Chapter 1

Climate Change Will Happen to You

By now, many of us have some sense of the basics of climate change. We've seen images of melting ice, stranded polar bears, and calving glaciers. We've examined the charts depicting the rise in atmospheric carbon dioxide or heard about them. We've surmised whether Hurricane Katrina and various floods or droughts were caused by global warming. Maybe we've seen *An Inconvenient Truth* or read books about climatology. In fact, if polls are to be believed, most Americans accept the basic reality of climate change and would like the nation and the international community to do something about it.

But many of us might also hesitate to accept aspects of the science about climate change—whether it's actually happening or whether human activities are causing it. Since nothing I will say in the rest of this book will make much sense unless readers grapple first with these questions, if you are still cautious in these respects I recommend that you turn now to the Appendix, where I discuss them, and then return to this chapter.

Working through those concerns carefully is essential: if our decisions are to have a firm basis, if we are to live with real deliberation, we should not skip over any stage of the process. It's not likely we can become fully conscious of our situation as human beings without having paused to learn the fundamental physical facts of climate change. If you have already done so, keep reading: this is the chapter for you.

As it turns out, recognizing the reality of climate change—and its being caused by human beings—is only the start of a deep engagement with what confronts us. The further we go and the more we recognize the potential impact of climate change on our own lives, the more we may try to protect ourselves from what we learn so that we can continue with our

lives in good conscience. Often it is quite easy to do so. For good reason, the typical discussion of global warming sticks close to the science; the difficulty of the subject for lay readers and the need for an explanation that can cut through the fog of rancorous debate require that the subject be handled with as little fuss as possible. But as a result, even the best presenters of the science write as if the facts will speak for themselves, as if there are no obstacles in our lives that would interfere with a full acceptance of what they say. In fact, few of us are free of such obstacles; most of us filter what we hear in some fashion or indulge a tendency to simplify or deny, misconstrue or exaggerate, the full import of the facts—at least in part, and perhaps unconsciously.

Delving further into climate change, in short, requires an increasingly direct confrontation with realities that we would rather ignore. Accordingly, for nearly all of us, the chief task is to break through the tendency to keep the entire problem at a distance from our actual lives. The challenge is to identify and confront the most representative ways we evade what the scientific research teaches us and thus to encounter the truth as fully as we can.

So let's begin with perhaps the first key objection one might make to the notion that climate change is a serious and immediate threat to humanity.

Yes, a voice protests, *climate change is real and will have serious consequences, but not right away; we have plenty of time to figure out what we'll do to keep its worst effects from taking place.*

To some extent, my discussion of our current situation in the opening pages of this book may provide an adequate, if hasty, reply. But to respond more fully to this objection, it may be valuable to slow down here and outline the overall context of contemporary scientific thinking on this question.

This objection relies on the scientific uncertainty with regard to exactly how much harm greenhouse gas emissions will eventually have. The estimates in the assessments of the Intergovernmental Panel on Climate Change (henceforth IPCC), the international body that assembles and summarizes the current state of scientific knowledge for the benefit of the world's governments (and was awarded the Nobel Peace Prize, along with Al Gore, in 2007), have indeed varied widely. More importantly,

however, the sense that we have time to put together a response is also implicit in the slow pace of negotiations over international agreements about emissions—not to mention the even slower pace of compliance with the cuts already specified in the Kyoto Protocol. (Very few nations that signed those accords have begun to make substantial cuts in their emissions, despite the publicity over their promise to do so.)[14] The same patience is evident in the fact that these negotiators either set modest cuts in emissions (as at Kyoto) or distant dates for compliance.

The greatest virtue of this patient approach is its realism about the difficulty of finding agreement, changing our carbon-based culture, and cutting emissions deeply enough to make a difference. Anyone who reflects on how difficult it will be to transform our societies to the necessary degree must empathize with the bone-deep pragmatism of negotiators, their acceptance of the political conditions we face and the necessity of working within them to achieve anything that will matter.

But very little in the scientific research can justify such patience. For one thing, a portion of the carbon dioxide we emit remains in the atmosphere for a century or more. As a result, even if we soon curtail the amount of carbon dioxide we produce, levels of that gas will remain high throughout the rest of this century at least, forcing changes to the climate throughout that long period. In effect, our actions long ago are being felt today, and our actions today will be felt for many decades to come. The longer we continue our current habits, the greater the difficulties future generations will have to face. Unless we are fairly certain that today's emissions will do no harm later on, we should do what we can today.

Moreover, although views differ about the effects that will follow from our emissions, it would be foolish to assume that only the more optimistic projections are true. If the science is uncertain in this regard, we should listen to the full spectrum of considered judgment before opting for a slow-motion strategy. If we listen in this way, we will soon discover that things may be substantially *worse* than we might think.

The major debate among climate change scientists today is not whether climate change is real but whether it will have a more severe effect on Earth's ecosystems in the future than we previously thought. One element contributing to this debate is research into the problem of positive feedback loops of the sort I mentioned at the beginning of

this book. These vicious circles emerge when the warming temperature causes the release of more greenhouse gases into the atmosphere, which cause a further increase in temperature, and on around again. Once these vicious circles become strong enough, they constitute "tipping points" that lead to an irreversible sequence of events and an unstoppable rise in temperature. The more gases we emit and the longer we wait to change our habits, the more likely we will cross these tipping points, making it even more difficult to postpone the arrival of serious climate change with all its consequences.

In his book on the subject, *With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change*, Fred Pearce reviews a wide array of potential "positive feedback loops" that could arise in a number of regions of the world. Some of these tipping points may indeed be decades away. But we threaten to cross others in the fairly near future, if we have not done so already.[15]

Several key examples of tipping points are those I explored at the beginning of this book. As I mentioned there, the stunning melt of the Arctic sea ice in the summer of 2012 suggests to many observers that this process has now crossed the tipping point and become irreversible.

A second example, also related to the discussion in the introduction, is the possibility that the methane clathrates on the seabeds around the globe will begin to melt and release gas into the atmosphere.[16] If this feedback loop gets going on any large scale, we are in for big trouble, for there are untold quantities of methane capable of being released in this fashion. One estimate suggests that the methane in the clathrates in all the world's oceans is around four thousand times the amount in today's atmosphere.[17]

Researchers typically guess that such a clathrate melt will take place only at much later stages of climate change. In 2008, Mark Lynas suggested that this potential clathrate melt might take place on an Earth that had warmed 5° Centigrade over preindustrial temperatures.[18] But already, as I mentioned above, the clathrate melt is beginning on a shallow continental shelf of the Arctic Ocean. That relatively local event does not suggest that the clathrates around the world are about to melt as well. But because clathrates exist in such huge numbers, even a melt in only a small fraction of their total bulk would be enough to shift the Earth's

climate severely. We are already seeing what might be the beginnings of that event, in which case it is making itself felt at temperatures far lower than we expected, and several decades earlier as well.

There is yet another worrisome instance looming not far from the arctic region. One of the most pressing instances of a possible tipping point is the melting permafrost throughout the far North—in Siberia, Alaska, and northern Canada. When it melts, it releases immense volumes of carbon dioxide and methane. Once the release of these gases hits a certain point, it will cause so much further warming—and further melting of the permafrost—that the results will be irreversible.

The tipping point for the permafrost is not far away. One study that appeared in January 2011 strikingly predicts that the feedback loop in the far North will cause the arctic permafrost to become a net source (not sink) of carbon and methane after the mid-2020s and will be strong enough to cancel between 42 and 88 percent of the planet's land-based capacity to absorb those emissions.[19]

These examples may imply that only the feedback loops of the far North—the Arctic ice, the clathrates, the permafrost—are of concern. But consider what is transpiring in the Amazon region. Rising temperatures and an associated decline in rainfall have led to the drying of the Amazon rainforest, causing trees there to grow less and making them more vulnerable to decay and to wildfires, as well as to the very serious droughts of 2005 and 2010.[20] This process has gone so far by now that by some estimates this ecosystem now *releases more carbon dioxide into the atmosphere than it absorbs*.[21] Think about it: the Amazon, once famous for being one of the Earth's best ecosystems for soaking up immense quantities of carbon dioxide—and for pumping huge quantities of oxygen into the atmosphere—may already be helping to *drive* global warming rather than alleviate it, and if not, is likely to do so very soon. Once we cross that tipping point for good, an entire array of planetary systems that dominate not far from the Equator will be transformed as well. That example suggests that the Earth's systems *in every region* are vulnerable to severe disarray; no area of the biosphere is safe.

As realities like this suggest, if we ignore the causes that set these vicious circles into motion, we will face an impossible challenge, for in the following years, the results could wipe out any gains we might make

in reducing our greenhouse gas emissions. The Arctic sea melt is already irreversible. If any one of these other processes crosses the tipping point, we are in for major trouble. Yet all of these tipping points are drawing nearer every day. Our contribution to climate change right now is significant enough, but once very large ecosystems get into the game, they will dwarf what we can do.

There you go again, another voice objects; *you are sounding much too loud an alarm. Climate change is real and is caused by human beings, but don't make any reckless statements about its potential effects. Don't get carried away; cut back on statements that go too far, that warn against all kinds of horrible and devastating consequences.* Some "skeptics" apply this advice to nearly all discussions of climate change, advocating what they regard as a "moderate" estimate of global warming's dangers; others, such as Claire Parkinson, a clear-sighted scientist well within the mainstream who otherwise has a great deal to teach us, targets more narrow claims.[22]

No doubt it is best for all participants in the debate to stick as closely as possible to demonstrable findings. But because this argument places far more emphasis on curbing wild talk than the danger of the crisis itself, it ultimately treats caution and politeness as more important than the future of the planet. Such a preference reveals an excessive distaste for the language of crisis. This kind of talk, some think, is *always* irresponsible, just a form of panic-mongering. Evidently, a responsible, sane person should avoid speaking of an emergency or doing anything reckless, like proposing that we consider modifying our way of life. But to focus on excessive statements rather than the underlying threat of climate change diverts attention from the most pressing concerns to relatively marginal ones. It's as if these authors live in a house that is starting to burn down, but would do anything rather than actually sound the alarm: that would be noisy and rude!

This preference for understating the severity of the threat, as it turns out, is shared not only by a handful of scientists but may characterize the general tone of climate science overall. One recent study suggests that "scientists are biased not toward alarmism but the reverse," toward "erring on the side of less rather than more alarming predictions," possibly because researchers generally adhere to the "scientific norms of restraint, objectivity, skepticism, rationality, dispassion, and moderation." The

authors of this study argue that climate scientists have more often understated the potential impact of climate change than the opposite, fearful of coming across as alarmist or incautious in their findings.[23]

While in many contexts this bias toward caution may serve scientific research well, in the arena of controversy over climate change it may reinforce our belief that the situation is not that dire after all. In short, it can feed into our sense that things are all right and will work themselves out in some fashion. Such a viewpoint is clearly a mode of denial, even if one who espouses it is otherwise remarkably insightful. As Parkinson herself admits late in her book, she is less concerned about the future than others because she believes that "surely" inventors will create new energy alternatives that will make fossil fuels a thing of the past, and by implication will do so in time for us to avoid the ill effects of climate change.[24] But it is naive to suggest that a solution will simply appear or that it even if it does it will take effect immediately. Inventions take time to manufacture and even longer to produce on a massive scale that this occasion requires. Only a supreme confidence, however unjustified—only a belief in the secular equivalent of a miracle—can explain such a distaste for talk of crisis.

All right, one might say, *it's happening, we're causing it, and it may be worse than we thought. But from what I see, it may not happen* **here**. After all, most of the images we associate with climate change depict what is happening elsewhere—in the Arctic, for example, or around the distant islands that will soon be swallowed by rising waters. Seldom do we see images of the effects of climate change on us where we live. Of course, we are aware that our summers are warmer than before, our growing seasons longer, our climate more erratic and surprising. But so far very few of us have been lost on melting sea ice or swamped by the rising tides.

Most of us are so used to thinking about climate change in this manner that it is very difficult for us to get beyond it. Perhaps only a brutal restatement of our situation will get us out of the habit and help us focus on what will happen to us in our own immediate surroundings. So here it is: climate change is devastating, absolutely powerful, undismissible, *even if* in our darker, most selfish moments we might want to say "damn the ice caps" or "the hell with Tuvalu," *even if* we might wish to mutter so as no one can hear, "pfft to plankton" or "good riddance to the coral

reefs." Climate change won't just harm others, forcing the Peruvians to suffer from thirst or sweeping more Bangladeshis away in flooding seas; on the contrary, we better pay serious attention, for our *own* way of life is on the line.

For one thing, as I mentioned in the introduction, the changes in the Arctic are already altering weather patterns over the northern hemisphere. Just consider the strange events in the United States in 2012: the huge thunderstorm and tornado complex—the derecho—that swept over central and eastern portions of the country starting on June 29; the vast wildfires in the West beginning as early as April; the massive drought in the Midwest, threatening food crops and on occasion closing Mississippi River traffic; and Superstorm Sandy that wreaked havoc over major parts of the Northeast in November. In that single year, the altered climate caused significant harm to nearly every region of the country. And that's just 2012: the same pattern is borne out by the bizarre episodes—too many to list—in the seasons since then. Researchers now state outright that there is a strong link between climate change and these extreme weather patterns. According to the Environment America Research & Policy Center, the frequency of extreme precipitation events has increased by 30 percent from 1948 to 2011.[25] Are you confident that you will escape such events in the forthcoming years and decades?[26]

Climate change will be just as real where you live as anywhere else on Earth. In the United States, it will raise average temperatures; increase the amount of moisture in the air, making heavy precipitation events (of rain or snow) more likely, thus causing an increase in flooding and landslides; increase the number of blisteringly hot days in the summer; change the water cycle and increase evaporation, in most regions resulting in a drier landscape and more frequent droughts; and create the conditions for more insect and waterborne diseases. It will force the migration of local species into new habitats further north, as well as the absorption of species moving from the south, thus altering the balance between mutually dependent forms of life within each local ecosystem. The changes to the water cycle will alter the rivers, streams, and open landscapes throughout the country and the fundamental character of each region. These changes, and many more, are likely to have an adverse effect on food production, outdoor activities, seasonal rituals, the physical structures we have built,

public health, and local and regional economies. We may end up living in natural systems that are not only rapidly changing, but also much weaker and in some cases dying out altogether. We'll be far less comfortable right where we live than we once were.[27]

At first changes of this kind may seem overstated. For example, the fact that the zones with a particular average annual temperature will be shifting northwards might not initially sound so bad. After all, one might argue, ecosystems further south hang together quite well; wouldn't they fare equally well if they moved to the north? But many species are less able to compete with or displace species that already live in regions to the north, to reproduce quickly and thus adjust to new living conditions, and to move across miles of territory in a few years, suggesting that some portions of an ecosystem will migrate successfully while others will not. Some species might be mobile enough to move on, but if they did so, would lose access to their sources of food or to the habitats (river valleys, mountains) where they previously flourished. Forms of life that flourish in mountainous terrain may have only so far up the mountainside to migrate before running out of room. Unlike animals or birds, plants rooted in the soil might find it difficult to move quickly into new terrain. Many species will adapt to new conditions, but many others will not. Studies show that in the second half of the twentieth century, species on average migrated toward the poles at the rate of four miles per decade, while the zones in which they live—those defined by specific average temperatures—have migrated far more quickly, about thirty-five miles per decade.[28] Over time, as warming continues, the species that can't move very fast will find themselves within much warmer temperature belts, will be unable to flourish within a climate too hot for them, and will succumb to natural forces.

Such pressures can take many forms. Consider the changes taking place in the pine forests of western North America, especially in British Columbia. The pine beetle, a native insect in those regions, is now reproducing at a much greater rate than before; thanks to the warming winters, the warmer summers, and the reduction in summer precipitation, it is becoming a much more dominant species in those habitats than before. As a result, it is killing millions of acres of trees, converting the boreal forest of British Columbia from a carbon sink to a net emitter of carbon.[29]

Such vast damage in those forests, needless to say, will have profound impacts in the entire ecosystem, changing the water cycle, the growth patterns across the formerly wooded landscape, and much more. This transformation is largely due to the activities of a *single species* and perfectly illustrates how the complex interactions between species in ecosystems make them terribly vulnerable to climate change.

But changes due to the expansion of single species throughout a region are relatively subtle compared to the even broader transformations that every ecosystem will have to undergo. The effect of pine beetles in western forests pales in comparison to the even more dramatic effects of rising temperatures on the water cycle. The warming of the ecosystem increases evaporation and causes the gradual drying of the land, killing trees even where they are not vulnerable to insects. Recent research into the state of forests throughout the western United States shows that they are already experiencing a demographic shift—an increase in the number of trees dying and a decrease in the number of new trees growing per year—and that as a result they are approaching "thresholds for abrupt dieback." The drier conditions as well as the increasing activity of various species of insects is leading to rising mortality in those forests.[30] Evidently, climate change often works through several effects at once, each compounding the impact of others, creating conditions that are worse than any single process could bring about.

Similar changes are taking place in every region of the United States. In the Northeast, for example, climate change will drive the maple forests further north, eventually depriving the region of the autumn colors distinctive to the region, and the rising seas and increasing intensity of storms will lead to greater storm surges, damages to wetlands, coastal flooding, and erosion (as the stunning effects of Superstorm Sandy have made abundantly clear). The Southeast will become so hot and dry that its pine forests may disappear; oxygen depletion in the region's lakes will kill off fish in lakes and streams; and more powerful tornadoes and hurricanes will damage inland regions and coastal areas alike. The Southwest faces a dramatically altered future, one in which droughts will be longer and more intense than they were in the past, causing rivers and lakes to diminish and fires to spread more easily. The reduction in the snowpack over the Sierra Nevada in eastern California will lead to severe water

shortages in much of that state; in mid to late summer, people there may turn on the tap and find no water coming out. Needless to say, these and other changes will harm each region's food supply, sources of energy, distinctive landscape, and quality of life—if such a drab list of consequences can possibly capture the scale and intensity of what will take place.[31]

It's not difficult to extrapolate this pattern to the rest of the planet. Clearly, climate change will have severe consequences for ecosystems around the world. Forests all across the world are in serious danger.[32] Moreover, the stress on ecosystems is putting a fair portion of the planet's species under terrific pressure. Although it boggles the mind to sum up the possible effects on the Earth as a whole, some scientists have attempted to do so: one often-cited study by scientists on several continents who examined 1000 species concluded that under a mid-range estimate of the severity of climate change—that is, with an increase of only around 2° Celsius above preindustrial levels, and only 1.2° over current temperatures—15 to 37 percent of Earth's land species could be "committed to extinction" by 2050, although a more recent study qualifies those findings and provides a somewhat less pessimistic assessment.[33]

What about the sea? We often forget that climate change acidifies the oceans, harming organisms that rely on calcium carbonate to form shells or skeletons, including the coccolithophores, one of the most abundant types of plankton. The prospect that the further absorption of carbon dioxide into the oceans could damage the plankton, the first links of the marine food chain, is especially chilling. Scientists do not understand the potential effects of further acidification well, but given what we do know already, we have little reason for optimism.[34] One study states that the oceans are acidifying at a rate ten times faster than they did 55 million years ago during a period of mass extinction for marine life, and another finds roughly a 1 percent decline per year in plankton since 1950 due to warming temperatures at the ocean's surface.[35] A recent study conducted by the International Programme on the State of the Ocean found far greater declines in oceanic life than expected; Alex Rogers, its scientific director, stated, "[A]lmost right across the board we're seeing changes that are happening faster than we'd thought, or in ways that we didn't expect to see for hundreds of years."[36]

So far I have emphasized how climate change will put nearly all ecosystems into severe disarray and force a good portion of the Earth's species into extinction. But for human beings, these biological realities are only part of the picture. For us, such vast damage will also deplete the pleasure we take in natural beauty—in the blossoming of a tree, the cry of a bird, the subtle coloring of a fish, the scent of bark, the interweaving of forms on a tangled bank. The devastation of Earth's living forms is also a traumatic blow to the beauty of the common day, the poetry of everyday life.

So what, someone might respond; *we've always had extinction, and we always will; there is nothing here to be upset about.* But this time we're not talking about one species giving up its habitat to another over many decades or being pushed out under ordinary processes of natural selection. We're talking about a volatile combination of factors: wiping out the ecological niche of many species; making complex biological interrelations vulnerable to unforeseen interactions; and putting entire ecosystems under duress. In fact, extinction at *this* pace and at *these* numbers deserves a stronger term; it is not just extinction, but the death or at least decay of entire natural systems, if not of the Earth itself. Some previous events in the planet's history caused a similar devastation—the impact of meteors, for example—but do we really want to compete with meteors to see which force can mess up the Earth the most?

All this is bad enough. But at the moment we are causing much more than climate change. If you factor in everything *else* that advanced industrial civilization is doing to our local and regional ecosystems, the situation becomes even more difficult. All kinds of familiar practices on which we in the United States rely today—monoculture agriculture; the depletion of water aquifers; the release of vast quantities of nitrogen into ecosystems from fertilizer; large-scale farming of chickens, pigs, and cows, creating unprecedented quantities of manure effluent; the destruction of wetlands; the expansion of cities, suburbs, and exurbs; strip mining, mountaintop coal mining, and oil drilling in formerly protected areas; the release of untold quantities of plastics into the world's waterways and oceans; overfishing; and the inadvertent importation of exotic species, to name a few—already place our ecosystems under duress. To add

climate change, with all its consequences, to this pressure simply multiplies the danger.

All these factors make it clear that the transformations to ecosystems will take place right in our own neighborhoods. If you need an image to capture the relevance of climate change for you and yours, take a look at the natural life that surrounds you wherever you live and imagine it damaged or disappearing. Then remember for a moment that if climate change decimates an ecosystem, it won't come back—at least not in the form we know, and not for millennia. It will be gone for good.

Very well, someone might reply, *that may be true for most regions, but some areas will no doubt benefit from climate change: their growing seasons will expand, more life will flourish there, and the winters will be more temperate. Isn't climate change good news for* **some** *people?*

It's true that climate change models have suggested that some areas may experience warming that will improve the growing season, for example, or reduce the discomforts of winter. But it's naive to imagine that these changes are truly beneficial. As we've already seen, the warming climate has *devastated* the boreal forest of British Columbia; the loss of those cold winter nights, and of the shorter growing season, has *not* been a benefit there. Any so-called benefit to other regions is likely to have similar effects.

Nevertheless, it's worth taking this objection seriously and thinking it through with another thought experiment. If we imagine that some region would actually benefit, then what might follow? For one thing, can we suppose that the people who live in the lucky region rely exclusively for their well-being on what happens there? Or do they live in houses built of imported materials, drive cars manufactured in other regions, eat food grown elsewhere? Conversely, do they sell their own wares to people who live elsewhere? What supports the economy of their region? If ecosystems in other regions are suffering, so also will the economic base in those regions, and the trading relationships will suffer as well. No region can imagine that it would survive easily on its own.

But for a moment, let's take this experiment to a second level and imagine that it could thrive all by itself. Perhaps people in a particular region would be very good at creating a self-sustaining economy. Very well. But if residents of other regions are suffering, doesn't it seem likely

they would migrate to the areas that lucked out? As a result, wouldn't those better-off areas be overwhelmed with people seeking a better life? What's more, does it seem likely these migrants would have been able to sell their homes at a good price? Would they always have secured jobs that paid them as well? The people in the lucky zone might find themselves trying to accommodate an inflow of stressed-out, disadvantaged people hoping to find a good place to live. If nonhuman species will have to migrate, people will too. What's more, they will often have to migrate across national borders, leading to a whole range of crucial political questions. Once you factor in human mobility, you change the entire dynamic: a region whose *climate* might not be bad will have to face a massive *social* transformation, one that may stress out the region's ecosystem in turn.

So it simply isn't credible to suggest that climate change would benefit anyone in the long term. Because of the intricate web of our economies and the inevitability of migration, there are no guarantees. Perhaps if those who lived in this hypothetical lucky region put together a self-sustaining economy—*and* declared political independence, surrounded the entire zone with a thirty-foot fence to keep everyone else out, and taxed themselves silly to create a state-of-the-art military that could defeat any invaders—*then* they could live in relative abundance (if also in a state of perpetual selfishness and paranoia). Does *that* sound like a good future?

All right, says one last voice, *even if everything you say is true—even if climate change will alter the ecosystems where I live or cause a massive social transformation in my region, what difference does it really make to* **me**? *I don't care about nature; if a lot of species go extinct, it's not going to affect* **me**. *Ecosystems may come and go, but in the modern world, what does it matter? I don't really object to social change in my neighborhood, either; by now we're all used to new developments of that kind. As long as I have a job and can live in my urban environment, with a car, a cell phone, a nice Internet connection, good heating, a working air conditioner, and plenty of food at my local supermarket, everything's going to be fine*.

The voice that speaks here is at last the distinctive, perhaps mostly unconscious, voice of our own innate, indestructible narcissism. That profound cluelessness arises in all of us at the prospect of our own mortality: though we acknowledge the reality of our eventual deaths on some level, we don't often live in accordance with that insight. The same applies

even more to the thought of what may happen to the Earth. Perhaps the greatest help to our narcissism in the face of global warming is the air conditioner: evidently, as long as we are assured we'll be able to live in a relatively comfortable indoor temperature in perpetuity, we sense that there is nothing much to worry about.

This version of the near future may seem surprisingly plausible. Perhaps even if the seas rise, the planet warms, and vast portions of the Earth are devastated by climate change, wealthy people living in some places will live in circumstances not entirely different from what they are used to. If they wish, they might well ignore the bad news arriving from around the country and the world—at least for a while. They might even dismiss the changes to the climate of their region, the dying forests on nearby mountains, the shrinking local rivers, and the new vulnerability of many plants, birds, and animals that live in their vicinity. But eventually they will find it difficult to ignore the dust storms that may result from the drying of vast regions; the dwindling water supply; the much harsher snowstorms, rainstorms, tornadoes, hurricanes, or windstorms; the occasional severe floods (surprising, no doubt, given the general drying of the landscape); or the landslides and avalanches in nearby terrain.

But natural disasters will only be part of the story. The slow devastation of ecosystems around the world will eventually take its toll. We are not likely to welcome the consequences of stress to agricultural regions, leading to rising food prices; nor of stress to the local water cycle, resulting in a lower water supply and perhaps water rationing; nor of global warming itself, causing occasional summer days with brutally high temperatures. We will not be happy that climate change will cause long-term difficulty for many industries, including fishing, forestry, tourism, and outdoor recreation, and will impose immense costs on regions recovering from natural disasters. Nor will we be pleased when climate change begins to eat away at the nation's economic growth rate—or more likely, cause a perpetual *negative* growth rate, forcing us into a permanent and devastating Climate Change Depression. It will be especially challenging to deal with these and other difficulties while also helping an increasing number of retirees meet their monthly expenses and pay for their medical care. Moreover, the consequences of international chaos on ordinary lives might be painful as well. When nations begin to enter severe

domestic crises, endure new rounds of terrorist activity, or wage war against each other over basic natural resources, food supplies, population pressures, or rights of migration, one may find one's own nation at war as well—or suffering the economic or political consequences of that unrest in other ways, even potentially within its own borders.

To imagine that we can shield ourselves from all these trends by retreating to living spaces, turning on the air conditioner, and entertaining ourselves in some fashion simply ignores reality. In one way or another, the transformation of the planet will seep through those walls. We may find ourselves incensed at the result and might even mutter: *why didn't they* **tell** *me it would be like this?*

There really is no evading it: climate change is well under way, caused by human beings, *and it will happen to you.*

Notes

14. Robert P. Semple, Jr., "Remember Kyoto? Most Nations Don't," *New York Times*, December 3, 2011, http://www.nytimes.com/2011/12/04/opinion/sunday/remember-kyoto-most-nations-dont.html?_r=0.

15. Fred Pearce, *With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change* (Boston: Beacon Press, 2007).

16. See Pearce, *With Speed and Violence*, 91–98.

17. Thomas Blunier, "'Frozen' Methane Escapes from the Sea Floor," *Science*, volume 288, number 5463 (April 7, 2000), 68–69. doi:10.1126/science.288.5463.68.

18. Mark Lynas, *Six Degrees: Our Future on a Hotter Planet* (Washington, D.C.: National Geographic 2008), 220–228.

19. Kevin Schaefer and others, "Amount and timing of permafrost carbon release in response to climate warming," *Tellus B*, volume 63, Issue 2 (April 2011), 165–180, doi:10.1111/j.1600-0889.2011.00527.x.

20. On these droughts see Simon L. Lewis and others, "The 2010 Amazon Drought," *Science*, volume 331, number 6017 (February 4, 2011), 554, doi:10.1126/science.1200807; on the only partial recovery of the rainforest from the 2005 drought by the 2010 drought see Yadvinder Malhi and others, "Persistent effects of a severe drought on Amazonian forest canopy," *Proceedings of the National Academy of Sciences of the United States of America*,

volume 110, number 2 (published online before print December 24, 2012), 565–570, doi:10.1073/pnas.1204651110.

21. Fred Pearce, *With Speed and Violence*, 65. For more on the effects of climate change on the Amazon, see Nikolas Kozloff, *No Rain in the Amazon: How South America's Climate Change Affects the Entire Planet* (New York: Palgrave Macmillan, 2010).

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23. Keynyn Brysse and others, "Climate change prediction: Erring on the side of least drama?" *Global Environmental Change*, volume 23, issue 1 (February 2013), 327–337.

24. Parkinson, *Coming Climate Crisis?* 321.

25. See Nathan Willcox, "Extreme downpours up 30%. Scientists link trend to global warming," Environment America, July 31, 2012, http://www.environmentamerica.org/news/ame/new-report-extreme-downpours-30-percent and the underlying report, Environment America Research and Policy Center, "When it Rains, it Pours: Global Warming and the Increase in Extreme Precipitation from 1948 to 2011," July 31, 2012, http://www.environmentamerica.org/reports/ame/when-it-rains-it-pours.

26. For a summary of the leading climate change stories of 2012, which includes events that occurred in the United States, see Greg Laden, "Top Climate Stories of 2012," ScienceBlogs, December 28, 2012, http://scienceblogs.com/gregladen/2012/12/28/top-climate-stories-of-2012/.

27. For a brief, readable overview assessing the impact of climate change on each region of the United States, see the United States Global Change Research Program, *Global Climate Change Impacts in the U.S., 2009 Report*, http://nca2009.globalchange.gov/.

28. Hansen, *Storms of My Grandchildren*, 146.

29. W. A. Kurz and others, "Mountain pine beetle and forest carbon feedback to climate change," *Nature* 452 (April 24, 2008), 987–990, doi:10.1038/nature06777.

30. Phillip J. van Mantgem and others, "Widespread Increase of Tree Mortality Rates in the Western United States," *Science*, volume 323, number 5913 (January 23, 2009), 521–24, doi:10.1126/science.1165000.

31. See the assessment at the United States Global Change Research Program, *Global Climate Change Impacts in the U.S., 2009 Report*, http://nca2009.globalchange.gov/.

32. Justin Gillis, "With Deaths of Forests, a Loss of Key Climate Protectors," *New York Times*, October 1, 2011, http://www.nytimes.com/2011/10/01/science/earth/01forest.html?pagewanted=all.

33. Chris D. Thomas and others, "Extinction Risk from Climate Change," *Nature* 427 (January 8, 2004), 145–148, doi:10.1038/nature02121. For a lucid meditation on the implications of these findings, see Mark Lynas, *Six Degrees*, 115–119. The recent, smaller study surprisingly finds that taxonomic groups (rather than species) migrate at an average rate matching the shifts in temperature, significantly complicating the picture; see I-Ching Chen and others (including Chris Thomas), "Rapid Range Shifts of Species Associated with High Levels of Climate Warming," *Science* 333 (August 19, 2011), 1024–26, doi:10.1126/science.1206432. For a general guide to climate change's effect on ecosystems, see Robert Henson, *The Rough Guide to Climate Change* (London: Rough Guides, 2006).

34. For a report on recent research on the consequences of ocean acidification, see Richard Kerr, "Ocean Acidification Unprecedented, Unsettling," *Science*, volume 328, number 5985 (June 18, 2010), 1500–1501, doi:10.1126/science.328.5985.1500, which emphasizes the toll that acidification will take on a wide range of marine organisms. On ocean acidification and the coccolithophores, see Jacqueline Ruttiman, "Sick Seas," *Nature* 442 (August 31, 2006), 978–980, doi:10.1038/442978a; and Dalin Shi and others, "Effect of Ocean Acidification on Iron Availability to Marine Phytoplankton," *Science*, volume 327, number 5966 (February 5, 2010), 676–679, doi:10.1126/science.1183517.

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