E. coli bacteria, and often "trap animals, coating their gills and suffocating them."[68]

Here's all I'm trying to say: The planet on which our civilization evolved no longer exists. The stability that produced that civilization has vanished; epic changes have begun. (My favorite bleak headline, from *USA Today* in May 2009, describes a new study from the American Meteorological Society: "Global Warming May Be Twice as Bad as Previously Expected.")[69] We *may*, with commitment and luck, yet be able to maintain a planet that will sustain *some kind* of civilization, but it won't be the same planet, and hence it can't be the same civilization. The earth that we knew—the only earth that we ever knew—is gone.

If that stable earth allowed human *civilization*, however, something else created *modernity*, the world that most of us reading this book inhabit. That something was the sudden availability, beginning in the early eighteenth century, of cheap fossil fuel. An exaggeration? One barrel of oil yields as much energy as twenty-five thousand hours of human manual labor—more than a decade of human labor per barrel. The average American uses twenty-five barrels each year, which is like finding three hundred years of free labor annually. And that's just the oil; there's coal and gas, too.[70] It's why most of the people reading this book don't do much manual labor anymore, and why those who do use machines that make them hundreds of times more powerful than their forebears. It's why we're prosperous, why our economies have grown. It's also, of course, why we have global warming and acid oceans; in essence we've spent two hundred years digging up all that ancient carbon, combining it with oxygen for a moment to explode the pistons that take us to the drive-through, and

then releasing it into the atmosphere, where it accumulates as carbon dioxide. That cloud of carbon is nothing more than a ghostly reflection of the pools of oil and veins of coal where it once dwelled—each gallon of gasoline represents a hundred tons of ancient plants.[71] All day every day we burn coal and gas and oil, from the second we make the coffee till the second we turn out the lights. (And is the furnace still running? The air-conditioning?) If an alien landed in the United States on some voyage of exploration, he might well report back to headquarters that we were bipedal devices for combusting fossil fuel.

Which is why it's unlucky in the extreme that at precisely the same moment that we've destabilized the climate that underwrote civilization, we've also started to come up short on the fossil fuel that underwrote modernity. The two phenomena (very much intertwined) have struck us with the same uncanny speed. Just as a few scientists began warning a generation ago about rising temperatures, so a tiny band of geologists began fretting about dwindling oil supplies. In 1956, two years before the first carbon dioxide monitor was installed on Mauna Loa, a petroleum geologist named M. King Hubbert first predicted that U.S. oil production would reach its zenith between 1965 and 1970. He was spot-on—but nobody worried too much, because so much oil was flowing in from the great fields of the Middle East. In recent years, however, there have been troubling signs that those fields, too, are starting to dwindle, and clear evidence that no new fields big enough to make up for their decline have been discovered. "Peak oil" began as a fringe idea—just like climate change—but in recent years more and more establishment figures have signed on to the idea that we may really be reaching the point where the amount of oil we can wrest from the planet will go down, not up.

The debate ended on November 12, 2008. If you didn't notice,

blame post-Obama hangover or the ragged fear (and low oil prices) that came with the height of the financial crisis. November 12 was the day the Bush administration decided to stop buying up toxic assets and instead just recapitalize the banks, and the day that Obama named his transition team. But the real news that day, the data that rewrote the history books, came from the International Energy Agency, which published its long-awaited World Energy Outlook. The IEA defines conservative—it's the group set up by rich nations in the wake of the oil shocks of the 1970s to maintain a steady supply of energy. And their economists had always insisted that there would be a growing supply of oil for decades to come. No problem, no problem, no problem. Plenty of oil.

This time around, the tune changed markedly. First, said the IEA, production in current oil fields is falling by about 7 percent a year, a figure that will rise steadily to 9 percent over the next few decades. In other words, the level of oil in these giant fields has dropped far enough that we can no longer get as much as we used to. Never mind fueling the growing Asian thirst for oil; simply running in place would mean finding four new Saudi Arabias by 2030. But since demand *will* keep rising in Asia (92 percent of American adults own cars, compared with 6 percent of Chinese) and elsewhere, staying abreast will mean finding *six* new Saudi Arabias—or a new Kuwait—every year. The IEA put it in dollar figures: keeping up our oil economy will require $350 billion in exploration and investment every year through 2030. That's compared with a total of $390 billion that the world spent on those items in the whole period of 2000–2007, when the economy was booming.[72] And even the IEA's gloom may well have been too optimistic. A few weeks later, Merrill Lynch energy analysts, using new numbers for non-OPEC oil fields, calculated that we'll need *ten* new Saudi Arabias by 2030.[73] As the former

CIA director and defense secretary James Schlesinger put it, "The battle is over, the oil peakists have won."[74]

On the old planet—the one with an Arctic ice cap, the one where hurricanes didn't strike Spain and Brazil, the one where jellyfish didn't bloom in great slimy clouds across the oceans—we had one Saudi Arabia and one Kuwait. They sat atop enormous pools of oil. Now, every day more so, they sit atop big empty holes. And there are no more Saudi Arabias, no matter how much money you have. So does modernity disappear along with the oil? It's a question worth asking, when six of the twelve largest companies in the world are fossil-fuel providers, four make cars and trucks, and one, General Electric, is, as its name implies, heavily involved in the energy industry. Just buying fossil fuel requires almost a tenth of global GDP, and almost all the other 90 percent depends on burning the stuff.[75]

Oil is also the mother of most petrochemicals and plastics. Richard Heinberg, the analyst who was one of the first to alert the world to the impending oil peak, once compiled a list of things made from oil that ran from computer chips, insecticides, anesthetics, and fertilizers, right through lipstick, perfume, and pantyhose, to aspirin and parachutes. "Without petrochemicals," Heinberg wrote, "medical science, information technology, modern cityscapes, and countless other aspects of our modern technology-intensive lifestyles would simply not exist. In all, oil represents the essence of modern life."[76] That we've wasted it so mindlessly is depressing. (From the mid-1980s on American automakers stopped worrying about efficiency and instead concentrated on torque; as a result, by 2002 the average American car would go from zero to sixty in 10.5 seconds, a dynamic 3.5 seconds faster than a generation earlier.)[77] But it's also understandable. Again: cheap energy is not a useful part of our economy. It *is* our economy. "Before 1850 most Americans didn't even know

coal could be burned," writes Paul Roberts. "Yet by 1900 U.S. mines were outproducing those in England. What were people using all this extra energy for? Mainly people were manufacturing more things: more textiles, more machines, more food and ale, more paper. The pattern was clear: the more you produced, the more energy you needed. And conversely, the more energy you used, the more things you produced."[78]

Because there was lots of it on that old planet, energy was cheap. You've seen the pictures—the early oil strikes where the fields were under such high pressure that as soon as you punctured them with a drill the crude would spew into the air. It was, more or less, free for the taking. No more; what's left is in hard-to-get-at places and requires fantastic technical skill. Norway's Troll A platform in the North Sea, for instance, is the largest man-made structure ever moved: each of its three concrete legs is 994 feet long with an elevator that takes nine minutes to travel from the seabed to the drilling platform above. (To celebrate its tenth anniversary, a Norwegian pop idol sang a concert at the bottom of the elevator shaft, the deepest musical performance in history.) All of which means that drilling oil is getting progressively more expensive, not just in dollar terms but, more important, in what economists call "energy return on investment," or EROI. If the EROI on an oil well is 20:1, you get twenty units of energy out for every unit you put in. Twenty to one is pretty good—a lot better than, say, taking Canadian tar sands and melting them down to get usable oil. That might produce an EROI of 5.2:1 by some recent estimates. Corn ethanol for oil? Once you've figured in all the energy it takes to grow the stuff and process it, you're lucky to break even.[79] Charles Hall, a professor at the State University of New York, argued recently that "to offer any remotely viable contribution to society, a liquid fuel should not be dependent on subsidies from petroleum and should have an EROI of at least 5:1." Solar panels:

somewhere between 2.5 and 4.3:1, at least for now.[80] Which is not to say that solar panels are a bad idea—this book is being written with juice flowing straight from my roof. Only that they won't replace fossil fuels straight up.

We got a taste of that in the remarkable spring of 2008, as oil prices started to rise through the roof. Economies were strong, demand was rising—and there was no new supply to meet it. Paul Roberts pointed out in 2004 that six of the last seven global recessions had been preceded by spikes in the price of oil, and now we can safely make that seven of the last eight. Economic historians will long debate exactly why the economy keeled over in the fall of the year, but collapsing home prices seem to be the most basic answer. And they collapsed not just because of mortgage fraud but also because people began to take note of reality: in a world where four-dollar-a-gallon gas was even a possibility, who wanted a starter castle ninety minutes from work? "As oil prices started to bite, the new housing built in distant suburbs and even more remote 'exurbs' became less viable for commuters," wrote the oil analyst Phil Hart.[81] Between 2004 and 2008, when gas prices rose past two dollars to their eventual peak, the three cities with the largest declines in housing prices were the entirely auto-dependent Las Vegas, Phoenix, and Detroit; Portland, Oregon, the bike-and-trolley capital of the country, saw the largest rise in home value.[82]

But it's not only transportation. Since oil is in everything, its price affects the entire economy. In the spring of 2009, a University of California economist reported that "nearly all of last year's economic downturn could be attributed to the oil price shock"; despite his data, he reported, "it was a conclusion he didn't quite believe in himself," except that each of the previous run-ups in oil prices—1973, 1979, 1990, even 2001—also corresponded with recessions.[83] Once the economy collapsed, of course, oil prices

collapsed with them; we went back to consuming a little less than the planet was capable of producing. But should the economy recover, oil prices will almost certainly bounce right back. As the financier George Soros, who made a pile betting on the rise and fall of oil in 2008, wrote that autumn, "any relief will be temporary."[84]

In fact, one all-too-likely result of peak oil will be even more use of our most abundant fossil fuel, good old coal. And the certain result of using more coal will be . . . more global warming, since it's the dirtiest of all the fossil fuels, producing twice the carbon dioxide of oil. As James Hansen and his NASA team pointed out, any increased reliance on coal is enough to guarantee that we'll never get back to 350. Cue doom.

These are the kinds of traps we fall into on this new planet. We can't burn more oil because it's running out. The stuff we can still find to burn triggers even more global warming. The most vicious of cycles.

We know, definitively, that the old planet "worked." That is, it produced and sustained a modern civilization. We don't know that about the new one.

The traditional way of imagining the effects of climate change is simply to list disparate data points—to go around the world inventorying the items that one scientist or another has managed to model and predict. In a sense, to list the symptoms. So:

- Engineers in Dublin are convinced that higher tides caused by climate change are eroding the famous O'Connell Bridge that spans the River Liffey at the foot of the Irish capital's main thoroughfare.[85]
- A state of emergency was declared in the Marshall Islands late on Christmas Eve in 2008, as widespread flooding displaced

hundreds of islanders, the third time in two weeks that powerful storm surges had swamped the main cities of Majuro and Ebeye, each of which sits less than three feet above sea level. The floodwaters not only damaged houses and roads but also destroyed cemeteries.[86]

- "Tick drags" across my home state of Vermont are finding these agents of Lyme disease alive in the forest even in January and February. In the spring of 2008, the state entomologist Jon Turmel found thirty to forty ticks on his pant leg after walking twenty feet along the Connecticut river valley in the village of St. Johnsbury. He described the tick population in the area as "extreme." Indeed.[87]
- The residents of Ocean Isle Beach, North Carolina, are spending as much as thirty thousand dollars each to place giant sandbags in front of their homes in an effort to ward off the ocean. "There used to be a street in front of our house, and then a row of cottages," says Lisa Schaeffer. After Tropical Storm Hanna her home stood just five yards from the sea.[88]
- Along the Yukon River in Canada, warmer water has made Chinook salmon "more susceptible to the parasite *Ichthyophonus*. Subsistence farmers must now catch 150 salmon to yield 100 usable ones," according to a Natural Resource Defense Council study.[89]
- Reduced winter ice cover means that evaporation will proceed year-round, and hence the water level in Lake Erie could fall between three and six feet in the next seventy years, making shipping difficult (for every inch the lake drops, a commercial ship must leave behind 270 tons of cargo) and shifting the shoreline several miles in Sandusky Bay.[90] Moreover, the range of the official Ohio state symbol, the buckeye tree, may shift north, out of the state entirely and into the territory of its college football archrival, Michigan.[91]

- A Harvard study found that ragweed grows 10 percent taller and produces 60 percent more pollen as the temperature warms.[92]

The other time-honored method for communicating this kind of news is to find individual victims and share their stories, in the hope that narrative will accomplish what statistics can't. We don't pay much attention to poor people, so it can astonish us to read stories of just how hard life has become, like the ones John Vidal collected for London's *Guardian* in the fall of 2008.

- "Juan Antonio's eyes are full of tears," Vidal reports. "If good rains do not come, he says, he will pack his bag, kiss his wife and two children goodbye, and join the annual exodus of young men leaving hot, dry, rural northeast Brazil for the biofuel fields in the south." Droughts in the region are longer and more frequent now than in the past. "Climate change is biting," a Brazilian agronomist named Lindon Carlos tells him. "It is much hotter than it used to be and it stays hotter for longer."
- "It's far warmer now," says one Bangladeshi villager in the Deara district, whose only name is Selina. "We do not feel cold in the rainy season. We used to need blankets but now we don't. There is extreme uncertainty of weather. It makes it very hard to farm and we cannot plan. The storms are increasing and the tides now come right up to our houses."
- "Tekmadur Majsi farms in the upland Nepali village of Ketbari," Vidal writes. "Small floods once a decade or so are routine, but now they've grown larger and more common." Majsi is not hopeful for the future. "We always used to have a little rain each month, but now when there is rain it's very different. It's more concentrated and intense," he tells the reporter. "It means crop yields are going down."[93]

Vidal's reporting is not unique. Eliza Barclay of the *Miami Herald* traveled to the Cordillera Blanca, eleven thousand feet up in the Peruvian Andes, where she met a man named Gregorio Huanuco, who farmed as his ancestors had for generations. In 1990 Huanuco began to notice change: "a battering hailstorm, two months without rain, a warm winter. Then the quirky weather became more consistent and other oddities began to appear: rats nibbling away at his cereal crops and a fungus blanketing his potatoes." Huanuco's way of life was slipping away. "Before we planted all year long, any month we wanted to," he said. "Now we only get water a few times a year and so we cannot plant as much, and the pests and diseases keep coming."[94]

Or consider what Ben Simon, a reporter for Agence France-Presse, found on the slopes of Mount Speke, one of Uganda's highest peaks. The snowcap was almost gone, and farmers trying to eke out a living have to climb farther up the hill each year to find a climate cool enough to grow their beans. He quoted Nelson Bikalnumuli: "People just keep moving up, up, up. I fear soon we may be on top of each other."[95]

In Haiti, where an unprecedented four fierce hurricanes hit in quick succession in 2008, Marc Lacey of the *New York Times* found a mother living with her six children on a roof in the city of Gonaïves. "At the main cathedral, the water rushed in the front door, toppling pews and leaving the place stained with mud and smelling of sewage," he reported. "Upstairs, dozens of people have taken refuge, huddled together on the concrete floor. When a visitor arrived, they rubbed their bellies and pleaded for nourishment."[96]

Or perhaps you have a hard time identifying with poor peasants stranded in impoverished villages. Consider, then, the story of the MV *Nautica*, a stately liner of the Oceania Cruise company, in whose thousand-square-foot suites "every inch is

devoted to your pleasure," with "euro-top mattresses," forty-two-inch plasma screens, wraparound teak verandas, and "a second bathroom for guests." (The ship's spa offers an "exotic lime and ginger salt glow with massage," or, more worryingly, an "exotic coconut rub and milk ritual.") Anyway, the *Nautica* set off on its thirty-two-day "Odyssey to Asia" in the summer of 2008 but had to scrap "three magical days in the capital of the former British colony of Burma," after Cyclone Nargis wrecked both the nation and its image. "Considering the destruction, we said, no, not a wise move to be scheduling a call there," one mate explained. But the compensating longer stay in Mumbai was scrapped, too, after terrorist attacks, and then cruising through the Gulf of Aden the ship was attacked by pirates who fired eight shots. "We didn't think they would be cheeky enough to attack a cruise ship," said Wendy Armitage of Wellington, New Zealand. So the *Nautica* reset course for the Maldives, where nothing bad happened.[97] Although the same month the liner was in port, the president of the Maldives announced that his low-lying nation was planning to save a billion dollars annually from its tourist income so that it could buy land and relocate the population to Sri Lanka or Australia before the ocean finally rose too high for its survival. "We will invest in land," he said to CNN. "We do not want to end up in refugee tents if the worst happens."[98] The Maldives weren't alone, by the way. A few months later the Pacific island nation of Kiribati announced a similar plan.[99]

The trouble with this endless collection of anecdotes, though, is that it misses the essential flavor of the new world we're constructing. Every individual problem, even if it's impossible to endure, is fairly simple and straightforward. The temperature rises, and the buckeye tree migrates north. The temperature

rises, and the hurricanes get more frequent and you starve. The temperature rises, and the level of the ocean comes up and it floods your cemetery and you really can't live on your island anymore. The temperature rises, and even in the Mandara Spa on the Salon Deck, it's hard to imagine that "the nimble fingers of an able masseuse will soothe away all the cares of the world."[100] Simple, understandable.

In truth, though, our new planet is much more complex and interesting. It's not just that the things we used to do are getting harder; it's that these initial and obvious effects lead us into a series of double and triple binds that make *any* action hard. We don't really know where to turn, because the planet we now inhabit doesn't work the way the old one did. Sometimes the irony couldn't be clearer. We've already seen that the far North is melting fast. As the sea ice goes, the albedo, or reflectivity, of the Arctic changes, with the mirror of white ice replaced by sun-absorbing blue. And the permafrost melts, and the methane escapes, and peat bogs dry out and add to the load of carbon. But something else happens, too. All of a sudden you can start drilling for gas and oil in these places. The Arctic, by some estimates, may hold 20 percent of the planet's undiscovered reserves, not enough to hold off peak oil for very long but enough to guarantee one more pulse of carbon into the atmosphere.

Now try a slightly more complicated problem. We've been burning down rain forests for a long time to create cheap agricultural land in the Amazon, and that obviously puts carbon into the atmosphere. It was enough of a worry—remember all those "save the rain forest" concerts in the 1990s?—that Brazil started enforcing its conservation laws, and the rate of loss began to ebb. But as those holes grew beneath the Middle East, and oil became more expensive, the market for biofuels strengthened. All of a sudden soybean farmers started pushing deeper into the jungle; deforestation jumped 64 percent in 2008 as oil prices rose.[101] One observer reported watching "bulldozers operating like Panzer divisions leveling and burning forests."[102] Meanwhile, Britain's Meteorological Office released new research in November 2008 (the same week, in fact, as the IEA report on declining oil supplies), which showed that climate change was producing drier conditions over much of the region, making the rain forest more prone than ever to natural fires—within a decade much of southeast Amazonia would be in the zone of higher fire risk.[103] Those fires produce even more carbon, and by destroying the forest they also remove a natural sink for carbon. What is left behind is a hotter, drier clearing: African research shows that the daytime temperature in the soil above a cleared patch is eight degrees higher than in the nearby forest, and the humidity is 49 percent, compared with 87 percent in the forest.

Something like that appears to be what's happening across the tropics. In the Amazon, reports the researcher Peter Bunyard, "already we are seeing parts of the Basin drying out and forming savanna, with its drought-tolerant shrubs and grasses, in what may well be the beginnings of a savannizing process that could lead to desertification."[104] In normal times—that is, on the old earth—the Amazon managed to move water much farther inland from the oceans than the rain would normally fall. The first swath of jungle gets wet, and then transpires the moisture through its leaves, forming new clouds that produce new rainfall farther west—all in all, a series of six pulses that move the ocean's bounty all the way to the Andes. The energy involved is prodigious—the equivalent of 4 million or more atomic bombs' worth a day. The forest, in essence, is "a gigantic irreplaceable water pump," in Bunyard's phrase, which in turn powers much

of the planet's current air circulation system, taking "energy out and away from the Amazon basin to the higher latitudes, to the more temperate parts of the planet. Argentina, thousands of miles away from the Amazon Basin, gets no less than half its rain courtesy of the rainforest, a fact that few, if any, of the Argentinian landowners are aware of. And in equal ignorance the U.S. receives its share of the bounty, particularly over the Midwest." In fact, studies show that rainfall over the Amazon Basin is paralleled, four months later, by spring and summer rain across the U.S. corn belt.[105]

All of this is wildly complicated. It is perhaps enough to say that the Amazon is one of our planet's largest physical features, and it is far more vulnerable than we'd assumed, both to the onslaught of deforestation for food and biofuels, and to the changes in temperature that we've kicked off. The net result of the various forces, Bunyard says, will be a "much-diminished rainfall regime over the Amazon," with "rapid forest dieback and death." Oh, and as that happens, the decomposition of all the old forest "may well lead to more than 70 gigatons of carbon escaping as carbon dioxide into the atmosphere."[106] Instead of the "lungs of the planet" sucking in carbon and breathing out oxygen, the great green jungle turns into one more smokestack.

But the Amazon is far away, mysterious. You've more likely been to the high forests of the North American West, to the Rockies and the Sierras—probably driven the Road to the Sun at Glacier Park, or motored over Donner Pass. Certainly you've looked at Ansel Adams's photographs—this is our iconic idea of the wild. These ranges are also, like the poles or the Amazon, key natural features on which we depend. As the *Sacramento Bee* once described it, the Sierra is "a giant water faucet in the ...y, a 400-mile-long, 60-mile-wide reservoir held in cold stor... supplies California with more than 60 percent of its

water, much of it when it's needed most: over the hot, dry summer months."[107] Already that snowpack has shrunk by more than 10 percent, with the forecast that it will shrink as much as 40 percent more by midcentury and as much as 90 percent by century's end.

But let's not speculate; let's just focus on what has already happened: "Temperatures have warmed during winter and early-spring storms," noted one study. "Consequently the fraction of precipitation that fell as snow declined, while the fraction that fell as rain increased." And when rain falls in the winter in the Sierras, bad things happen—the massive New Year's Day flood in 1997, for example, when rain fell as high up the mountains as eleven thousand feet and the ensuing deluge resulted in disaster declarations for all forty-six counties in northern California. California's four wettest winters on record have come since 1996; in 2008 the state's energy planners started conducting drills for dealing with epic floods that forecasters say are becoming ever more likely.[108] Something else happens when the snowpack melts early—the sun now has time to dry out the forest, guaranteeing a longer fire season and drier trees.[109] In fact, the average California fire season runs seventy-eight days longer than it did in the 1970s and 1980s; it used to start in June and end in September, but now the Forest Service hires firefighting crews in the middle of April, and they are often still working into November and December. Half the National Forest Service budget is now spent extinguishing fires: "The agency is no longer the U.S. Forest service but rather the U.S. Fire Service," one congressman complained.[110]

As with hurricanes, it's not just more fires but bigger ones. On average, large fires now burn four times as long as a generation ago, and in recent years three-quarters of the bad fires across the West came in years when the snow melted well ahead of

schedule. "We're getting in a place where we are almost having a perfect storm" for wildfire, said one Forest Service official. And, of course, it all feeds back on itself. The Moonlight fire, in September 2007 near Lake Tahoe, burned for two weeks and in that time pumped an estimated 5 million tons of carbon dioxide into the atmosphere, the same as 970,000 cars driving for a year, the same impact as a coal-fired power plant. "The intensity of the fire was pretty spectacular," the incident commander told Tom Knudson of the *Sacramento Bee*. When it was over, even the soil was incinerated, making it hard for the conifer forest to return. Researchers now believe that more large fires will lead to thinner, scrubbier woods, and indeed, black oak, whitethorn manzanita, and other brush species are rapidly expanding across parts of the Sierra that once grew mostly pine. One result? Western forests, which are currently responsible for 20 to 40 percent of total U.S. carbon sequestration, may soon become a source of carbon dioxide, not a sink for the gas.[111] Another, just as depressing: the biggest trees, the largest living things on earth, are disappearing. A Yosemite study found in 2009 that the "density of large-diameter trees in the forest" has fallen by a quarter in recent decades. "These large, old trees have lived centuries and experience many dry and wet periods," one researcher said. "So it is quite a surprise that recent conditions are such that these long-term survivors have been affected." The decline could "accelerate" as the climate warms, the study adds.[112]

Let's move a few hundred miles east, to the spine of the Rockies, where trees are dying in incredible numbers. Partly it's chronic; heat stress and lack of water have doubled the "background mortality" of trees in the area.[113] But there's also acute trouble. By 2008 Wyoming and Colorado alone housed more than three million acres of dead trees.[114] In the next five years,

Colorado expects to lose another 5 million acres—virtually every lodgepole pine larger than five inches in diameter. Farther north, in British Columbia, 33 million acres of lodgepole have already turned from green to rust-red, all dead. The culprit is the mountain pine beetle, Latin name *Dendroctonus,* which translates as "tree killer." Once the beetle drills into the bark, the tree gives off a white, waxy resin in an attempt to seal the insect in its hole. But the attacker can give off a pheromone that draws swarms of other beetles. Eventually the tree is overwhelmed.[115] "The scope and scale of the destruction is like nothing we have ever seen," says Jay Jensen, executive director of the Council of Western State Foresters. "We're seeing the end of some forests as we know them."[116]

Why is it happening? Because we've raised the temperature enough that the beetles can overwinter more easily. Milder winters since 1994 have reduced the winter death rate of beetle larvae in Wyoming from 80 percent per year to less than 10 percent.[117] You need stretches of thirty or forty degrees below zero up in the mountains to kill off the beetles, and that doesn't happen much anymore. (In Glacier National Park, for instance, only 25 of the 150 glaciers that were there in 1850 still exist, and all of them are shrinking rapidly.)[118] Meanwhile, hotter, drier summers have made trees weaker and less able to fight off the swarming beetles. And what is the result? All the obvious things: greatly increased fire risk, followed by mudslide and erosion. Dead trees falling on roads and toppling power lines. In Colorado and Wyoming, officials closed thirty-eight campgrounds so trees wouldn't drop on tents. And a kind of despair. "It's really something to see," a Utah state forester said. "You would be very surprised. It's hard to describe until you see it—it's just dead trees as far as the eye can see."[119]

Oh, and this you'd never guess: lots more carbon flooding into the atmosphere. A study in the journal *Nature* in the fall of 2008 offered this tally: during outbreaks of pine beetle infestation, "the resulting widespread tree mortality reduces forest carbon uptake and increases future emissions from the decay of killed trees." Since these outbreaks are "an order of magnitude larger in area and severity than all previous recorded outbreaks," the impact "converted the forest from a small net carbon sink to a large net carbon source."[120] Indeed, in early 2009 the Canadian government, which had long argued that its carbon-sequestering forests should count against its tar-sand burning in UN tallies of its carbon dioxide output, quietly dropped the claim. Now that the trees have died, timber companies want to log them off, but environmentalists have pointed out that that would in turn release much of the carbon stored in the peaty soils beneath the trees, igniting what one called a "carbon bomb." By some estimates, Canada's forests alone contain 186 billion tons of carbon, or the equivalent of twenty-seven years of global emissions from burning coal and gas and oil.[121]

Once trends like this get rolling, we can't slow them. We don't know how to refreeze the Arctic or regrow a rain forest. Here's what it looks like: in the last six years, as warming temperatures and drought have killed off the native vegetation that holds soil in place, windstorms have dumped twice as much dust across the American West.[122] In April 2009, after the biggest of the storms blew through Silverton, Colorado, one witness said the landscape "looked like Mars. . . . You could feel the dust, you could taste the dust." But as usual the damage reverberates. The storms drop huge quantities of dirt on the snowpack of the Rocky Mountains, darkening the white ice and significantly speeding up its melt. "It's effectively like turning the sun up fifty percent," explains one University of Utah professor.[123] The snowpack now melts "weeks earlier than normal," according to Scott Streator of Greenwire, which spells "disaster for thousands of farmers and ranchers in the region who depend on slowly melting snow to provide water" flows over the dry summer months.[124] "A lot of the water's gone by the time the crops need it," one researcher explained.[125]

So let's review. The planet we inhabit has a finite number of huge physical features. Virtually all of them seem to be changing rapidly: the Arctic ice cap is melting, and the great glacier above Greenland is thinning, both with disconcerting and unexpected speed. The oceans, which cover three-fourths of the earth's surface, are distinctly more acid and their level is rising; they are also warmer, which means the greatest storms on our planet, hurricanes and cyclones, have become more powerful. The vast inland glaciers in the Andes and Himalayas, and the giant snowpack of the American West, are melting very fast, and within decades the supply of water to the billions of people living downstream may dwindle. The great rain forest of the Amazon is drying on its margins and threatened at its core. The great boreal forest of North America is dying in a matter of years. The great storehouses of oil beneath the earth's crust are now more empty than full. Every one of these things is completely unprecedented in the ten thousand years of human civilization. And some places with civilizations that date back thousand of years—the Maldives in the Indian Ocean, Kiribati in the Pacific, and many other island nations—are actively preparing to lower their flags and evacuate their territory. The cedars of Lebanon—you can read about them in the Bible—are now listed as "heavily threatened" by climate change.[126] We have traveled to a new planet, propelled on a burst of carbon dioxide. That new planet, as is often the case in science

fiction, looks more or less like our own but clearly isn't. I know that I'm repeating myself. I'm repeating myself on purpose. This is the biggest thing that's ever happened.

And the attempt to make it right usually makes things worse.

Sometimes the loops are almost comical. Versace is building a new hotel in Dubai, for instance, but the beach sand now gets so hot that guests burn their feet. Solution: a "refrigerated beach." As the hotel's founder explained, "We will suck the heat out of the sand to keep it cool enough to lie on. This is the kind of luxury top people want."[127]

Sometimes it's not shake-your-head funny but almost unavoidable. As more and more of Australia desertifies, the country could find itself "using 400 percent more energy to supply its drinking water by 2030 if the policy trend towards seawater desalination were to continue."[128]

And often—usually in the poor world—it's simply tragic. "Drinking water in Bangladesh is often full of salt as rising sea levels force water further inland," a Dhaka newspaper reporter wrote recently. That means women have to trek ever farther for a pitcher of clean water—sometimes several trips of several miles a day. "Some reports claim women and adolescent girls no longer have enough time and energy to carry out household duties like cooking, bathing, washing clothes and taking care of the elderly and infirm. It is even affecting their marriage prospects and family lives. Families who struggle to get clean water don't want daughters to leave their homes and marry elsewhere." Adolescent girls forced to drink increasingly saline water found their skin was "turning rough and unattractive," and "men from outside the area had no interest in marrying them."[129]

That's life on our new planet. That's where we live now.