we assume that slowdown is unlikely and new great shifts lie just around the corner? What will happen if things stay much the same as they are now while the rate of change simply slows down?

Imagine that you have spent your life on a speeding train and you suddenly feel the brakes being applied. You would worry what was about to happen next. Now imagine that not just you but all the people you know—as well as their parents, grandparents, and great-grandparents, as far back as anyone can remember—have all lived on that very same speeding train, and that the train has been accelerating for virtually all of their lives. For you, hurtling forward at breakneck speed is comfortingly normal, but now you can begin to feel the slowdown, a new and frightening feeling. However, because the train is still rushing forward, people all around you are still talking of acceleration—the increasing pace of change—although in reality the train is no longer going ever faster. Something has changed. Out of the window the landscape is going by less quickly; everything is slowing down. An era is ending.

The great acceleration that has occurred in recent generations created the culture in which we live. It created our current expectation for a particular kind of progress. By “us” I mean the large majority of older people now living on Earth, those who have for the most part seen their health, housing, and workplaces improve compared to what their parents and grandparents experienced. I mean those who have witnessed education being extended, those who have seen both absolute poverty and immiseration recede during their lifetimes. I am thinking of those who now have a sense that their children’s generation will not be much better off than they are now, those who are feeling a new sense of slowdown.

It is because we have so few examples of slowdown to draw on from the past couple of centuries that we find our times especially confusing today. However, slowing down is a very good thing—and the alternative is unimaginably bad. If we do not slow down, there is no escape from imminent disaster. We would wreck our very home, the planet we live on. We need to slow down because we have nowhere else to speed to without catastrophic consequences. Slowdown means we need not fear the nightmare scenario of worldwide famine depicted at the end of Paul and Anne Ehrlich’s 1968

S
N
L
2

book *The Population Bomb*, in which they concluded of India that its people should be allowed to starve: “Under the triage system [suggested by them] she [India] should receive no more food.”² This kind of concern and brutal conclusion were rife in the recent past. Images of out-of-control acceleration became commonplace. For instance, Joel E. Cohen, a mathematical biologist, wrote in 1992:

Back in 1970 Ansley Coale, a demographer at Princeton, observed that the population of the United States had increased by half since 1940. At that growth rate, he calculated, the US population would reach a billion shortly before the year 2100. Within six or seven more centuries we would reach one person per square foot of land area in the United States, and after about 1,500 years our descendants would outweigh the Earth if they continued to increase by 50 percent every 30 years. We can even calculate that, at that rate of increase, our descendants would, in a few thousand years, form a sphere of flesh whose radius would, neglecting relativity, expand at the velocity of light.³

Ansley Coale was making his calculations just a year or so after the point when what he was measuring ceased to accelerate any further. By the early 1990s we began to worry less about acceleration. It was then that we began to realize that continued acceleration was no longer possible.

Slow down.

Now take a step backward.

Look at what is happening all around you.

It is New Year’s Day 2019. I have just listened to an early-morning radio discussion about how, if we humans planned a trip to the planets of Uranus and Neptune this year and began working on that plan straightaway, we could get a spaceship there by 2043. It would take almost a quarter of a century just to see those planets up close.

We are trapped by time—and space. It simply takes too long to get to anywhere else. We are stuck here, on Earth, for (hopefully) a very long time to come. Fortuitously, human population growth began to slow down dramatically in the late 1960s (ironically, around the very same time as the first human walked on the moon). There is now nowhere where the population is any longer accelerating. Deceleration has become the norm, and today in much of Europe, the Far East, and in large parts of the Americas, total human population numbers are falling.

SLOWDOWN 4

A slowdown in population does not necessarily mean immediate stability, but rather stability to come. It is most likely that a century from now the average number of children in a family will be fewer than two. Slowdown means that within a century the new global norm will be a slowly shrinking total planetary human population. This would also mean a continuously aging population for many decades to come, but the rate of aging will itself also slow in the near future as the rise in human life expectancy slows down.⁴ The age of the world's oldest person has not increased in the past twenty years.⁵

Of course, as the slowdown progresses, there will be shocks and many surprises which, by definition, are entirely unpredictable; but it is now sensible to admit that the process has begun. Understanding that to be true requires looking at the recent past and present very differently from how we have become accustomed to viewing our times. But first, we must consider what continuing to speed up would look like.

SEEING THE GREAT ACCELERATION

There are many ways in which change can be shown, but if you want to really see the detail of change—and what is changing within the change itself—that is best done by viewing a timeline. The method used in this book is unusual, employed only very rarely in Western social science.⁶ However, it is a remarkably effective way of showing how large a total is while simultaneously highlighting how that total is also changing, over both very short periods of time and—most important—overall. Furthermore, timelines drawn as they are drawn in this book allow the second derivative of change, the change in the rate of change, to also be appreciated. The short appendix at the end of this book gives more details of how these particular graphs can be both drawn and read.

Isaac Newton and those of his time who understood rates of change could easily have comprehended the method that is used to make the timelines shown in this book, which are statistical graphs. The first known statistical graph dates back to 1623, just a few decades before Newton was born.⁷ What is new today is how widely we share the understanding of such concepts, which in the past very few were allowed to be taught. Because of this wider and wider sharing, the rate of growth in discovery also initially rose rapidly. As it rose, until recently, we were changing how we think more quickly with every human generation—with new graphs, new mathematics, new physics, entire new academic disciplines, with science as a truth to replace the old gods—with new everything.

S
N
L
4

TO WORRY 5

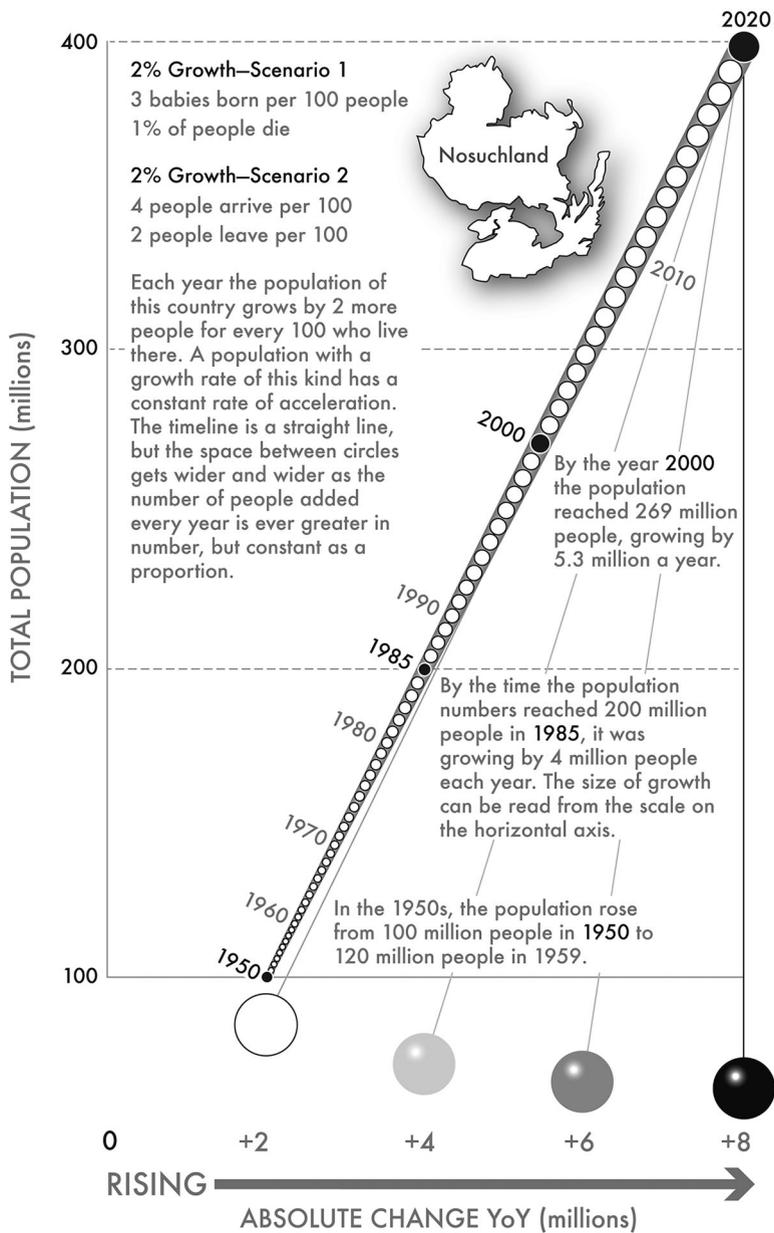
The example timeline drawn in figure 1 shows the population of an imaginary country, Nosuchland, which was home to 100 million people in the year 1950 and then experienced an increase in that number by 2 percent a year every year thereafter. Japan had a population of about that size in 1950, and was growing at that rate that year. In the first year, the population of Nosuchland rises by 2 million people to 102 million. Even at this apparently modest rate of change, the total population grows rapidly, and after thirty-five years it has doubled; by 1985 there are 200 million people living in our imaginary country and the annual increase has grown to 4 million a year (2 percent). Just twenty-one years later, in 2006, the population has tripled, reaching 300 million and growing at a huge 6 million a year. The timeline simply plots the size of the population against the absolute rate of change in that size. The relative rate of change, a percentage, is always 2 percent. In contrast, the absolute rate of change, a number of people, keeps rising as 2 percent of a growing population is always rising. The pendulum drawn on the timeline illustrates the speed of change as it moves away and to the right.

On the timeline in figure 1, constant acceleration appears as a straight line, with the gaps between the years, between the circles on the line, becoming progressively wider and wider over time. This is what is crucially different about this way of showing change. Drawn in this way, on a timeline, we are able to see the speed at which change is happening by allowing growth to appear as literally being faster when the actual amount of change is greater. The pendulum shown at the bottom of the figure is largely decorative. On all the figures in this book it highlights the very first and very last two points in time shown, the rates of change at those two times, and hence the change in the rate of change between those two time points.

The pattern shown in figure 1 is what used to happen before 1970 in more affluent countries. But today changes like this are increasingly rare, usually found only following a war or a similarly devastating catastrophe, or in the poorest of places where there is currently little else that is getting better and much that is still becoming worse: less fair, more brutal, more desperate. In contrast, in a real place, like Japan, actual annual population growth slowed from 2.0 percent in 1950 to 1.0 percent in 1958, rising again to 1.5 percent in 1973, falling back to 1.0 percent in 1977, 0.5 percent in 1986, and first actually decreasing in 2012.

There are very few countries in the world today that have a population trajectory anything like the one depicted in the timeline shown in figure 1. However, when I was born (over half a century ago), almost all countries

—S
—N
—L
5



1. Population of an imaginary country, 1950–2020 (accelerating at 2% per year). This is a hypothetical example of very simple constant acceleration. Note that “YoY” is shorthand for “year on year.”

S
N
L
6

TO WORRY 7

were on that kind of trajectory of around 2 percent population growth (give or take a percentage point) and, through my birth, I was unwittingly adding to the collective nightmare to come—or so many people feared at the time.⁸ I was born in 1968. In that year, many of the small cohort of people who had access to the most recently acquired knowledge thought that the imaginary country shown in this timeline reflected their own grim future.

In 1968 those who looked could see only the section of the graph from 1950 to 1968, and then imagined the rest. A year later, in 1969, when a couple of men landed on the moon, it was as if we were about to literally step off the planet, because those men had just done that. No wonder the Ehrlichs in *The Population Bomb* were arguing for an exodus from Earth that would allow the lucky few to escape the global famine to come. But just fifty years later, everything has changed.

A child born today can expect to live to see the world's human population shrink—with no disaster needed to bring that about. If there are huge disasters in the future in which millions die, that would probably result in a subsequent acceleration of total population growth, not a permanent reduction. We can predict with ever-growing certainty that if we manage to avoid such colossal disasters, then for the first time in human history, the species will very soon naturally decline in number. We have entered the slowdown.

BACK TO NORMALITY

In many ways, slowdown will take us back to what was normal before the great acceleration. To give just one example, prices could begin to stabilize worldwide. There is no need for inflation in a more stable future. Our grandchildren might find that a beer costs the same when they are sixty years old as it did when they had just turned twenty-one. In that world they may well not be able to make great amounts of money simply by “investing.” Most of the gains from investment in the past came from taking money from the future larger population. For instance, I may have borrowed money to build a house that I believe will be worth more in the future, but if the population in the future is smaller, then my house may never rise in price. My speculation may fall flat. I will not profit greatly in the future, but also—and vitally—other people will not be ripped off.

Great economic inequalities are very hard to sustain during and following a population slowdown. It becomes much more difficult to make money out of a shrinking and aging population. People may also become

savvier as things change less, and it could become harder to fool them with an ever-increasing and more complex stream of the “latest” and “newest” consumables, especially if the slowdown in technical innovation means there is, in fact, less of real novelty on offer.

Sales tactics that worked only because of accelerating social, economic, political, and demographic change—because of the ever-expanding market—will no longer bring the same rewards during, and especially following, the slowdown. This is partly why tech companies now throw so many more advertisements at us every day. Those who market goods that are not much needed, that you might be persuaded to think you need but that do not increase your well-being, are becoming ever more desperate as we all become collectively wiser.

We have to stop seeing stagnation as an ill. Slowdown means our schools, workplaces, hospitals, parks, universities, palaces, and homes will stagnate, no longer transforming as much as they have changed for each of the past six generations. It means more durable goods and less waste. Social and environmental problems that we currently worry about will not be problems in the future. We will, of course, have new problems—including ones we cannot even imagine right now.

Slowdown is itself a very new problem. There is no easy way of predicting its implications, as we have no past model of slowdown beyond the few countries today that are among the first to have started to slow down. We have to use the experiences of those places to give us clues. All that we can be certain of is that the slowdown has begun. In fact, it began some while ago. As we take notice of the slowdown, at some point it will become a cause of great concern. Humans always worry and probably always will.

It may help to offer an analogy. Three hundred years ago, people had a lot of things to worry about. These problems included the fear of burning in the fires of hell if they did not live a religiously correct life. Many people still have that worry, but not as many of them as before, and the fear is arguably not as keenly felt as when almost everyone believed, and many tentative nonbelievers felt it safer to hedge their bets. We built many churches in the newly growing cities of the Western world to mitigate the particularly acute risk of burning (forever) in hell. At the very same time, the church builders ran economies based on slavery or the indirect profits of slavery.

Slavery was not abolished in the United States until 1865, after the end of the American Civil War, in Britain and its dominions not until 1883, and in Brazil not until 1888. With so much profit flowing back to Europe, the incentive to formally end slavery was low. Long before then, most slave-

holders and those they enslaved would have found it hard to believe that one day slavery would be mostly illegal (even though indentured labor still exists, and modern-day slavery is rife). Nor would it have been believed, not very long ago, that in the future churches and chapels would be mostly empty, with many converted into homes or nightclubs.

Despite all the changes that we have experienced, we still find it hard to imagine how different things could be. Especially if that difference in the future is the slowing down of change.

The way in which fears change is a telling consideration when observing the differences between the generations. Which of the fears that appear entirely rational to us today will not worry us in the slightest in the future? Climate change could be one such. This is not because climate change is not real or extremely serious, but because it is the paramount change of our times, mostly caused by our behavior over the past half-dozen decades. In future we will no longer pollute the air as we do today. What we do not know now is how long it will take us to get to that future. The longer we take, the more serious are the consequences.

It can take a couple of human generations, around fifty years or more, to fully adapt after it becomes obvious that we need to change. But when we are confronted with the need to do so, we do regularly adapt and alter our behavior. Because we are also very impatient animals, we don't recognize how much we can change and indeed already have changed. For us, change always seems to be far too slow in coming, and we are easily frustrated. But we adapt quickly to new circumstances, and so we will likely adapt well to slowdown.

Humans will always fret. It is in our nature. We evolved to be the hunted as well as the hunter. Our peripheral vision is wide because those who could see who or what was coming survived more often. Consider how we had no idea two hundred years ago that an invisible by-product of the burning of coal, carbon dioxide, would stay in the air for so long and not be quickly reabsorbed, with such a huge and toxic effect. Inevitably there will be something else we are doing today that will also have terrible repercussions of which we have as yet no conception at all. We are only animals, after all. As one well-known thinker once put it, it's a wonder humans can even feed themselves.⁹

We once feared nuclear winter, and the coming of the next "natural" ice age. A few years ago, I made a list of many calamities that have been the focus of our fears over the past century. My favorite was the "killer bees" invasion once prophesied to sweep across California. As a child I

heard stories about bees that came straight from the movies. The 1974 film *Killer Bees*, which starred Edward Albert and Kate Jackson, was quickly followed by *Swarm* in 1978, and in 2011 we were alarmed by *1313: Giant Killer Bees!*¹⁰ Bees seem to be more closely linked to the end of time than most other species. Today we worry about there being too few bees to pollinate our crops.

Slowdown is not an end of history or the coming of salvation. We are not heading toward a utopia, although life for most people may be less precarious, with better housing, education, and less onerous work than in the recent past. We are heading for stability. Stability may be a little boring, like Pittsburgh, Stockholm, Kyoto, Helsinki, Ottawa, or Oslo, especially if you are hankering after excitement and bright lights. However, we will definitely come up with new things to be afraid of. A great deal of this fear will be very helpful because it will be protective; worrying is how we make ourselves safe. But we so often worry about the wrong things: about our children falling out of trees, for instance. Tree climbing is far safer than you might imagine.¹¹ Our worries are so often about the dangers of the past, without us realizing it. We have developed an innate fear of heights, but we're less concerned by large metal objects moving at speed because, until we invented cars, few such objects threatened us.

Try to imagine what your descendants might worry about in 2222—when the global human population has been falling for many decades and economic equality is high, and when the planet is no longer warming up but may even be starting to cool as the current interglacial warm period slowly begins to end. At some point before that year, sea levels will become more stable than they are today, although much higher than now. Power sources will be secure and largely nonpolluting. AI (artificial intelligence) will have turned out to be useful—but still very artificial and not that intelligent. In this future we should all be well fed, but fewer of us will be too fat. What will we worry about then? It will definitely be a great worry—whatever it is! To be human is to worry imaginatively—to always be searching for utopia, but to fear disaster.¹²

A slowdown is upon us, and this is something to be very thankful for. The alternative—an ever-growing total human population, ever more economically divided societies, ever-greater consumption per head—would be a catastrophe. Without both population growth and material economic growth, capitalism—the economic system we have become so used to that we cannot imagine it ending—transforms into something else. Something

far more stable and sensible. Whether people will be happier or not in that future world is impossible to know. They might more often come to see that you cannot find happiness through acquiring more possessions and more exotic experiences. There is so much we cannot know. But we should at least recognize that the slowdown is upon us and can now be found in so many surprising areas.

It is less and less the case that we are all being rapidly hurled into an unknown future; but we are only just emerging from the dense fog of our roller-coaster past, and are now beginning to see the clouds parting as our journey slows. There are good seasons to come, but not fertile seasons in which our numbers, inventions, and aggregate wealth grow exponentially; in fact, our numbers will very soon stop growing at all. The past few generations have seen great progress as well as great suffering, including the worst of all wars in terms of fatalities, genocides, and the most despicable of all human behaviors—including the planning and construction required for the mass nuclear annihilation of our species.

It may take us some time to accept that we now face a future of fewer discoveries, fewer new gizmos, and fewer “great men.” But is this such a bitter pill to swallow? We will also see fewer despots, less destruction, and less extreme poverty. And we will never again worship the “creative destruction” that twentieth-century economists so stupidly lauded at the height of the great acceleration. That was the bizarre idea that everything got better as firms went bust because only firms that deserved to go under did so. This nihilistic rhetoric was logical according to their weird (but at the time mainstream) survival-of-the-fittest theory of corporate evolution.

Given that we are still being taught that scientists keep on discovering great things at an ever-accelerating rate, it will initially be very hard for many people to accept what they might at first see as the gloomy prospect of slowdown. But progress is all relative, and it is progress itself—in the form of female emancipation—that is most clearly powering the slowdown. Progress toward stability was driven not by the achievements almost entirely ascribed to men and their wonderful inventions, but by the choices that women first made once they had won just a little of the freedom to work, vote, and plan the size of their families.

THE DECLINE

What does a slowdown look like? Let's begin again with our example of a country of 100 million people in 1950 and an annual growth rate of

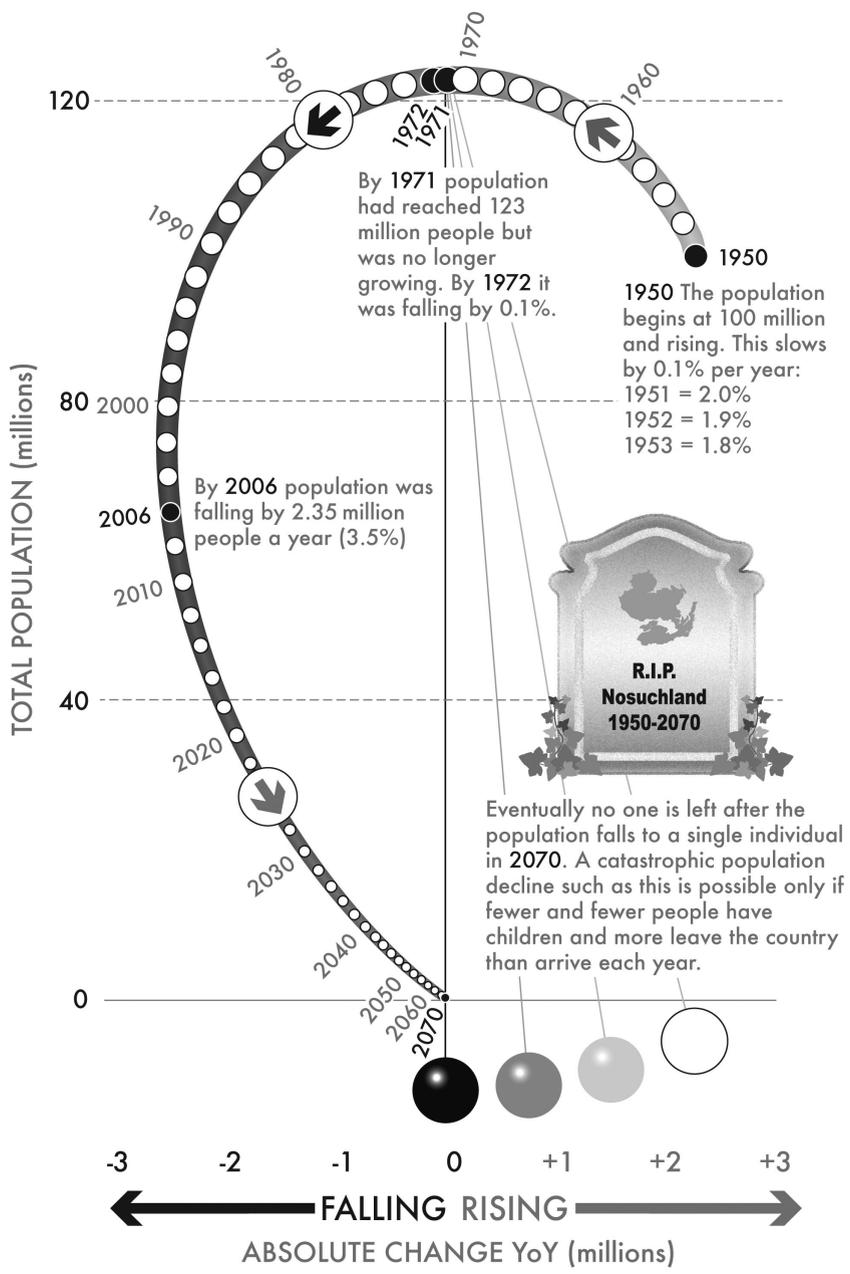
2 percent. This is exactly the same starting population we saw in figure 1, and exactly the same starting rate of population growth as in that example: 2 percent. However, let's reduce that growth rate by subtracting a tenth of a percentage point a year, so that in the second year the annual population growth is 1.9 percent, and by the twentieth year (1970) the growth rate is 0 percent.

The number of people who would be living in this imaginary country by the year 1952 would have been 102 million multiplied by 1.019. The number of people in the year 1973 would be 123 million times 0.997. Instead of the straight line that you saw in figure 1, you now see a curve. The population of the imaginary country peaks at 123 million in 1970 and next drops back to 100 million by 1991, falling further to 45 million by 2015. It is because of the reality of slowdown such as this that almost all the other timelines in this book depict curves sloping backward in one way or another, not continued exponential growth. Figure 2 shows what the most dramatic slowdown looks like.

The circles, each representing a year in the timeline (each being centered on an exact point in time mid-year) are, by 1970, all equally spaced apart rather than moving further and further apart as time progresses. Change each year appears to be very similar to the year before and after. But the rate of change is itself slowly changing. After 1970 the circles begin to move progressively closer together. This becomes obvious if you consider how the population will head toward zero but never quite reach zero, given the formula for change imposed in this imaginary scenario. The circles also become smaller and smaller after 1970 as the population of this imaginary country falls.

The timeline shown in figure 2 is the mirror-image dystopia to the first timeline of this book. Figure 1 illustrated a population accelerating ever upward. Figure 2 shows a population that will soon die out altogether: not a slowdown but an extinction. This is the plot of the 1992 story *The Children of Men* (adapted into a film in 2006), set in a fictional England in 2021.¹³

In figure 2, the population is hurtling toward extinction. Fewer children are being born every single year, and finally none at all. As people die they are insufficiently replaced, even via immigration. There are simply not enough people. This is what a fatal decline looks like. When the number of people and the annual rate of change are plotted simultaneously, it becomes obvious how such a trend plays out. This is what we would see



2. Population of an imaginary country, 1950–2070 (initially rising but thereafter decelerating). This is a hypothetical example of population acceleration transforming to deceleration.

if, on average, we each always had significantly fewer than two children; moreover, fertility would not even need to be as low if every year more people chose to leave this imaginary country than chose to arrive. Such a decline has happened before in human history, albeit involving thousands of people rather than millions, such as those who left the great ancient cities along the Silk Road: Loulan (Krorän), Niya (or Cađota), Otrar (or Farab), and Subashi (in what is now Xinjiang).

You will almost certainly never have heard of the places just listed, or even the city-states they were once a part of, because they were all abandoned and now exist only as ruins. In recent decades they have yielded up archaeological wonders and so we know their names again. There will be many other such places yet to be discovered. Building a new silk road will uncover many, but it will not result in ever more traffic and goods being traded, because soon there will be fewer consumers, especially fewer native consumers. Everything eventually always slows down. The pendulum included in figure 2 is settling toward zero.

THE BEGINNING OF THE END

It is odd that we so rarely worry about population decline, given that today a majority of people on Earth live in places where, for many years and often for many decades, on average people have been having fewer than two children. Many people can have two children, and just a few have none or one, as long as low numbers of others have three or more children, for the average to be well below two. We often find such simple mathematics hard to grasp, and this is partly why it takes time for our fears to catch up with reality and for us to imaginatively generate new fears to replace the old. We still often fear the old demons, the ones that our parents had good reason to fear but that are no longer the threat they once were.

Soon, even in the very poorest countries, people will no longer necessarily starve or grow up stunted. Many who live in the poorest regions of the world currently have as many children as they do only because of high rates of infant mortality, meaning that they must ensure that at least a few survive. Lack of access to contraception also plays a part, but now only in a decreasingly small part of the world. Soon we will stop worrying about whether we, in total, have enough food, and then worry much more about whether what we are eating is good for us, and soon we will all be eating far less meat.

TO WORRY 15

Soon our descendants (or other people's descendants) will look back at how we are now and ask why we could not see the transformation that was under way. But, in our defense, it is worth remembering that when you are on a speeding train and the brakes are suddenly applied, you feel that you are being thrown forward. It is only when you look back that you see you are no longer moving forward as quickly as before. This book looks back.