

STATE OF NEW MEXICO
BEFORE THE ENVIRONMENTAL IMPROVEMENT BOARD

IN THE MATTER OF THE PETITION FOR)
HEARING TO ADOPT NEW REGULATIONS)
AND TO AMEND VARIOUS SECTIONS OF)
20.2.1, 20.2.2, 20.2.70, and 20.2.72 NMAC,)
STATEWIDE CAP ON GREENHOUSE GAS)
EMISSIONS) No. EIB 08-19(R)

REBUTTAL TESTIMONY OF BILL McKIBBEN

Q. PLEASE STATE YOUR NAME, TITLE AND CREDENTIALS.

A. Bill McKibben I am an American environmentalist and writer who frequently write about global warming and alternative energy and advocates for more localized economies. In 2009 I led the organization of 350.org , which coordinated what *Foreign Policy* magazine called “the largest ever global coordinated rally of any kind,” with 5,200 simultaneous demonstrations in 181 countries. The magazine named me to its inaugural list of the 100 most important global thinkers, and MSN named me one of the dozen most influential men of 2009.

I grew up in suburban Lexington, Massachusetts. I was president of the *Harvard Crimson* newspaper in college. Immediately after college I joined the *New Yorker* magazine as a staff writer, and wrote much of the “Talk of the Town” column from 1982 to early 1987. I quit the magazine when its longtime editor William Shawn was forced out of his job, and soon moved to the Adirondack Mountains of upstate New York.

My first book, The End of Nature, was published in 1989 by Random House after being serialized in the *New Yorker*. It is regarded as the first book for a general audience about climate change, and has been printed in more than 20 languages. Several editions have come out in the United States, including an updated version published in 2006.

My next book, The Age of Missing Information, was published in 1992. It is an account of an experiment: McKibben collected everything that came across the 100 channels of cable TV on the Fairfax, Virginia system (at the time among the nation's largest) for a single day. I spent a year watching the 2,400 hours of videotape, and then compared it to a day spent on the mountaintop near his home. This book has been widely used in colleges and high schools, and was reissued in a new edition in 2006.

Subsequent books include Hope, Human and Wild, about Curitiba, Brazil and Kerala, India, which he cites as examples of people living more lightly on the earth; *The Comforting Whirlwind: God, Job, and the Scale of Creation*, which is about the Book of Job and the environment; Maybe One, about human population; Long Distance: A Year of Living Strenuously, about a year spent training for endurance events at an elite level; Enough, about what I see as the existential dangers of genetic engineering; Wandering Home, about a

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion

1 long solo hiking trip from my current home in the mountains east of Lake Champlain in
2 Ripton, Vermont back to his longtime neighborhood of the Adirondacks.

3 In March 2007 I published Deep Economy: the Wealth of Communities and the Durable
4 Future. It addresses what I see as shortcomings of the growth economy and envisions a
5 transition to more local-scale enterprise.

6 In late summer 2006, I helped lead a five-day walk across Vermont to demand action on
7 global warming that some newspaper accounts called the largest demonstration to date in
8 America about climate change. Beginning in January 2007 I founded stepitup07.org to
9 demand that Congress enact curbs on carbon emissions that would cut global warming
10 pollution 80 percent by 2050. With six college students, I organized 1,400 global warming
11 demonstrations across all 50 states of America on April 14, 2007. Step It Up 2007 has been
12 described as the largest day of protest about climate change in the nation's history. A guide
13 to help people initiate environmental activism in their community coming out of the Step It
14 Up 2007 experience entitled Fight Global Warming Now was published in October 2007
15 and a second day of action on climate change was held the following November 3.

16 March 2008 saw the publication of The Bill McKibben Reader, a collection of 44 essays
17 written for various publications over the past 25 years.

18

19 My newest book is Eaarth: Making a Life on a Tough New Planet. I explain that our old
20 familiar globe is suddenly melting, drying, acidifying, flooding, and burning in ways that no
21 human has ever seen. We've created, in very short order, a new planet, still recognizable but
22 fundamentally different. We may as well call it Eaarth. That new planet is filled with new
23 binds and traps. A changing world costs large sums to defend—think of the money that went
24 to repair New Orleans, or the trillions it will take to transform our energy systems. But the
25 endless economic growth that could underwrite such largesse depends on the stable planet
26 we've managed to damage and degrade. We can't rely on old habits any longer. Our hope
27 depends, I argue, on scaling back—on building the kind of societies and economies that can
28 hunker down, concentrate on essentials, and create the type of community (in the
29 neighborhood, but also on the Internet) that will allow us to weather trouble on an
30 unprecedented scale. Change—fundamental change—is our best hope on a planet suddenly
31 and violently out of balance.

32

33 I am a frequent contributor to various magazines including *The New York Times*, *The*
34 *Atlantic Monthly*, *Harper's*, *Orion Magazine*, *Mother Jones*, *The New York Review of*
35 *Books*, *Granta*, *Rolling Stone*, and *Outside*. He is also a board member and contributor to
36 *Grist Magazine*.

37 I have been awarded Guggenheim and Lyndhurst Fellowships, and won the Lannan Prize
38 for nonfiction writing in 2000. He has honorary degrees from Green Mountain College,
39 Unity College, Lebanon Valley College and Sterling College.

40 I currently reside with my wife, writer Sue Halpern, and his daughter, Sophie, who was born
41 in 1993, in Ripton, Vermont. I am a scholar in residence at Middlebury College.

42

43 Q. ON WHOSE BEHALF ARE YOU PRESENTING THIS TESTIOMNY?

44 A. I am presenting this testimony on behalf of New Energy Economy.

45

46

47 Q. PLEASE LIST SOME OF THE PUBLICATIONS YOU HAVE AUTHORED

1 REGARDING CLIMATE CHANGE AND SOCIETAL IMPACTS?

2 A. I am a frequent contributor to various magazines including *The New York Times*, *The*
3 *Atlantic Monthly*, *Harper's*, *Orion Magazine*, *Mother Jones*, *The New York Review of*
4 *Books*, *Granta*, *Rolling Stone*, and *Outside*. He is also a board member and contributor to
5 *Grist Magazine*.

6 Below listed are some of my articles and various interviews for magazines and radio
7 programs.

8 [The Only Way to Have a Cow](#) | *Orion Magazine*

9 A call for America to divest its heart and stomach from feedlot beef [March/April 2010]

10 [Washington's Snowstorms, Brought to you by Global Warming](#) | *The Washington Post*

11 You want to hear my winter weather story? No, really, I know you do. [February 14, 2010]

12 [As the World Waits on the U.S., a Sense of Déjà Vu in Denmark?](#) | *Yale Environment 360*

13 Twelve years ago in Kyoto, the world was poised to act on a climate treaty but looked for a
14 clear signal from the United States. Now, with the Copenhagen talks set to begin, the
15 outcome once again hinges on what the U.S. is prepared to do. [November 30, 2009]

16 [Why 350 Is A Magic Number](#) | *New Matilda*

17 Facing climate disaster, African countries are calling for a fast greenhouse gas reduction to
18 350 parts per million ahead of the global climate protests this Saturday [October 20, 2009]

19 [First, Step Up](#) | *Yes! Magazine*

20 At any given moment we face as a society an enormous number of problems. But there's
21 only one thing we're doing that will be easily visible from the moon. That something is
22 global warming. [Spring 2008]

23 [Remember This: 350 Parts Per Million](#) | *Washington Post*

24 This month may have been the most important yet in the two-decade history of the fight
25 against global warming. Al Gore got his Nobel in Stockholm; international negotiators made
26 real progress on a treaty in Bali; and in Washington, Congress actually worked up the nerve
27 to raise gas mileage standards for cars. But what may turn out to be the most crucial
28 development went largely unnoticed. [December 28, 2007]

29 [The Power of the Click](#) | *Los Angeles Times*

30 The Internet is more than a campaign fundraising tool; it's creating a political force.
31 [October 16, 2007]

32 [Can Anyone Stop It?](#) | *New York Review of Books*

33 During the last year, momentum has finally begun to build for taking action against global
34 warming by putting limits on carbon emissions and then reducing them. Driven by ever-
35 more-dire scientific reports, Congress has, for the first time, begun debating ambitious
36 targets for carbon reduction. [October 11, 2007]

37 [The Race Against Warming](#) | *The Washington Post*

38 We're in a desperate race. Politics is chasing reality, and the gap between them isn't closing
39 nearly fast enough. [September 29, 2007]

- 1 Carbon's New Math | *National Geographic Magazine*
- 2 The CO2 from fossil fuels lingers in the atmosphere, so global warming can't be undone.
- 3 But catastrophe can still be averted. [October 2007]

- 4 Everybody's Organizing [PDF] | *elephant journal*
- 5 Waylon H. Lewis of elephant journal interviews Bill McKibben on intersection of the
- 6 environment and local economies and how Bill's recent trip to Tibet influenced Step it Up
- 7 2007. [Summer 2007]

- 8 Bill McKibben on Deep Economy | KQED's *Forum*
- 9 Forum talks with Bill McKibben about his recent work challenging things purchased, eaten
- 10 and used and the money that pays for it all. [March 2007]

- 11 Reversal of Fortune | *Mother Jones*
- 12 The formula for human well-being used to be simple: Make money, get happy. So why is
- 13 the old axiom suddenly turning on us? [March/April 2007]

- 14 Energizing America | *Sierra Magazine*
- 15 Fossil fuels burned brightly in their day, but now it's time to make the leap to safer, cleaner,
- 16 climate-friendly alternatives. [January/February 2007]

- 17 Bill McKibben on Greening Corporations | *Mother Jones* Radio Broadcast
- 18 Is corporate social responsibility for real, or is it just "greenwashing." [December 2006]

- 19 Bill Blakemore talks to Bill McKibben | Desmogblog Radio
- 20 Bill Blakemore, senior correspondent for ABC News, asks McKibben a few questions about
- 21 climate change and where we're headed politically. [October 2006]

- 22 State of the Planet 2006 | *Seed Magazine*
- 23 Whether this or future Earth Days help solve any particular environmental problems won't
- 24 matter a bit, unless we tackle the biggie—climate change. Bill McKibben reviews the
- 25 damage and points the way forward. The x-factor in preventing catastrophe, he says, will be
- 26 whether the American public—with its financial and cultural power to move mountains—
- 27 sort of gets it, or really gets it. [April/May 2006]

- 28 What a Real, Living, Durable Economy Looks Like | Powell's Books
- 29 Original essay written for Powells on global economy.

- 30 Meet the New Loss | *Grist Magazine*
- 31 Bill writes about Hurricane Katrina and how it brings a foretaste of environmental disasters
- 32 to come. [September 7, 2005]

- 33 Climate of Denial | *Mother Jones*
- 34 One morning in Kyoto, we won a round in the battle against global warming. Then special
- 35 interests and pseudoscience snatched the truth away. What happened? [May/June 2005]

- 36 Environmental Writer Bill McKibben 'Wanders Home' | National Public Radio
- 37 NPR's Alex Chadwick speaks with the environmental writer about his new book, *Wandering*
- 38 *Home—A Long Walk Across America's Most Hopeful Landscape: Vermont's Champlain*
- 39 *Valley and New York's Adirondacks*. [April 11, 2005]

- 1 We Are Plenty Good Enough | *Sierra Magazine*
- 2 Bill talks with Sierra Magazine about "brash plans to tinker with our genes." [November
- 3 2003]
- 4 Small Change: My Mileage is Better Than Your Mileage | *Orion Online*
- 5 An all-American idea for getting Americans to take gas consumption seriously.
- 6 [January/February 2003]
- 7 It's Easy Being Green | *Mother Jones*
- 8 George W. Bush doesn't get it yet. But renewable energy is no longer the stuff of noble
- 9 visions and pipe dreams: It's available, inexpensive, and increasingly—normal. [July/August
- 10 2002]
- 11 An End to Sweet Illusions | *Mother Jones*
- 12 America must open its eyes to the rest of the world. [January/February 2002]
- 13 An Alternative to Progress | *Mother Jones*
- 14 Bangladesh, despite all its problems, holds the promise of a kind of self-sufficiency not
- 15 imagined at the World Bank. [May/June 2001]
- 16 Across the Disappearing Finish Line | *Outside Magazine*
- 17 Searching for the keys to endurance, a ski racer pushes his body and heart to the limit—until
- 18 his father's sudden illness changes all the rules. [November 2000]
- 19 A Special Moment In History | *The Atlantic Monthly*
- 20 The dangers of overpopulation, the dangers of climate change, the dangers of pollution—
- 21 we've been hearing about all these dangers for years, and yet doomsday still hasn't come.
- 22 But what if we have already inflicted serious damage on the planet? And what if we have
- 23 only a few decades left in which to salvage a stable environment? These questions, the
- 24 author argues, are not hypothetical. [May 1998]
- 25 New York Review of Books
- 26 Links to my introductions and book reviews on the New York Review of Books site.
- 27
- 28
- 29 Q. COALITION OF ARIZONA/NEW MEXICO COUNTIES' WITNESS BALGORD
- 30 ARGUES THAT "CURRENT WARMING (DURING 2ND HALF OF 20TH CENTURY) IS
- 31 NOT PRIMARILY DUE TO GREENHOUSE GASES FROM EITHER NATURAL OR
- 32 MAN-MADE SOURCES" (Coalition of Arizona/New Mexico Counties' witness Balgord 1-
- 33 4). PLEASE EXPLAIN YOUR UNDERSTANDING OF OUR CURRENT GLOBAL
- 34 CLIMATE?
- 35 A. Imagine we live on a planet. Not our cozy, taken-for-granted earth, but a planet, a real
- 36 one, with melting poles and dying forests and heaving, corrosive sea, raked by winds,
- 37 strafed by storms, scorched by heat. An inhospitable place.
- 38
- 39 It's hard. For the ten thousand years that constitute human civilization, we've existed in the
- 40 sweetest of sweet spots. The temperature has barely budged; globally averaged, it's swung
- 41 in the narrowest of ranges, between fifty-eight and sixty degrees Fahrenheit. That's warm
- 42 enough that the ice sheets retreated from the centers of our continents so that we could grow
- 43 grain, but cold enough that mountain glaciers provided drinking and irrigation water to those
- 44 plains and valleys year-round; it was the "correct" temperature for the marvelously diverse

1 planet that seems right to us. And every aspect of our civilization reflects that particular
2 world. We built our great cities next to the seas that have remained tame and level, or at
3 altitudes high enough that disease-bearing mosquitoes could not overwinter. We refined the
4 farming that has swelled our numbers to take full advantage of that predictable heat and
5 rainfall; our rice and corn and wheat can't imagine another earth either. Occasionally, in one
6 place or another, there's an abrupt departure from the norm—a hurricane, a drought, and a
7 freeze. But our very language reflects their rarity: freak storms, disturbances.

8
9 In December 1968 we got the first real view of that stable secure place. *Apollo 8* was
10 orbiting the moon, the astronauts busy photographing possible landing zones for the
11 missions that would follow. On the fourth orbit, Commander Frank Borman decided to roll
12 the craft away from the moon and tilt its windows toward the horizon—he needed a
13 navigational fix. What he got instead, was a sudden view of the earth, rising. “Oh my
14 God,” he said. “Here’s the earth coming up.” Crewmember Bill Anders grabbed a camera
15 and took the photograph that became the iconic image perhaps of all time. “Earthrise,” as it
16 was eventually known, that picture of a blue-and-white marble floating amid the vast
17 backdrop of space, set against the barren edge of the lifeless moon.¹ Borman said later that it
18 was “the most beautiful heart-catching sight of my life, one that sent a torrent of nostalgia,
19 sheer homesickness, surging through me. It was the only thing in space that had any color
20 to it. Everything else was simply black or white. But not the earth,”² The third member of
21 the crew, Jim Lovell, put it more simply: the earth, he said, suddenly appeared as “a grand
22 oasis.”

23
24 *But we no longer live on that planet.* In the four decades since, the earth has changed in
25 profound ways, ways that have already take us out of the sweet spot where humans so long
26 thrived. We're every day less the oasis and more the desert. The world hasn't ended, but
27 the world as we know it has—even if we don't quite know it yet. We imagine we still live
28 back on that old planet, that the disturbances we see around us are the old random and
29 freakish kind. But they're not. It's a different place. It needs a new name. Eearth. Or
30 Monnde, or Tierre, Errde, окучить. It still looks familiar enough—we're still the third
31 rock from the sun, still three-quarters water. Gravity still pertains; we're still earthlike. But
32 it's odd enough to constantly remind us how profoundly we've altered the only place we've
33 know. I am aware, of course, that the earth changes constantly, and that occasionally it
34 changes wildly, as when an asteroid strikes or an ice age relaxes its grip. This is one of those
35 rare moments, the start of a change far larger and more thoroughgoing than anything we can
36 read in the records of man, on a par with the biggest dangers we can read in the records of
37 rock and ice.

38
39 Consider the veins of cloud that streak and mottle the earth in that glorious snapshot from
40 space. So far humans, by burning fossil fuel, have raised the temperature of the planet
41 nearly a degree Celsius (more than a degree and a half Fahrenheit). A NASA study in
42 December 2008 found that warming on that scale was enough to trigger 45 percent increase
43 in thunderheads above the ocean, breeding the spectacular anvil-headed clouds that rise five
44 miles above the sea, generating “super-cells” with torrents of rain and hail.³ In fact, total
45 global rainfall is now increasing 1.5 percent a decade.⁴ Larger storms over land now create

¹ Andrew Revkin, “Puberty on the Scale of a Planet,” *New York Times*, August 7, 2009.

² Robert Poole, “For the Apollo Astronauts, A Small World,” *Los Angeles Times*, July 19, 2009

³ Rosslyn Beeby, “Warming Fuels Rise in Tropical Storms,” *Canberra Times*, December 27, 2008.

⁴ “NASA Study links Severe Storm Increases, Global Warming,” *Pasadena Star News*, January 23, 2009.

1 more lighting; every degree Celsius brings about 6 percent more lightning, according to the
2 climate scientist Amanda Staudt. In just one day in June 2008, lightning sparked 1,700
3 different fires across California, burning a million acres and setting a new state record.
4 These blazes burned on the new earth, not the old one. "We are in the mega-fire era," said
5 Ken Frederick, a spokesman for the federal government.⁵ And that smoke and flame, of
6 course, were visible from space—indeed anyone with an Internet connection could watch the
7 video feed from the space shuttle *Endeavour* as it circled above the towering plumes in the
8 Santa Barbara hills.

9
10 Or consider the white and frozen top of the planet. Arctic ice has been melting slowly for
11 two decades as the temperatures have climbed, but in the summer of 2007 that gradual thaw
12 suddenly accelerated. By the time the long Arctic night finally descended in October, there
13 was 22 percent less sea ice than had ever been observed before, and more than 40 percent
14 less than the year that Apollo capsule took its picture. The Arctic cap was 1.1 million square
15 miles smaller than ever in recorded history, reduced by an area twelve times the size of
16 Great Britain.⁶ The summers of 2008 and 2009 saw a virtual repeat of the epic melt; in
17 2008 both Northwest and Northeast passages opened for the first time in human history.
18 The first commercial ship to make the voyage through the newly opened straits, the *MV*
19 *Camilla Dasgagnes*, had an icebreaker on standby in case it ran into trouble, but the captain
20 reported, "I don't see one cube of ice."⁷

21
22 This is not some mere passing change; this is the earth shifting. In December 2008, scientist
23 from the National Sea Ice Delta Center said the increased melting of Arctic ice was
24 accumulating heat in the oceans, and that this so-called Arctic amplification now penetrated
25 1,500 kilometers inland. In August 2009, scientists reported that lightning strikes in the
26 Arctic had increased twenty fold, igniting some of the first tundra fires ever observed.⁸ That
27 is, within a decade or two, a summertime spacecraft pointing its camera at the North Pole
28 would see nothing but open ocean. There'd be ice left on Greenland—but much less ice.
29 Between 2003 and 2008, more than a trillion tons of the island's ice melted, an area ten
30 times the size of Manhattan. "We now know that the climate doesn't have to warm any
31 more for Greenland to continue losing ice," explained Jason Box, a geography professor at
32 Ohio State University. "It has probably passed the point were it could maintain the mass of
33 ice that we remember."⁹ And if the spacecraft pointed its camera at the South Pole? On the
34 last day of 2008, the *Economist* reported that temperatures of the Antarctic Peninsula were
35 rising faster than anywhere else on earth, and that the West Antarctic was losing ice 75
36 percent faster than just a decade before.¹⁰

37
38 Don't let your eyes glaze over at this parade of statistics (and so many more to follow).
39 These should come as body blows, as mortar barrages, as sickening thuds. The Holocene is
40 staggered, the only world that humans have known is suddenly reeling. I am not describing
41 what will happen if we don't take action, or warning of some future threat. This is the

⁵ Brian K. Sullivan, "California Fire Season Now Year Round in Era of Mega Blazes," Bloomberg.com, November 18, 2008.

⁶ Jonathan Leake, "Arctic Ice Melting Even in Winter," Times online, October 26, 2008.

⁷ "First Commercial Ship Sails through Northwest Passage," *Climate Progress*, November 30, 2008.

⁸ Lisa Jarvis, "Kindling for Climate Change," *Chemical and Engineering News*, August 17, 2009.

⁹ Joseph Romm, "Loss Cause," Grist.org, December 19, 2008.

¹⁰ "The Curse of Carbon," *Economist*, December 31, 2008.

1 *current* inventory: more thunder, more lightning, less ice. Name a major feature of the
2 earth's surface and you'll find massive change.

3
4 For instance: a U.S. government team studying the tropics recently concluded that by the
5 standard meteorological definition, they have expanded more than two degrees of latitude
6 north and south since 1980—"a further 8.5 million square miles of Earth are now
7 experiencing a tropical climate." As the tropics expand, they push the dry subtropics ahead
8 of them, north and south, with "grave implications for many millions of people." in these
9 newly arid regions. In Australia, for instance, "westerly winds bringing much needed rain"
10 are "likely to be pushed further south, dumping their water over open ocean rather than on
11 land."¹¹ Indeed, by early 2008 half of Australia was in drought, and forecasters were
12 calling it the new normal. "The inflows of the past will never return," the executive
13 director of the Water Services Association of Australia told reporters. "We're trying to
14 avoid the term 'drought' and saying this is the new reality."¹² They are trying to avoid the
15 term *drought* because it implies the condition may someday *end*. The government warned
16 in 2007 that "exceptionally hot years," which used to happen once a quarter century, would
17 now "occur every one or two years."¹³ The brushfires ignited by drought on the scale
18 claimed hundreds of Australian lives in early 2009; four-story-high walls of flame "raced
19 across the land like speeding trains," according to news reports. The country's prime
20 minister visited the scene of the worst blazes. "Hell and its fury have visited the god people
21 of Victoria," he said.¹⁴

22
23 And such hell is not confined to the antipodes. By the end of 2008 hydrologists in the
24 United States were predicting that drought across the American Southwest had become a
25 permanent condition.¹⁵ There was a 50 percent chance that Lake Mead, which backs up on
26 the Colorado River behind Hoover Dam, could run dry by 2021.¹⁶ (When that happens, as
27 the head of the Southern Nevada Water Authority put it, "you cut off supply to the fifth
28 largest economy in the world," spread across the American West.)¹⁷ But the damage is
29 already happening: researchers calculate that the new aridity and heat have led to
30 reductions in wheat, corn, and barley yields of about 10 million tons a year.¹⁸ The dryness
31 keeps spreading. In early 2009 drought wracked northern China, the country's main wheat
32 belt. Rain didn't fall for more than a hundred days, a modern record.¹⁹ The news was much
33 the same in India, in southern Brazil, and in Argentina, where wheat production in 2009 was
34 the lowest in twenty years.²⁰ Across the planet, rivers are drying up. A massive 2009 study
35 looked at streamflows on 925 of the world's largest rivers from 1948 to 2004 and found that
36 twice as many were falling as rising. "During the life span of the study, fresh water

¹¹ Steve Conner, "Expanding Tropics a Threat to Millions," *Independent*, December 3, 2007.

¹² Rachel Kleinman, "No More Drought: It's a 'Permanent Dry,'" *Age*, September 7, 2007.

¹³ David Pallister, "Brushfires and Global Warming, Is There a Link?" *Guardian*, February 8, 2009.

¹⁴ David Pallister, "Australian Brushfire Toll Its Worst Ever," *Guardian*, February 8, 2009.

¹⁵ Patty Henetz, "Drought Deepens Strain on a Dwindling Colorado," *Salt Lake Tribune*, November 29, 2008.

¹⁶ Mike Stark, "Climate Change, Drought to Strain Colorado River," Associated Press, December 5, 2008.

¹⁷ Abraham Lustganta, "How West's Energy Boom Could Threaten Drinking Water," *San Diego Tribune*, December 21, 2008.

¹⁸ World Wildlife Fund, "Climate Change: Faster, Stronger, Sooner," October 20, 2008.

¹⁹ Tania Banigan, "Drought Threatens China Wheat Crop," *Guardian*, February 4, 2009.

²⁰ Michael Klare, "The Second Shockwave," *Foreign Policy in Focus*, March 18, 2009.

1 discharge into the Pacific Ocean fell by about six percent—or roughly the annual volume of
2 the Mississippi,” it reported.²¹
3

4 From the flatlands to the highest peaks. The great glaciologist Lonnie Thompson, drilling
5 cores on a huge Tibetan glacier in 2008, found something odd. Or rather, didn’t find: one of
6 the usual marker layers in any ice core, the radioactive particles that fell out from the atomic
7 tests of the 1960s were missing. The glacier had melted back through that history, wiped it
8 away. A new Nepalese study found temperatures rising a tenth of a degree Fahrenheit
9 annually in the Himalayas.²² That would be a degree every *decade* in a world where the
10 mercury barely budged for ten millennia. A long-standing claim that Himalayan glaciers
11 might disappear by 2035 has been discredited, but across the region the great ice sheets are
12 already shrinking fast: photos from the base of Mount Everest show that three hundred
13 vertical feet of ice—a mass as tall as the Statue of Liberty—have melted since the Mallory
14 expedition took the first photographs of the region in 1921.²³ But already, while there’s still
15 some glacier left, the new heat is flustering people. The rhododendrons that dominate
16 Himalayan hillsides are in some places blooming forty-five days of head of schedule,
17 wrecking the annual spring flower festival and “creating confusion among folk artists.”²⁴
18 The same kind of confusion is gripping mountaineers; one experienced high-altitude guide
19 recently reported abandoning some mountains he’d climbed for years because “of the
20 melting of the ice that acts as a glue, literally holding the mountains together.”²⁵
21

22 It’s not just the Himalayas. In the spring of 2009, researchers arriving in Bolivia found that
23 the eighteen-thousand-year-old Chacaltaya Glacier is “gone, completely melted away as of
24 some sad, undetermined moment early this year.” Once the highest ski run in the world, it is
25 now nothing but rocks and mud.²⁶ But it’s not the loss of a ski run that really matters.
26 These glaciers are the reservoirs for entire continents, watering the billions of people who
27 have settled down stream because they guaranteed a steady supply. “When the glaciers are
28 gone, they are gone. What does a place like Lima do?” asked Tim Barnett, a climate
29 scientist at Scripps Oceanographic Institute. “In northwest China there are 300 million
30 people relying on snowmelt for water supply. There’s no way to replace it until the next ice
31 age.”²⁷
32

33 When I read these accounts, I flash back to a tiny village, remote even by Tibetan standards,
34 where I visited a few years ago. A gangly young man guided me a mile up a riverbank for a
35 view of the enormous glacier whose snout towered over the valley. A black rock the size of
36 an apartment tower stuck out from the middle of the wall of ice. My guide said it had
37 appeared the year before and now grew larger daily as its dark surface absorbed the sun’s
38 heat. We were a hundred miles from a school, far from TV; no one in the village was
39 literate. So out of curiosity I asked the young man: “Why is it melting?” I don’t know what

²¹ Suzanne Goldenberg, “Climate Change Threatens Ganges, Niger and Other Mighty Rivers,” *Guardian*, April 22, 2009.

²² Kyangjin Gomba, “Himalayan Villages on Global Warming Frontline,” Agence France-Presse, December 26, 2008.

²³ “On Thinner Ice: Melting Glaciers on the Roof of the World,” Asia Society, <http://www.asiasociety.org/onthinnerice>.

²⁴ Raju Gusain, “Climate Change Leads to Early Flowering,” *India Today*, February 4, 2009.

²⁵ Tim Rippel, “Slippery Slope,” *Hemispheres*, April 2009, p.63.

²⁶ John Enders, “Bolivia’s Chacaltaya Glacier Is Gone,” *Miami Herald*, May 5, 2009.

²⁷ Doug Struck, “On the Roof of Peru, Omens in the Ice,” *Washington Post*, July 29, 2006.

1 I expected—some story about angry gods? He looked at me as if I was visiting for the planet
2 Moron.

3
4 “Global warming,” he said. “Too many factories.” No confusion there. We hiked back to
5 his hut and shook hands. I climbed into the Land Cruiser, which took me to the airplane.
6 And so forth.

7
8 Or consider the ocean, that three-fourths of the planet that we usually don’t consider.
9 Different? One hundred eleven hurricanes formed in the tropical Atlantic between 1995 and
10 2008, a rise of 75 percent over the previous thirteen years. They’re stronger, stranger.
11 “Storms are not just making landfall and going away like they did in the past,” said a
12 researcher at the National Center for Atmospheric Research. “Somehow these storms are
13 able to live longer today.” In the summer of 2008, he added, “meteorologists watched in
14 amazement as Tropical Storm Fay crisscrossed Florida a record-breaking four times” before
15 it finally broke up; Hurricane Gustav carried its hurricane force winds all the way to Baton
16 Rouge, a hundred miles inland, surprising the evacuees who had fled there from the coast.²⁸
17 In the last half decade we’ve seen the earliest-forming Category 5 hurricane ever recorded
18 (Emily, 2005) and the first January tropical cyclone (Zeta, 2006), the first known tropical
19 cyclone in the South Atlantic (Catarina, 2004), and the first known tropical storm ever to
20 strike Spain (Vince, 2005). The hurricane season of 2008 was the only one on record in the
21 Atlantic that featured major hurricanes in five separate months, from Bertha (July) to
22 Paloma (November). And elsewhere? “The increase in ocean temperatures,” according to
23 one study, “has led Bangladesh to encounter more than twelve storm warnings per year
24 when the previous average was three.” A succession of typhoons hit the country in 2006,
25 inundating two-thirds of the nation; year later Cyclone Sidr killed three thousand.²⁹ In the
26 summer of 2009 a train of typhoons rolled across the Pacific Ketsana dropped record rain
27 on Manila and Vietnam; Morakot dumped nine and a half *feet* of rain on parts of Taiwan.
28 All together? According to the *New York Times*, “the last thirty years have yielded four
29 times as many weather-related disasters as the first three quarters of the 20th century
30 combined.”³⁰

31
32 But lay aside hurricanes and wreckage. Just concentrate for a minute on how the sea is
33 changing. For far longer than human civilization, those globe-girdling oceans have been
34 chemically constant. They’re so vast that we’ve taken their stability as a given. Even most
35 oceanographers were shocked a few years ago when researchers began noticing that the seas
36 were acidifying as they absorbed some of the carbon dioxide we’ve poured into the
37 atmosphere. “It’s been thought pH in the open oceans is well buffered, so it’s surprising to
38 see these fluctuations,” said the University of Chicago biologist Timothy Wootton, who
39 found acid levels rising ten times faster than expected.³¹ Already ocean pH has slipped from
40 8.2 to 8.1; take one of those strips you dip in a hot tub, and you can tell the difference. The
41 consensus estimate is the pH will reach 7.8 by century’s end.³² The sea is already 30
42 percent more acid than it would have been because of our emissions, a process that Britain’s
43 Royal Society described as “essentially irreversible.”³³ Already the ocean is more acid than

²⁸ Rick Jervis, “Data Show U.S. Riding Out Worst Storms on Record,” *USA Today*, October 22, 2008.

²⁹ NTS Asia-Secretariat, “Climate Refugees, A Crisis in the Making,” October 2008.

³⁰ Charles M. Blow, “Farewell, Fair Weather,” *New York Times*, May 31, 2008.

³¹ Julian Siddle, “Marine Life Faces ‘Acid Threat,’” BBC, November 30, 2008..

³² Robert Lee Hotz, “A Look into Future Oceans for Shellfish Reasons,” *Wall Street Journal*, April 4 2009.

³³ “The Curse of Carbon,” *Economist*, December 31, 2008.

1 anytime in the last eight hundred thousand years, and at current rates by 2050 it will be more
2 corrosive than anytime in the past 20 million years. In that kind of environment, shellfish
3 can't make thick enough shells. (Think of DDT and birds' eggs if you want an analogy).
4 By the summer of 2009, the Pacific oyster industry was reporting 80 percent mortality for
5 oyster larvae, apparently because water rising for the ocean deep was "corrosive enough to
6 kill the baby oysters."³⁴ At a conference in the spring of 2009, the American researcher
7 Nancy Knowlton put it with refreshing bluntness: "Coral reefs will cease to exist as physical
8 structures by 2100, perhaps 2050."³⁵ "We are overwhelming the system," say Richard
9 Zeebe, an assistant professor of oceanography at University of Hawaii. "It's pretty
10 outrageous what we've done."³⁶ Which is as objective a scientific statement as you're likely
11 to hear.

12
13 The idea that humans could fundamentally alter the planet is new. The Swedish chemist
14 Svante Arrhenius broached the notion a century ago that we were "evaporating our coal
15 mines into the air," and calculated that this would eventually raise temperatures, but nobody
16 paid much attention. It wasn't until the 1950s that scientists even began measuring the
17 amount of carbon dioxide in the atmosphere, from a small hut on the side of Hawaii's
18 Mauna Loa, and they found that indeed the atmospheric concentration was steadily rising.
19 But we didn't have the computing power to know what to make of that the early 1980s,
20 when a few research teams began investigating, and almost nobody outside of a few labs
21 had heard of the notion until a NASA scientist named James Hansen testified before
22 Congress in June 1988 that global warming was almost certainly beginning. Even then,
23 though, the people most worried about the problem called it a future threat: the declaration
24 that concluded the huge Rio summit on the environment in 1992 didn't even mention
25 climate change, but did recommend, meekly, that "in order to protect the environment, the
26 precautionary approach shall be widely applied by States according to their capabilities,"
27 People spoke mostly about global warming in the future tense; the word was always *threat*,
28 right up through the 2008 presidential campaign.

29
30 Q. PLEASE DESCRIBE THE TERMS GOVERNMENT LEADERS USE WHEN THEY
31 SPEAK OF A CHANGING CLIMATE?

32 A. Unveiling his global warming initiatives at the University of New Hampshire, Barack
33 Obama sounded a familiar note: "This is our generation's moment to save future generations
34 from global catastrophe."

35
36 Here's his opponent, John McCain, a few months later: "We and the other nations of the
37 world must get serious about substantially reducing greenhouse gas emissions in the coming
38 years or we will hand off a much-diminished world to our grandchildren."³⁷

39
40 In fact, if you've got a spare month some time, google *global warming* and *grandchildren*.
41 Among the 585,000 essentially identical and anodyne responses:
42 Ted Kennedy, to Congress in 2008: "I cannot look into the eyes of my grandchildren and
43 tell them: Sorry, I...can't do anything about it."
44

³⁴ Craig Welch, "Oysters in Deep Trouble," *Seattle Times*, June 14, 2009.

³⁵ John Aglionby, "Scientists Fear for Seas at Climate Talks," FT.com, May 14, 2009.

³⁶ Douglas Fischer, "The Ocean's Acid Test," *DailyClimae.com*, November 12, 2008.

³⁷ "Transcript: John McCain's Foreign Policy Speech," *New York Times*, March 26, 2008.

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion

- 1 Barbara Boxer, at the National Press Club: “Will our grandchildren know the thrill of
- 2 holding their child’s had watching with excitement a towering snow-capped mountain or
- 3 awesome, calving glaciers?”
- 4
- 5 Arnold Schwarzenegger, signing new energy legislation: “I want to make California No. 1
- 6 in the fight against global warming. This is something we owe our children and
- 7 grandchildren.” And Arnold at the United Nations: “We hold the future in our hands.
- 8 Together we must ensure that our grandchildren will not have to ask why we failed to do the
- 9 right thing, and let them suffer the consequences.” And in a statement he e-mailed to the
- 10 Chinese news agency Xinhua explaining the state’s new mileage laws: “Last month I signed
- 11 an Executive Order creating the world’s first Low Carbon Fuel standard so our vehicles will
- 12 emit less carbon and bring a healthier future to our children and grandchildren.” Hasta la
- 13 vista, grandchildren!
- 14
- 15 Joe Lieberman: “Shame on us if 100 or 200 years from now our grandchildren and great-
- 16 grandchildren are living on a planet that has been irreparably damaged by global warming,
- 17 and they ask, “How could those who came before us...have let this happen?”
- 18
- 19 David Attenborough: “If we do care about our grandchildren then we have to do
- 20 something.”
- 21 Former Illinois governor Rod Blagojevich, addressing his Climate Change Advisory Group:
- 22 “By committing ourselves to action in Illinois, we can help minimize the effects of climate
- 23 change and ensure our children and grandchildren inherit a healthy world full of
- 24 opportunity.”
- 25
- 26 The late Jerry Falwell: “I can tell you, our grandchildren will laugh at those who predicted
- 27 global warming. We’ll be in global cooling by then, if the Lord hasn’t returned. I don’t
- 28 believe a moment of it. The whole thing is created to destroy America’s free enterprise
- 29 system and our economic stability.”
- 30
- 31 Sir Richard Branson, chair of Virgin Airways: “I think businesses can influence leaders who
- 32 are not worrying enough about our grandchildren.”
- 33
- 34 Bill Clinton, stumping for his wife in Colorado: “We just have to slow down our economy
- 35 and cut back our greenhouse gas emissions ‘cause we have to save the planet for our
- 36 grandchildren.”
- 37
- 38 Let’s let the movie critic Roger Ebert sum up the general feeling, in his review of Al Gore’s
- 39 *An Inconvenient Truth*: “You owe it to yourself to see this film. If you do not, and you have
- 40 grandchildren, you should explain to others why you decided not to.”
- 41
- 42 Q. HOW DID IT HAPPEN THAT THE THREAT TO OUR DESCENDANTS, WHICH
- 43 REQUIRED THAT WE HEED AN ALARM AND ADOPT PRECAUTIONARY
- 44 PRINCIPLES AND BEGIN TO TAKE MEASURED ACTION LEST WE HAVE A
- 45 CRISIS FOR FUTURE GENERATIONS, ET CETERA – HOW DID THAT SUDDENLY
- 46 TURN INTO THE ARCTIC MELTING AWAY, THE TROPICS EXPANDING, THE
- 47 OCEAN TURNING ACID, THE SOUTHWEST FACING DUSTBOWL CONDITIONS?
- 48 HOW DID “100 OR 200 YEARS FROM NOW BECOME YESTERDAY?”
- 49 (Coalition of Arizona/New Mexico Counties’ witness Balgord at 1-4; City of Farmington’s

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough-Material] - Deletion

1 witness Kappelmann at 24-28.)

2
3 A. The answer, more or less, is that global warming is a huge experiment. We've never
4 watched it happen before, so we didn't know how it would proceed. Here's what we knew
5 twenty years ago: the historic level of carbon dioxide in the atmosphere, the level that
6 produced those ten thousand years of stability, was roughly 275 parts per million. And also
7 this: since the dawn of the Industrial Revolution we'd been steadily increasing that total,
8 currently raising it more than two parts per million annually. But no one really knew where
9 the red line was—it was impossible to really know in advance at what point you'd cross a
10 tripwire and set off a bomb. Like, say, melting all the ice in the Arctic.

11
12 The number that people tossed around for about a decade was 550 parts per million. Not
13 because we had any real data showing it was the danger point, but because it was double the
14 historic concentration, which made it relatively easy to model with the relatively crude
15 computer programs scientists were using. One paper after another predicted what would
16 happen sea levels or forest composition or penguin reproduction if carbon dioxide levels
17 doubled to 550 parts per million. And so—inevitably and insidiously—that's the number
18 we fixated on. Since it wouldn't be reached until the middle of the twenty-first century, it
19 seemed to offer a little margin; it meshed plausibly with political time, with the kind of
20 gradual solutions leaders like to imagine. That is, a doubling of carbon dioxide would
21 happen well beyond the time that anyone now in power was likely to still be in office, or
22 still running the company. It was when everyone's *grandchildren* would be in charge. As
23 late as 2004, the journalist Paul Roberts, in his superb book *The End of Oil*, was able to
24 write quite correctly that "most climate models indicate that once concentrations exceed 550
25 ppm we will start to witness 'dangerous' levels of warming and damage, especially in
26 vulnerable areas, such as low-lying countries or those already suffering drought." But by
27 then some doubt was beginning to creep in. Odd phenomena (large chunks of the Antarctic
28 falling into the ocean, say) were unnerving scientists enough that in Roberts's words, most
29 "would much rather see concentrations stabilized at 450ppm...where we might avoid most
30 long-term effects and instead suffer a kind of 'warming light,' moderate loss of shorefront
31 land, moderate loss of species, moderate desertification," and so on. And since even 450
32 was still 15 percent above our current levels, "we have a little room to breath, which is
33 handy."³⁸

34
35 Or would have been. But as it turns out, we had been like commentators trying to call an
36 election on the basis of the first precinct to report. Right about 2005 the real returns began
37 to flood in, *flood* being the correct verb. And what they showed was that those old
38 benchmarks—550, 450—had been wishful thinking. No breathing room, not when
39 hurricane seasons like 2005 were setting new records for insurance payouts, not when polar
40 ice was melting "fifty years ahead of schedule," not when the tropics "appear to have
41 already expanded during only the last few decades of the 20th century by at least the same
42 margins as models predict for this century."³⁹ Indeed, "ahead of schedule" became a kind
43 of tic for headline writers: "Arctic Melt-off Ahead of Schedule" (the *Christian Science*
44 *Monitor*, which quoted one scientist as saying "we're a hundred years ahead of schedule" in
45 thawing Greenland), "Dry Future Well Ahead of Schedule" (The *Australian*), "Acidified
46 Seawater Showing Up Along Coast Ahead of Schedule" (the *Seattle Times*). The

³⁸ Paul Roberts, *The End of Oil*, (Boston: Houghton Mifflin Harcourt, 2004), p.125.

³⁹ Connor, "Expanding Tropics."

1 Implication was that global warming hadn't read the invitation correctly and was showing
2 up at four for the reception instead of six. In fact, of course, the "schedule" was wrong.
3 And of course it was wrong—this was, as I've said, a huge experiment. Twenty-five years
4 ago almost nobody even knew the planet was gong to warm at all, never mind how fast.
5 It was that summer melt of Arctic ice in 2007 that seemed to break the spell, to start raising
6 the stakes. The record minimums for ice were reached in the last week of September; in
7 mid-December James Hansen, still the planet's leading climatologist, gave a short talk with
8 six or seven slides at the American Geophysical Union meeting in San Francisco. What he
9 said went unreported at the time, but it may turn out to be among the most crucial lectures in
10 scientific history. He summarized both the real-world data that had emerged in recent years,
11 including the ice-melt, and also the large body of research on paleoclimate—basically, the
12 attempt to understand what had happened in the distant past when carbon dioxide levels
13 climbed and fell. Taken together, he said, these two lines of inquiry made it clear that the
14 safe number was, at most, 350 parts per million.

15
16 The day Jim Hansen announced that number was the day I knew we'd never again inhabit
17 the planet I'd been born on, or anything close to it. Because we're already past 350—way
18 past it. The planet has nearly 390 parts per million carbon dioxide in the atmosphere.
19 We're too high. Forget the grandkids; it turns out this was a problem for our *parents*.
20 We can if we're very lucky and very committed, eventually get the number back down
21 below 350. This book will explore some of the reasons this task will be extremely hard, and
22 some of the ways we can try. The planet can, slowly, soak up excess carbon dioxide if we
23 stop pouring more in. That fight is what I spend my life on now, because it's still possible
24 we can avert the very worst catastrophes. But even so, great damage will have been done
25 along the way, on land and in the sea. In September 2009 the lead article in the journal
26 *Nature* said that about 350 we "threaten the ecological life-support systems that have
27 developed in the late Quaternary environment, and severely challenge the viability of
28 contemporary human societies."⁴⁰ A month later, the journal *Science* offered new evidence
29 of what the earth was like 20 million years ago, the last time we had carbon levels this high:
30 sea levels rose one hundred feet or more, and temperatures rose as much as ten degrees.⁴¹
31 The Zoological Society of London reported in July 2009 that "360 is now known to be the
32 level at which coral reefs cease to be viable in the long run."⁴²

33
34 We're not, in other words, going to get back the planet we used to have, the one on which
35 our civilization developed. We're like the guy who ate steak for dinner every night and let
36 his cholesterol top 300 and had the heart attack. Now he dines on Lipitor and walks on
37 treadmill, but half his heart is dead tissue. We're like the guy who smoked for forty years
38 and then he had a stroke. He doesn't smoke anymore, but the left side of his body doesn't
39 work either.

40
41 Q. HOW QUICKLY IS THE SCIENCE CHANGING ON CLIMATE, WHAT DO THE
42 NEW STUDIES REVEAL AND HOW IS IT BEING RECEIVED?
43 (Coalition of Arizona/New Mexico Counties' witness Balgord at 1-4; City of Farmington's
44 witness Kappelmann at 24-28.)
45

⁴⁰ John Rockstrom et al., "A Safe Operating Space for Humanity," *Nature* 461 (September 27, 2009): 472-75.

⁴¹ A. Tripathi et al., "Coupling of CO₂ and Ice Sheet Stability," *Science*, October 8, 2009.

⁴² Zoological Society of London, "Coral Reefs Exposed to Imminent Destruction from Climate Change," news release, July 6, 2009.

1 A. the National Oceanic and Atmospheric Administration released a new study showing that
2 a new understanding of ocean physics proved that “changes in surface temperature, rainfall,
3 and sea level are largely irreversible for more than a thousand years after carbon dioxide
4 emissions are completely stopped.” Its author, Susan Solomon, was interviewed on
5 National Public Radio that night. “People have imagined that if we stopped emitting carbon
6 dioxide that the climate would be back to normal in one hundred years or two hundred
7 years,” she said. “What we’re showing here is that that’s not right.”⁴³ No one is going to
8 refreeze the Arctic for us, or restore the pH of the oceans, and given the momentum of
9 global warming we’re likely to cross many more thresholds even if we all convert to solar
10 power and bicycles this afternoon.

11
12 Which, it must be said, we’re not doing. The scientists didn’t merely underestimate how
13 fast the Arctic would melt; they overestimated how fast our heats would melt. The
14 Intergovernmental Panel on Climate Change, or IPCC, carefully calculated a variety of
15 different “emissions pathways” for the future, ranging from a world where we did
16 everything possible to make ourselves lean and efficient to a “business-as-usual” model
17 where we did next to nothing. In the last decade, as the United States has done very little to
18 change its energy habits, and as the large Asian economies have come online, carbon
19 emissions have risen “far above even the bleak scenarios” considered in the reports. In the
20 summer of 2008, at an academic conference at Britain’s Exeter University, a scientist named
21 Kevin Anderson took the podium for a major address. He showed slide after slide, graph
22 after graph, “representing the fumes that belch from chimneys, exhausts and jet engines, that
23 should have bent in a rapid curve towards the ground, were heading for the ceiling instead.”
24 His conclusion: it was “improbable” that we’d be able to stop short of 650 parts per million,
25 even if rich countries adopted “draconian emissions reductions within a decade.” That
26 number, should it come to pass, would mean that global average temperatures would
27 increase something like seven degrees Fahrenheit, compared to the degree and a half they’ve
28 gone up already.

29
30 “As an academic I wanted to be told it was a very good piece of work and the conclusions
31 were sound,” Anderson said. “But as a human being, I desperately wanted someone to point
32 out a mistake, and to tell me we had got it completely wrong.” According to David Adam’s
33 account in the *Guardian*, nobody did. “The cream of the UK climate science community sat
34 in stunned silence.” In fact, Adam conducted a small poll himself among researchers,
35 politicians, and activists. “Ask for projections around the dinner table after a few bottles of
36 wine, and more vote for 650 ppm than 450ppm as the more likely outcome,” he reported.⁴⁴
37 Though the economic downturn that took hold in 2009 has at least temporarily slowed the
38 rise—in fact American carbon dioxide emissions were expected to fall nearly 5 percent in
39 2009.⁴⁵ Which is good news. Just not good enough. To give you an idea of how
40 aggressively the world’s governments are willing to move, in July 2009 the thirteen largest
41 emitters met in Washington to agree on an “aspirational” goal of 50 percent cuts in carbon
42 by 2050, which falls pretty close to the category of “don’t bother.”⁴⁶

43
44 The Copenhagen conference, in December 2009, was supposed to be the place where the
45 world took an “historic step forward.” Instead, it turned into a fiasco of the first order.

⁴³ Richard Harris, “Global Warming is Irreversible, Study Says,” *All Things Considered*, January 26, 2009.

⁴⁴ David Adam, “Too Late,” *Guardian*, December 9, 2008.

⁴⁵ “U.S. CO₂ Emissions are Falling,” Reuters, August 11, 2009.

⁴⁶ Jonathan Weisner, “Global Warming Goal Set,” *Wall Street Journal*, July 3, 2009.

1 Sure, there were giant rock concerts and a spirited protest march and twenty thousand
2 environmentalists from around the world who showed up to lobby the talks. And there was
3 actually powerful resistance to a meaningless deal from most of the nations of the world—
4 the poor countries and the low-lying island nations stuck hard to their assessment that
5 without deep cuts in emissions from the rich countries their very survival was at stake. Well
6 more than half the nations of the world endorsed a strong target of 350 parts per million; the
7 great cathedral in the center of the city, and then thousands of the world’s other churches,
8 rang their bells 350 times on the Sunday in the middle of the negotiations.

9
10 But the very next day the UN started locking the nongovernmental organizations out of the
11 conference. An internal paper, leaked to the world’s press, showed that even the UN knew
12 the whole process was half-sham, because the proposed deals would increase temperatures
13 much faster than the official rhetoric described. (My name was scrawled across the front,
14 but I didn’t leak it.) At week’s end President Obama jetted in to “show leadership” and
15 “break the deadlock,” but all he did was repeat America’s standing offer—by 2020 we’ll cut
16 our carbon emissions 4 percent below 1990 levels, a pledge whose stunning weakness his
17 aides continued to blame on the difficulty of getting anything tougher through Congress.
18 Fearing a face-destroying collapse, Obama negotiated a brief “Copenhagen accord” with the
19 Chinese that lacked any targets or time frame for emissions, and then the president jetted out
20 of town, eager to beat a snowstorm descending on Washington. The next day virtually every
21 newspaper in the world declared it a debacle. As Joss Garman put it in London’s
22 *Independent*: “It is no exaggeration to describe the outcome of Copenhagen as a historic
23 failure that will live in infamy.”

24
25 But as usual you didn’t need words to make the point at all, because numbers would do. A
26 team of computer jockeys from MIT and elsewhere formed a group called Climate
27 Interactive and built, in the months before Copenhagen, a sophisticated software model that
28 could instantly analyze any proposal and tell you what it would mean a hundred years down
29 the road. Here’s what they found: if you took every government pledge made during the
30 conference and added it all together, the world in 2100 would have *more than 725 parts per*
31 *million carbon dioxide*, or slightly double what scientists now believe is the maximum safe
32 level of 350. Even if you took all the possible “conditional proposals, legislation under
33 debate and unofficial government statements”—in other words, even if you erred on the side
34 of insane optimism—the world in 2100 would have about 600 parts per million carbon
35 dioxide. That is, we’d live if not in hell, then in some place with a very similar temperature.

36
37 Q. PLEASE EXPLAIN WHAT ARE FEEDBACK LOOPS? (Coalition of Arizona/New
38 Mexico Counties’ witness Balgord at 2,3)

39 A. So far we’ve been the cause for the sudden surge in greenhouse gases and hence global
40 temperatures, but that’s starting to change, as the heat we’ve caused has started to trigger a
41 series of ominous feedback effects. Some are fairly easy to see: melt Arctic sea ice, and you
42 replace a shiny white mirror that reflects most of the incoming rays of the sun back out to
43 space with a dull blue ocean that absorbs most of those rays. Others are less obvious and
44 much larger: booby traps, hidden around the world, waiting for the atmosphere to heat.
45 For instance, there are immense quantities of methane—natural gas—locked up beneath the
46 frozen tundra, and in icy “clathrates” beneath the sea. Methane, like carbon dioxide, is a
47 heat-trapping gas; if it starts escaping into the atmosphere, it will add to the pace of
48 warming. And that’s what seems to be happening, well ahead (need it be said) of schedule.
49 In 2007, atmospheric levels of methane began to spike. Scientists weren’t sure where they

1 were coming from, but the fear was that those tundra and ocean sources were starting to
2 melt in earnest. In the summer of 2008, a Russian research ship, the *Jacob Smirnitskyi*, was
3 cruising off the country's northern coast in the Laptev Sea when the scientists on board
4 started finding areas of the water's surface foaming with methane gas. Concentrations were
5 a hundred times normal. "Yesterday, for the first time, we documented a field where the
6 release was so intense that the methane did not have to dissolve into the sea water but was
7 rising as methane bubbles to the sea surface," one of the scientists e-mailed a journalist at
8 the *Independent*. "These methane chimneys were documented on an echo sounder and with
9 seismic instruments."⁴⁷ The head of the research team, Igor Semiletov of the University of
10 Alaska in Fairbanks, noted that temperatures over eastern Siberia had increased by almost
11 ten degrees in the last decade. That's melting permafrost on the land, and hence more
12 relatively warm water is flowing down the region's rivers into the ocean, where it may in
13 turn be melting the icy seal over the underwater methane. The melting permafrost is also
14 releasing methane on land. "On helicopter flights over the delta of the Lena River, higher
15 methane concentrations have been measured as altitudes as high as 1,800 meters," reported
16 Natalia Shaknova, of the Russian Academy of Sciences.⁴⁸ In recent winters scientists have
17 reported that far northern ponds and marshes stayed unfrozen even in the depths of winter
18 because so much methane was bubbling out from underneath. "It looks like a soda can is
19 open underneath the water," o one researcher explained.⁴⁹

20
21 That's scary. Scarier even than the carbon pouring out of our tailpipes, because we're not
22 directly releasing that methane. We burned the coal and gas and oil, and released the first
23 dose of carbon, and that raised the temperature enough to start the process in motion. We're
24 responsible for it, but we can't shut it off. It's taken on a life of its own. One recent
25 estimate: the permafrost traps 1,600 billion tons of carbon. A hundred billion tons could be
26 released this century, mostly in the form of methane, which would have a warming effect
27 equivalent to 270 years of carbon dioxide emissions at current levels. "It's a kind of slow-
28 motion time bomb," said Ted Schurr of the University of Florida in March 2009. At a
29 certain point, he added, "the feedback process would continue even if we cut our greenhouse
30 emissions to zero."⁵⁰

31
32 We don't know if methane release has begun in earnest yet, or the exact threshold we'd need
33 to pass. But there are dozens of such feedback loops out there. Peat covers about 2 percent
34 of the planet's land surface, mostly in the far north—think moors, bogs, mires, swamp
35 forests. They are wet places filled with decaying vegetation, a kind of nursery for what in
36 many millennia could become coal. Because they're wet, they're very stable; the plants
37 decompose very very slowly, so peatlands make a perfect "sink" for carbon, holding
38 perhaps half as much as the atmosphere. But say you raise the temperature and hence the
39 rate of evaporation, the water table starts to fall, and those swamps start to dry out. And as
40 they do, the carbon in all the decaying vegetation starts to decompose more quickly and
41 flood into the atmosphere. A 2008 study found, in fact, that "peatlands will quickly respond
42 to the expected warming in this century by losing labile soil organic carbon during dry
43 periods." How much? Well, peat bogs worldwide hold the equivalent of sixty-five years of
44 fossil-fuel burning, and the expected warming will dry out enough of them to cause the loss

⁴⁷ Steve Connor, "Exclusive: Methane Time Bomb," *Independent*, September 23, 2008.

⁴⁸ Volker Mrasek, "A Storehouse of Greenhouse Gases is Opening in Siberia," *Spiegel* online, April 17, 2008.

⁴⁹ Melissa Block, "Scientist Measures an Overlooked Greenhouse Gas," *All Things Considered*, September 10, 2007.

⁵⁰ Fred Pearce, "Arctic Meltdown is a Threat to Humanity," *New Scientist*, March 25, 2009.

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion

1 of between 40 and 86 percent of that carbon.⁵¹ It's as if we'd conjured up out of nowhere a
2 second human population that's capable of burning coal and oil and gas nearly as fast as we
3 do.

4
5 At the same time that we're triggering new pulses of carbon into the atmosphere, we're also
6 steadily weakening the natural systems that pull it out of the air. Normally—over all but the
7 last two hundred years of human civilization—the carbon dioxide level in the atmosphere
8 remained stable because trees and plants and plankton sucked it up about as fast as
9 volcanoes produced it. But now we've turned our cars and factories into junior volcanoes,
10 and so we're not just producing carbon faster than the plant world can absorb it; we're also
11 making it so hot that the plants absorb less carbon than they used to. In a 2008 experiment,
12 scientists carved out small plots of grassland and installed them in labs where they could
13 heat them artificially. "During this anomalously warm year and the year that followed, the
14 two plots sucked up two-thirds less carbon than the plots that had been exposed to normal
15 temperatures," the researchers reported.⁵² The same thing may be happening at sea, where
16 in January 2009 scientists "issued a warning" after finding "a sudden and dramatic collapse
17 in the amount of carbon emissions absorbed" in fast-warming areas of the Sea of Japan.⁵³
18 Imagine that you desperately need to bail out your boat, but you find that your buckets are
19 filled with holes that keep getting larger. "Fifty years ago, for every ton of CO₂ emitted to
20 the atmosphere, natural sinks removed 600 kilograms per ton, and the amount is falling."⁵⁴
21 Those are big holes.

22
23 Q. WHAT IS THE LINK BETWEEN FOOD, FOOD SHORTAGES AND CLIMATE
24 CHANGE? (Coalition of Arizona/New Mexico Counties' witness Balgord at 3)

25
26 A. At an international meeting in Poland in December 2008, Martin Parry, one of the co
27 chairs of the Intergovernmental Panel on Climate Change, gave a talk that began like this:
28 "The 2008 food crisis is the largest impact of climate change so far. It was caused partly by
29 the poorly-thought-through switch to biofuels as a way of combating climate change, and
30 partly by the drought in western Australia, which local scientists have identified as having
31 been caused by climate change." The result, Parry said, was that in 2008, 40 million people
32 had been added to the list of those "at risk of hunger," taking the total to 963 million, or
33 one-sixth of the world's population.⁵⁵ That is, in one year climate change had managed to
34 turn 40 million people—more than the population of California—hungry. Not "this could
35 happen." This happened. And in 2009 the number topped a billion.⁵⁶

36
37 In January 2009, a team analyzing twenty-three climate models told us about the future.
38 They compared the expected new temperatures by century's end with what we know about
39 wheat and corn. They found that it will routinely get so hot that the crops will grow much
40 less vigorously; wheat yields could easily fall 20 to 40 percent, on a planet that's expected
41 to host 3 billion more people. We've already begun to see this in action. In 2003, France

⁵¹ Joe Romm, "For Peat's Sake: A Point of No Return as Alarming as the Tundra Feedback,"
ClimateProgress.org, October 13, 2008.
⁵² "Sinking Feeling: Hot Year Damages Carbon Uptake by Plants," Agence France-Presse, September 17,
2008.
⁵³ David Adam, "Sea Absorbing Less CO₂, Scientists Discover," *Guardian*, January 12, 2009.
⁵⁴ Global Carbon Project 2008, "Carbon Budget and Trends 2007," September 26, 2008.
⁵⁵ <http://www.climatemediapartnership.org/spip.php?article709>.
⁵⁶ Lester Brown, "Could Food Shortages Bring Down Civilization?" Earth Policy News, September 29, 2009.

1 had the kind of heat wave that will become the new normal as the decades roll on. Not only
2 did thirty thousand people die because of heat stress, but corn production fell by a third, fruit
3 harvests by a quarter, and wheat by a fifth. The jovial notion that we'll compensate by
4 simply moving farther north eventually becomes absurd. "You can't move that far north
5 because all you end up with is pretty infertile tundra," one of the researchers, the University
6 of Washington's David Battisti, pointed out. "When all the signs point in the same
7 direction, and in this case it's a bad direction, you pretty much know what's going to
8 happen," he said. "You are talking about hundreds of millions of additional people looking
9 for food because they won't be able to find it where they find it now."⁵⁷ The chief scientist
10 at the U.S. State Department said recently that its analysis foresees famines severe enough
11 to affect a billion people at a time in the next few decades; Britain's chief scientist said in
12 the spring of 2009 that "a perfect storm" of food and water shortages could hit by 2030.⁵⁸
13 Here's the Stanford University researcher Rosamond Naylor, who conducted some of the
14 most recent calculations: "I think what startled me the most is that when we looked at our
15 historic examples there were ways to address the problem within a given year. People could
16 always turn somewhere else to find food. But in the future there's not going to be any place
17 to turn."⁵⁹ It doesn't get any more basic than that.

19 Q. PLEASE SPEAK TO THE EFFECTS CLIMATE CHANGE WILL HAVE ON
20 ANIMALS, SEA LIFE? (Coalition of Arizona/New Mexico Counties' witness Balgord at 3-
21 4)

22 A. We're not the only species involved. Often, speaking to audiences, I'll find people who
23 have moved to a zone of spooky calm: yes, they say, human beings may do themselves in,
24 but "the planet" will survive. That's true in some sense, at least until the sun explodes, but
25 it won't be anything like the planet we've known. We're hard at work transforming it—
26 hard at work sabotaging its biology, draining its diversity, affecting every other kind of life
27 that we were born onto this planet with. We're running Genesis backward, decreasing. Melt
28 the Arctic, for instance, and you wreak havoc with the region's phytoplankton, "the crucial
29 nutrient at the base of the food web on which marine life depends."⁶⁰ In the far South, a
30 2008 study noted, three-fourths of big penguin colonies may soon disappear.⁶¹ I've stood in
31 the middle of these rookeries, a hundred thousand mating pairs shrieking, their babies
32 demanding food. It's the greatest example of fecundity I've ever seen—you can smell them
33 miles away. They define the insane abundance of the world we've known, and their
34 absence will help to define the new world we're creating.

35
36 The changes could hardly be more fundamental. For instance, a team of scientists showed
37 recently that all manner of animals are likely to shrink, literally, as temperatures climb.
38 Larger animals have a lower ratio of surface area to volume, so they retain heat more easily
39 and do better in cooler climes, whereas smaller species radiate heat more easily. "It makes
40 sense to be bigger when it's colder," says Wendy Foden, a biologist at the World

⁵⁷ Martin Mittelstaedt, "Unprecedented Heat Will Trigger Global Food Crisis," *Toronto Globe and Mail*, January 9, 2009.

⁵⁸ Lewis Smith, "Billion People Face Famine by Mid-Century, Says Top Scientist," *Times*, (London), March 23, 2009.

⁵⁹ Maggie Fox, "Climate Warming Means Food Shortage, Study Warns," Reuters, January 9, 2009.

⁶⁰ "Death Bloom of Plankton a Warning," *San Francisco Chronicle*, November 21, 2008.

⁶¹ Ker Than, "3/4 of Big Antarctic Penguin Colonies to Disappear?" *National Geographic News*, December 1, 2008.

1 conservation Union. “As the world gets warmer, species will shrink.”⁶² In July 2009,
2 researchers in fact found that Scottish sheep had been shrinking three ounces a year for two
3 decades because of warmer temperatures; the same with red-winged gulls and certain
4 crustaceans. “Whether in the future we’re going to get miniature bonsai sheep I have no
5 idea,” said a biologist at Imperial College in London.⁶³

6
7 And as the world gets warmer, it also gets steadily simpler. “From Peru to Namibia to the
8 Black Sea to Japan...massive swarms of jellyfish are blooming,” researchers said in 2008,
9 “closing beaches and wiping out fish, either by devouring their eggs and larvae, or out-
10 competing them for food.” In the Sea of Japan, 500 million Nomurai jellyfish—each more
11 than tow meters in diameter—are clogging fishing nets; a region of the Bering Sea is so full
12 of jellies that it’s been renamed “Slime Bank.” “Jellyfish grow faster and produce more
13 young in warmer waters,” one researcher explained.⁶⁴ The fish and whales that remain live
14 in a world changing as fast as ours, in every way. New studies show, for instance, that as
15 seawater grows more acid, it absorbs less sound, making the whole ocean noisier. As one
16 scientist put it. “It’s the cocktail party effect.”⁶⁵ Meanwhile, scientists reported in October
17 2009 that “as sea temperatures have risen in recent decades, enormous sheets of a mucus-
18 like material have begun to form” in the world’s seas. Some of these “blobs” are two
19 hundred kilometers long, carry high levels of *E. coli* bacteria, and often “trap animals,
20 coating their gills and suffocating them.”⁶⁶

21
22 Q. IF THAT STABLE EARTH ALLOWED HUMAN *CIVILIZATION*, HOWEVER,
23 SOMETHING ELSE CREATED *MODERNITY*: THAT WAS THE SUDDEN
24 AVAILABILITY, IN THE EIGHTEENTH CENTURY, OF CHEAP FOSSIL FUEL –
25 HOW DID THAT EFFECT US AND HOW LONG WILL IT CONTINUE?
26 (Coalition of Arizona/New Mexico Counties’ witness Baggord at 1-4; City of Farmington’s
27 witness Kappelmann at 24-28.)

28
29 A. One barrel of oil yields as much energy as twenty-five thousand hours of human manual
30 labor—more than a decade of human labor per barrel. The average American uses twenty-
31 five barrels each year, which is like finding three hundred years of free labor annually. And
32 that’s just the oil; there’s coal and gas, too.⁶⁷ It’s why we’re prosperous, why our economies
33 have grown. It’s also, of course, why we have global warming and acid oceans; in essence
34 we’ve spent two hundred years digging up all that ancient carbon, combining it with oxygen
35 for a moment to explode the pistons that take us to the drive through, and then releasing it
36 into the atmosphere, where it accumulates as carbon dioxide. That cloud of carbon is
37 nothing more than a ghostly reflection of the pools of oil and veins of coal where it once
38 dwelled—each gallon of gasoline represents a hundred tons of ancient plants.⁶⁸ All day
39 every day we burn coal and gas and oil, from the second we make the coffee till the second

⁶² Catherine Brahic, “Honey, Climate Change is Shrinking the Species,” *New Scientist*, September 11, 2008.

⁶³ Alex Morales, “Sheep Shrinking Each Generation Amid Global Warming,” *Bloomberg.com*, July 3, 2009.

⁶⁴ Zoe Cormier, “It’s Attack of the Slime,” *Toronto Globe and Mail*, December 27, 2008.

⁶⁵ Silvia Aloisi, “Ocean Noise on Increase,” *Reuters*, December 3, 2008.

⁶⁶ Christine Dell’Amore, “Giant Mucus-like Sea Blobs on the Rise,” *National Geographic News*, October 8, 2009.

⁶⁷ Nate Hagens, interviewed by Marianne Lavelle, in “Beyond the Barrel,” January 7, 2008, *US News and World Report* online.

⁶⁸ Richard Heinberg, “George W. Bush and Peak Oil: Beyond Incompetence,” *Energy Bulletin*, March 21, 2006.

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion

1 we turn out the lights. (And is the furnace still running? The air-conditioning?) If an alien
2 landed in the United States on some voyage of exploration, he might well report back to
3 headquarters that we were bipedal devices for combusting fossil fuel.
4

5 Which is why it's unlucky in the extreme that at precisely the same moment that we've
6 destabilized the climate that underwrote civilization, we've also started to come up short on
7 the fossil fuel that underwrote modernity. The two phenomena (very much intertwined)
8 have struck us with the same uncanny speed. Just as a few scientists began warning a
9 generation ago about rising temperatures, so a tiny band of geologists began fretting about
10 dwindling oil supplies. In 1956, two years before the first carbon dioxide monitor was
11 installed on Mauna Loa, a petroleum geologist named M. King Hubbert first predicted that
12 U.S. oil production would reach its zenith between 1965 and 1970. He was spot-on—but
13 nobody worried too much, because so much oil was flowing in from the great fields of the
14 Middle East. In recent years, however, there have been troubling signs that those fields, too,
15 are starting to dwindle, and clear evidence that no new fields big enough to make up for
16 their decline have been discovered. "Peak oil" began as a fringe idea—just like climate
17 change—but in recent years more and more establishment figures have signed on to the idea
18 that we may really be reaching the point where the amount of oil we can wrest from the
19 planet will go down, not up.
20

21 The debate ended on November 12, 2008. If you didn't notice, blame post-Obama hangover
22 or the ragged fear (and low oil prices) that came with the height of the financial crisis.
23 November 12 was the day the Bush administration decided to stop buying up toxic assets
24 and instead just recapitalize the banks, and the day that Obama named his transition team.
25 But the real news that day, the data that rewrote the history books, came from the
26 International Energy Agency, which published its long-awaited World Energy Outlook.
27 The IEA defines conservative—it's the group set up by rich nations in the wake of the oil
28 shocks of the 1970s to maintain a steady supply of energy. And their economists had
29 always insisted that there would be a growing supply of oil for decades to come. No
30 problem, no problem, no problem. Plenty of oil.
31

32 This time around, the tune changed markedly. First, said the IEA, production in current oil
33 fields is falling by about 7 percent a year, a figure that will rise steadily to 9 percent over the
34 next few decades. In other words, the level of oil in these giant fields has dropped far
35 enough that we can no longer get as much as we used to. Never mind fueling that growing
36 Asian thirst for oil; simply running in place would mean finding four new Saudi Arabias by
37 2030. But since demand *will* keep rising in Asia (92 percent of American adults own cars,
38 compared with 6 percent of Chinese) and elsewhere, staying abreast will mean finding *six*
39 new Saudi Arabias—or a new Kuwait—every year. The IEA put it in dollar figures:
40 keeping up our oil economy will require \$350 billion in exploration and investment every
41 year through 2030. That's compared with a total of \$390 billion that the world spent on
42 those items in the whole period of 2000-2007, when the economy was booming.⁶⁹ And
43 even the IEA's gloom may well have been too optimistic. A few weeks later, Merrill Lynch
44 energy analysts, using new numbers for non-OPEC oil fields, calculated that we'll need *ten*

⁶⁹ Neil King Jr. and Spencer Swartz, "Oil Supplies Will Tighten, IEA Warns," *Wall Street Journal*, November 7, 2008.

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion

1 new Saudi Arabias by 2030.⁷⁰ As the former CIA director and defense secretary James
2 Schlesinger put it, “The battle is over, the oil peakists have won.”⁷¹
3
4 On the old planet—the one with an Arctic ice cap, the one where hurricanes didn’t strike
5 Spain and Brazil, the one where jellyfish didn’t bloom in great slimy clouds across the
6 oceans—we had one Saudi Arabia and one Kuwait. They sat atop enormous pools of oil.
7 Now, every day more so, they sit atop big empty holes. And there are no more Saudi
8 Arabias, no matter how much money you have. So does modernity disappear along with the
9 oil? It’s a question worth asking, when six of the twelve largest companies in the world are
10 fossil-fuel providers, four make cars and trucks, and one, General Electric, is, as its name
11 implies, heavily involved in the energy industry. Just buying fossil fuel requires almost a
12 tenth of global GDP, and almost all the other 90 percent depends on burning the stuff.⁷²
13 Oil is also the mother of most petrochemicals and plastics. Richard Heinberg, the analyst
14 who was one of the first to alert the world to the impending oil peak, once compiled a list of
15 things made from oil that ran from computer chips, insecticides, anesthetics, and fertilizers,
16 right through lipstick, perfume, and pantyhose, to aspirin and parachutes. “Without
17 petrochemicals,” Heinberg wrote, “medical science, information technology, modern
18 cityscapes, and countless other aspects of our modern technology-intensive lifestyles would
19 simply not exist. In all, oil represents the essence of modern life.”⁷³ That we’ve wasted it
20 so mindlessly is depressing. (From the mid-1980s on American automakers stopped
21 worrying about efficiency and instead concentrated on torque; as a result, by 2002 the
22 average American car would go from zero to sixty in 10.5 seconds, a dynamic 3.5 seconds
23 faster than a generation earlier.)⁷⁴ But it’s also understandable. Again: cheap energy is not
24 a useful part of our economy. It *is* our economy. “Before 1850 most Americans didn’t even
25 know coal could be burned,” writes Paul Roberts. “Yet by 1900 U.S. mines were
26 outproducing those in England. What were people using all this extra energy for? Mainly
27 people were manufacturing more things: more textiles, more machines, more food and ale,
28 more paper. The pattern was clear: the more you produced, the more energy you needed.
29 And conversely, the more energy you used, the more things you produced.”⁷⁵
30
31 Because there was lots of it on the old planet, energy was cheap. You’ve seen the
32 pictures—the early oil strikes where the fields were under such high pressure that as soon as
33 you punctured them with a drill the crude would spew into the air. It was, more or less, free
34 for the taking. No more; what’s left is in hard-to-get-at places and requires fantastic
35 technical skill. Norway’s Troll A platform in the North Sea, for instance, is the largest man-
36 made structure ever moved: each of its three concrete legs is 994 feet long with an elevator
37 that takes nine minutes to travel from the long with an elevator that takes nine minutes to
38 travel from the seabed to the drilling platform above. (To celebrate its tenth anniversary, a
39 Norwegian pop idol sang a concert at the bottom of the elevator shaft, the deepest musical
40 performance in history.) All of which means that drilling oil is getting progressively more
41 expensive, not just in dollar terms but, more important, in what economists call “energy
42 return on investment,” or EROI. If the EROI on an oil well is 20:1, you get twenty units of

⁷⁰ Joe Romm, “Merrill: Non-OPEC Production Has Likely Peaked,” ClimateProgress.org, February 2, 2009.

⁷¹ <http://www.energybulletin.net/node/46556>.

⁷² Travis Bradford, *Solar Revolution* (Cambridge, Mass.: MIT Press, 2006), p. 40.

⁷³ Richard Heinberg, *The Oil Depletion Protocol* (Gabriola Island, British Columbia: New Society, 2006), p. 7.

⁷⁴ Roberts, *The End of Oil*, p. 153.

⁷⁵ *Ibid.*, p. 28.

1 energy out of every unit you put in. Twenty to one is pretty good—a lot better than, say,
2 taking Canadian tar sands and melting them down to get usable oil. That might produce an
3 EROI of 5.2:1 by some recent estimates. Corn ethanol for oil? Once you've figured in all
4 the energy it takes to grow the stuff and process it, you're lucky to break even.⁷⁶ Charles
5 Hall, a professor at the State University of New York, argued recently that "to offer any
6 remotely viable contribution to society, a liquid fuel should not be dependent on subsidies
7 from petroleum and should have an EROI of at least 5:1." Solar panels: somewhere
8 between 2.5 and 4.3:1, at least for now.⁷⁷ Which is not to say that solar panels are a bad
9 idea—this book is being written with juice flowing straight from my roof. Only that they
10 won't replace fossil fuels straight up.

11
12 We got a taste of that in the remarkable spring of 2008, as oil prices started to rise through.
13 Economies were strong, demand was rising—and there was no new supply to meet it. Paul
14 Roberts pointed out in 2004 that six of the last seven global recessions had been preceded by
15 spikes in the price of oil, and now we can safely make that seven of the last eight.

16
17 Economic historians will long debate exactly why the economy keeled over in the fall of the
18 year, but collapsing home prices seem to be the most basic answer. And they collapsed not
19 just because of mortgage fraud but also because people began to take note of reality: in a
20 world where four-dollar-a-gallon gas was even possibility, who wanted a starter castle
21 ninety minutes from work? "As oil prices started to bite, the new housing built in distant
22 suburbs and even more remote 'exurbs' became less viable for commuters," wrote the oil
23 analyst Phil Hart.⁷⁸ Between 2004 and 2008, when gas prices rose past two dollars to their
24 eventual peak, the three cities with the largest declines in housing prices were the entirely
25 auto-dependent Las Vegas, Phoenix, and Detroit; Portland, Oregon, the bike-and-trolley
26 capital of the country, saw the largest rise in home value.⁷⁹

27
28 But it's not only transportation. Since oil is in everything, its price affects the entire
29 economy. In the spring of 2009, a University of California economist reported that "nearly
30 all of last year's economic downturn could be attributed to the oil price shock"; despite his
31 data, he reported, "It was a conclusion he didn't quite believe in himself," except that each
32 of the previous run-ups in oil prices—1973, 1979, 1990, even 2001—also corresponded
33 with recessions.⁸⁰ Once the economy collapsed, of course, oil prices collapsed with them;
34 we went back to consuming a little less than the planet was capable of producing. But
35 should the economy recover, oil prices will almost certainly bounce right back. As the
36 financier George Soros, who made a pile betting on the rise and fall of oil in 2008, wrote
37 that autumn, "any relief will be temporary."⁸¹

38
39 In fact, one all-too-likely result of peak oil will be even more use of our most abundant
40 fossil fuel, good old coal. And the certain result of using more coal will be...more global
41 warming, since it's the dirtiest of all the fossil fuels, producing twice the carbon dioxide of
42 oil. As James Hansen and his NASA team pointed out, any increased reliance on coal is
43 enough to guarantee that we'll never get back to 350. Cue doom.

⁷⁶ Kurt Cobb, "The Net Energy Cliff," *Energy Bulletin*, September 14, 2008.

⁷⁷ Rob Hopkins, *The Transition Handbook* (White River Junction, Vt.: Chelsea Green, 2008), p. 51.

⁷⁸ Phil Hart, theOilDrum.com, October 23, 2008.

⁷⁹ Nate Silver, "The End of Car Culture," *Esquire*, May 14, 2009.

⁸⁰ "Did the Oil Price Boom of 2008 Cause Crisis?" *Wall Street Journal*, WSJ.com, April 3, 2009.

⁸¹ George Soros, "The Perilous Price of Oil," *New York Review of Books*, September 25, 2008.

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42

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.

Q. YOU HAVE MADE IT YOUR LIFE'S WORK TO GO AROUND THE WORLD INVENTORYING PREDICTIONS AND MODELING EFFORTS FROM SCIENTISTS AND ANECDOTES FROM CREDIBLE SOURCES ABOUT CLIMATE CHANGE. PLEASE LIST THEM.

(Coalition of Arizona/New Mexico Counties' witness Balgord at 1-4; City of Farmington's witness Kappelmann at 24-28.)

A.

- A. 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.⁸²
- 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.⁸³
- "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.⁸⁴
- 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.⁸⁵
- 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.⁸⁶
- Reduced winter ice cover means that evaporation will proceed year-round, and hence the water level in Lake Erie could fall between three the six feet in

⁸² "Fears for Landmark Bridge," *Independent Television News*, August 31, 2008.
⁸³ "Widespread Flooding Forces State of Emergency in Marshall Islands," Agence France-Presse, December 25, 2008.
⁸⁴ <http://healthvermont.gov/news/2008/060508lyme.aspx>.
⁸⁵ Alyssa Abkowitz, "Beating Back the Ocean Proves an Enduring Riddle," *Wall Street Journal*, September 12, 2008.
⁸⁶ Natural Resources Defense Council, "The Consequences of Global Warming," September 21, 2007.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43

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.⁸⁷ 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.⁸⁸

- A Harvard study found that ragweed grows 10 percent taller and produces 60 percent more pollen as the temperature warms.⁸⁹

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."⁹⁰

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 months a year and so we cannot plant as much, and the pests and diseases keep coming."⁹¹

⁸⁷ "New Report—Climate Change Threatens Ohio," environmentohio.org, December 17, 2008.

⁸⁸ Tom Henry, "Climate Change Called Certain and Most Predictions are Bad," *Toledo Blade*, October 13, 2008.

⁸⁹ Ibid.

⁹⁰ John Vidal, "Wetter and Wilder: The Signs of Warming Everywhere," *Guardian*, December 10, 2008.

⁹¹ Eliza Barclay, "Peru's Potato Farmers Adapt to Climate Change," *Miami Herald*, September 15, 2008.

1 Or consider what Ben Simon, a reporter for Agence France-Presse, found on the slopes of
2 Mount Speke, one of Uganda’s highest peaks. The snowcap was almost gone, and farmers
3 trying to eke out a living have to climb farther up the hill each year to find a climate cool
4 enough to grow their beans. He quoted Nelson Bikalnumuli: “People just keep moving up,
5 up, up. I fear soon we may be on top of each other.”⁹²
6

7 In Haiti, where an unprecedented four fierce hurricanes hit in quick succession in 2008,
8 Marc Lacey of the New York Times found a mother living with her six children on a roof in
9 the city of Gonaïves. “At the main cathedral, the water rushed in the front door, toppling
10 pews and leaving the place stained with mud and smelling of sewage,” he reported.
11 “Upstairs, dozens of people have taken refuge, huddled together on the concrete floor.
12 When a visitor arrived, they rubbed their bellies and pleaded for nourishment.”⁹³
13

14 Or perhaps you have a hard time identifying with poor peasants stranded in impoverished
15 villages. Consider, then, the story of the MV *Nautica*, a stately liner of the Oceania Cruise
16 company, in whose thousand-square-foot suites “every inch is devoted to your pleasure,”
17 with “euro-top mattresses,” forty-two-inch plasma screens, wraparound teak verandas, and
18 “a second bathroom for guests.” (The ship’s spa offers an exotic lime and ginger salt glow
19 with massage,” or, more worryingly, an “exotic coconut rub and milk ritual.”) Anyway, the
20 *Nautica* set off on its thirty-two-day “Odyssey to Asia” in the summer of 2008 but had to
21 scrap “three magical days in the capital of the former British colony of Burma,” after
22 Cyclone Nargis wrecked both the nation and its image. “Considering the destruction, we
23 said, no, not a wise move to be scheduling a call there,” one mate explained. But the
24 compensating longer stay in Mumbai was scrapped, too, after terrorist attacks, and then
25 cruising through the Gulf of Aden the ship was attacked by pirates who fired eight shots.
26 “We didn’t think they would be cheeky enough to attack a cruise ship,” said Wendy
27 Armitage of Wellington, New Zealand. So the *Nautica* reset course for the Maldives, where
28 nothing bad happened.⁹⁴ Although the same month the liner was in port, the president of the
29 Maldives announced that his low-lying nation was planning to save a billion dollars
30 annually from its tourist income so that it could buy land and relocate the population to Sri
31 Lanka or Australia before the ocean finally rose too high for its survival. “We will invest in
32 land,” he said to CNN. “We do not want to end up in refugee tents if the worst happens.”⁹⁵
33 The Maldives weren’t alone, by the way. A few months later the Pacific island nation of
34 Kiribati announced a similar plan.⁹⁶
35

36 The trouble with this endless collection of anecdotes, though, is that it misses the essential
37 flavor of the new world we’re constructing. Every individual problem, even if it’s
38 impossible to endure, is fairly simple and straightforward. The temperature rises, and the
39 buckeye tree migrates north. The temperature rises, and the level of the ocean comes up and
40 it floods your cemetery and you really can’t live on your island anymore. The temperature
41 rises, and even in the Mandara Spa on the Salon Deck, it’s hard to imagine that “the nimble

⁹² Ben Simon, “Lifestyle Melts Away with Uganda Peak Snow Cap,” Agence France-Presse, June 15, 2009.
⁹³ Marc Lacey, “Meager Living of Haitians Is Wiped Out by Storms,” *New York Times*, September 11, 2008.
⁹⁴ Jack Healy, “A Luxury Cruise in Harm’s Way,” *New York Times*, December 3, 2008.
⁹⁵ <http://www.findingdulcinea.com/news/international/2008/November/Maldives-May-Relocate-Due-to-Global-Warming.html>.
⁹⁶ Subramian Sharma, “

1 fingers of an able masseuse will sooth away all the cares of the world.⁹⁷ Simple,
2 understandable.
3

4 In truth, though, our new planet is much more complex and interesting. It's not just that the
5 things we used to do are getting harder; it's that these initial and obvious effects lead us into
6 a series of double and triple binds that make *any* action hard. We don't really know where
7 to turn, because the planet we no inhabit doesn't work the way the old one did. Sometimes
8 the irony couldn't be clearer. We've already seen that the far North is melting fast. As the
9 sea ice goes, the albedo, or reflectivity, of the Arctic changes, with the mirror of white ice
10 replaced by sun-absorbing blue. And the permafrost melts, and the methane escapes, and
11 the peat bogs dry out and add to the load of carbon. But something else happens, too. All of
12 a sudden you can start drilling for gas and oil in these places. The Arctic, by some
13 estimates, may hold 20 percent of the plane's undiscovered reserves, not enough to hold off
14 peak oil for very long but enough to guarantee one more pulse of carbon into the
15 atmosphere.
16

17 Now try a slightly more complicated problem. We've been burning down rain forests for a
18 long time to create cheap agricultural land in the Amazon, and that obviously puts carbon
19 into the atmosphere. It is enough of a worry—remember all those “save the rain forest”
20 concerts in the 1990s?—that Brazil started enforcing its conservation laws, and the rate of
21 loss began to ebb. But as those holes grew beneath the Middle East and oil became more
22 expensive, the market for biofuels strengthened. All of a sudden soybean farmers started
23 pushing deeper into the jungle; deforestation jumped 4 percent in 2008 as oil prices rose.⁹⁸
24 One observer reported watching “bulldozers operating like Panzer divisions leveling and
25 burning forests.”⁹⁹ Meanwhile, Britain's Meteorological Office released new research in
26 November 2008 (the same week, in fact, as the IEA report on declining oil supplies), which
27 showed that climate change was producing drier conditions over much of the region, making
28 the rain forest more prone that ever to natural fires—with a decade much of southeast
29 Amazonia would be in the zone of higher fire risk.¹⁰⁰ Those fires produce even more
30 carbon, and by destroying the forest they also remove a natural sink for carbon. What is left
31 behind is a hotter, drier clearing: African research shows that the daytime temperature in the
32 soil above a cleared patch is eight degrees higher than in the nearby forest, and the humidity
33 is 49 percent, compared with 87 percent in the forest.
34

35 Something like that appears to be what's happening across the tropics. In the Amazon,
36 reports the researcher Peter Bunyard, “already we are seeing parts of the Basin drying out
37 and forming savanna, with its drought-tolerant shrubs and grasses, in what may well be the
38 beginnings of a savannizing process that could lead to desertification.”¹⁰¹ You've most
39 likely been on the high forests of the North American West, to the Rockies and the
40 Sierras—probably driven the Road to the Sun at Glacier Park, or motored over Donner Pass.
41 Certainly you've looked at Ansel Adams's photographs—this is our iconic idea of the wild.

⁹⁷ http://www.oceanacruises.com/T_MainContentPage.aspx?PageUID=dc6fb51a-8819-465a-93b5-30aec64cde17.

⁹⁸ Tom Phillips, “Brazil: Deforestation Rises Sharply as Farmers Push into Amazon,” *Guardian*, September 1, 2008.

⁹⁹ Rex Weyler, “Deep Green: Forests, Carbon Sink or Carbon Bomb?” *Greenpeace.org*, May 14, 2009.

¹⁰⁰ Anna Armstrong, “Fiery Forecast,” *Nature Reports Climate Change*, November 27, 2008.

¹⁰¹ Peter Bunyard, “Climate Change and the Amazon,” in Herbert Girardet, *Surviving the Century* (London: Earthscan, 2007), p. 85.

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion

1 These ranges are also, the poles or the Amazon, key natural features on which we depend.
2 As the *Sacramento Bee* once described it, the Sierra is “a giant water faucet in the sky, a
3 400-mile-long, 60-mile-wide reservoir held in cold storage that supplies California with
4 more than 60 percent of its water, much of it’s needed most: over the hot, dry summer
5 months.”¹⁰² Already that snowpack has shrunk by more than 10 percent, with the forecast
6 that it will shrink as much as 40 percent more by mid-century and as much as 90 percent by
7 century’s end.

8
9 But let’s not speculate; let’s just focus on what has already happened: “Temperatures have
10 warmed during winter and early spring storms,” noted one study. “Consequently the
11 fraction of precipitation that fell as snow declined, while the fraction that fell as rain
12 increased.” And when rain falls in the winter in the Sierras, bad things happen—the
13 massive New Year’s Day flood in 1997, for example, when rain fell as high up the
14 mountains as eleven thousand feet and the ensuing deluge resulted in disaster declarations
15 for all forty-six counties in northern California. California’s four wettest winters on record
16 have come since 1996; in 2008 with epic floods that forecasters say are becoming ever more
17 likely.¹⁰³ Something else happens when the snowpack melts early—the sun now has time to
18 dry out the forest, guaranteeing a longer fire season and drier trees.¹⁰⁴ In fact, the average
19 California fire season runs seventy-eight days longer than it did in the 1970s and 1980s; it
20 used to start in June and end in September, but now the Forest Service hires firefighting
21 crews in the middle of April, and they are often still working into November and December.
22 Half the National Forest Service budget is now spent extinguishing fires: “The agency is no
23 longer the U.S. Forest service but rather the U.S. Fire Service,” one congressman
24 complained.¹⁰⁵

25
26 As with hurricanes, it’s not just more fires but bigger ones. On average, large fires now
27 burn four times as long as a generation ago, and in recent years three-quarters of the bad
28 fires across the West came in years when the snow melted well ahead of schedule. “We’re
29 getting in a place where we are almost having a perfect storm” for wildfire, said one Forest
30 Service official. And, of course, it all feeds back on itself. The Moonlight fire, in
31 September 2007 near Lake Tahoe, burned for two weeks and in that time pumped an
32 estimated 5 million tons of carbon dioxide into the atmosphere, the same as 970, 000 cars
33 driving for a year, the same impact as a coal-fired power plant. “The intensity of the fire was
34 pretty spectacular,” the incident commander told Tom Knudson of the *Sacramento Bee*.
35 When it was over, even the soil was incinerated, making it hard for the conifer forest to
36 return. Researchers no believe that more large fires will lead to thinner, scrubrier woods,
37 and indeed, black oak, whitehorn manzanita, and other brush species are rapidly expanding
38 across parts of the Sierra that once grew mostly pine. One result? Western forests, which
39 are currently responsible for 20 to 40 percent of total U.S. carbon sequestration, may soon
40 become a source of carbon dioxide, not a sink for the gas.¹⁰⁶ Another, just as depressing:
41 the biggest trees, the largest living things on earth, are disappearing. A Yosemite study
42 found in 2009 that the “density of large-diameter trees in the forest” has fallen by a quarter

¹⁰² Tom Knudson, “Sierra Warming, Later Snow, Earlier Melt,” *Sacramento Bee*, December 26, 2008.
¹⁰³ Doug Bartholomew, “Experts Planning for a Flood of Noah’s Ark Proportions,” *Daily Bulletin.com*, July 27, 2009.
¹⁰⁴ Knudson, “Sierra Warming.”
¹⁰⁵ Matthew Daly, “House Approves Special Spending to Fight Wildfires,” *Associated Press*, March 26, 2009.
¹⁰⁶ Tom Knudson, “Sierra Nevada Climate Changes Feed Monster, Forest-Devouring Fires” *Sacramento Bee*, November 30, 2008.

1 in recent decades. “These large, old trees have lived centuries and experience many dry and
2 wt periods,” one researcher said. “So it is quite a surprise that recent conditions are such
3 that these long-term survivors have been affected.” The decline could “accelerate” as the
4 climate warms, the study adds.¹⁰⁷

5
6 Let’s move a few hundred miles east, to the spine of the Rockies, where trees are dying in
7 incredible numbers. Partly it’s chronic; heat stress and lack of water have doubled the
8 “background mortality” of trees in the area.¹⁰⁸ But there’s also acute trouble. By 2008
9 Wyoming and Colorado alone housed more than three million acres of dead trees.¹⁰⁹ In the
10 next five years, Colorado expects to lose another 5 million acres—virtually every lodgepole
11 pine larger than five inches in diameter. Farther north, in British Columbia, 33 million acres
12 of lodgepole have already turned from green to rust-red, all dead. The culprit is the
13 mountain pine beetle, Latin name *Dendroctonus*, which translates as “tree killer.” Once the
14 beetle drills into the bark, the tree gives off a white, waxy resin in an attempt to seal the
15 insect in its hole. But the attacker can give off a pheromone that draws swarms of other
16 beetles. Eventually the tree is over whelmed.¹¹⁰ “The scope and scale of the destruction is
17 like nothing we have ever seen,” says Jay Jensen, executive director of the Council of
18 Western State Foresters. “We’re seeing the end of some forests as we know them.”¹¹¹

19 Why is this happening? Because we’ve raised the temperature enough that the beetles
20 can overwinter more easily. Milder winters since 1994 have reduced the winter death rate
21 of beetle larvae in Wyoming from 80 percent per year to less than 10 percent.¹¹² You need
22 stretches of thirty or forty degrees below zero up in the mountains to kill off the beetles, and
23 that doesn’t happen much anymore. (In Glacier National Park, for instance, only 25 or the
24 150 glaciers that were there in 1850 still exist, and all of them are shrinking rapidly.)¹¹³
25 Meanwhile, hotter, drier summers have made trees weaker and less able to fight off the
26 swarming beetles. And what is the result? All the obvious things: greatly increased fire
27 risk, followed by mudslide and erosion. Dead trees falling on roads and toppling power
28 lines. In Colorado and Wyoming, officials closed thirty-eight campgrounds so trees
29 wouldn’t drop on tents. And a kind of despair. “It’s really something to see,” a Utah state
30 forester said. You would be very surprised. It’s hard to describe until you see it—it’s just
31 dead trees as far as the eye can see.”¹¹⁴

32
33 Oh, and this you’d never guess: lots more carbon flooding into the atmosphere. A study in
34 the journal *Nature* in the fall of 2008 offered this tally: during outbreaks of pine beetle
35 infestation, “the resulting widespread tree mortality reduces forest carbon uptake and
36 increases future emissions from the decay of killed trees.” Since these outbreaks are “an
37 order of magnitude larger in area and severity than all previous recorded outbreaks,” the
38 impact “converted the forest from a small net carbon sink to a large net carbon source.”¹¹⁵
39 Indeed, in early 2009 the Canadian government, which had long argued that its carbon-

¹⁰⁷ Matt Walker, “Yosemite’s Giant Trees Disappear,” BBC News, May 30, 2009.
¹⁰⁸ Mireya Navarro, “Environment Blamed in Western Tree Deaths,” *New York Times*, January 23, 2009.
¹⁰⁹ Ed Stoddard, “Forests Fall to Beetle Outbreak,” Reuters, August 4, 2009.
¹¹⁰ Jim Robbins, “Bark Beetles Kill Millions of Acres of Trees in the West,” *New York Times*, November 18, 2008.
¹¹¹ Scott LaFee, “Pining Away,” SanDiego.com, December 21, 2008.
¹¹² http://dl.klima2008.net/ccsl/ccf_report_oct_06.pdf.
¹¹³ Eric Newhouse, “Climate Change Affecting Mountains Most,” *Great Falls Tribune*, February 9, 2009.
¹¹⁴ Stephen Speckman, “Bark Beetles Are Feasting on Utah Forests,” *Desert News*, September 8, 2008.
¹¹⁵ W. A. Kurz, “Mountain Pine Beetle and Forest Carbon Feedback,” *Nature* 452 (April 24, 2008): 987-90.

1 sequestering forests should count against its tar-sand burning in UN tallies of its carbon
2 dioxide output, quietly dropped the claim. Now that the trees have died, timber companies
3 want to log them off, but environmentalists have pointed out that that would in turn release
4 much of the carbon stored in the peaty soils beneath the trees, igniting what one called a
5 “carbon-bomb.” By some estimates, Canada’s forests alone contain 186 billion tons of
6 carbon, or the equivalent of twenty-seven years of global emissions from burning coal and
7 gas and oil.¹¹⁶

8
9 Once trends like this get rolling, we can’t slow them. We don’t know how to refreeze the
10 Arctic or regrow a rain forest. Here’s what it looks like: in the last six years, as warming
11 temperatures and drought have killed off the native vegetation that holds soil in place,
12 windstorms have dumped twice as much dust across the American West.¹¹⁷ In April 2009,
13 after the biggest of the storms blew through Silverton, Colorado, one witness said the
14 landscape “looked like Mars... You could feel the dust, you could taste the dust.” But as
15 usual the damage reverberates. The storms drop huge quantities of dirt on the snowpack of
16 the Rocky Mountains, darkening the white ice and significantly speeding up its melt. It’s
17 effectively like turning the sun up fifty percent,” explains one University of Utah
18 professor.¹¹⁸ The snowpack now melts “weeks earlier than normal,” according to Scott
19 Streater of Greenwire, which spell “disaster for thousands of farmers and ranchers in the
20 region who depend on slowly melting snow to provide water” flows over the dry summer
21 months.¹¹⁹ “A lot of the water’s gone by the time the crops need it,” one researcher
22 explained.¹²⁰

23
24 The planet we inhabit has a finite number of huge physical features. Virtually all of them
25 seem to be changing rapidly: the Arctic ice cap is melting, and the great glacier above
26 Greenland is thinning, both with disconcerting and unexpected speed. The oceans, which
27 cover three-fourth’s of the earth’s surface, are distinctly more acid and their level is rising;
28 they are also warmer, which means the greatest storms on our planet, hurricanes and
29 cyclones, have become more powerful. The vast inland glaciers in the Andes and
30 Himalayas, and the giant snowpack of the American West, are melting very fast, and within
31 decades the supply of water to the billions of people living downstream may dwindle. The
32 great rain forest of the Amazon is drying on its margins and threatened at its core. The great
33 boreal forest of North America is dying in a matter of years. The great storehouses of oil
34 beneath the earth’s crust are now more empty than full. Every one of these things is
35 completely unprecedented in the ten thousand years of human civilization. And some places
36 with civilizations that date back thousands of years—the Maldives in the Indian Ocean,
37 Kiribati in the Pacific, and many other island nations—are actively preparing to lower their
38 flags and evacuate their territory. The cedars of Lebanon—you can read about them in the
39 Bible—are now listed as “heavily threatened” by climate change.¹²¹ We have traveled to a
40 new planet, propelled on a burst of carbon dioxide. That new planet, as is often the case in
41 science fiction, looks more or less like our own but clearly isn’t.

¹¹⁶ Howard Witt, “Canada’s Forests, Once Huge Help on Greenhouse Gases, Now Contribute to Climate Change,” *Chicago Tribune*, January 2, 2009.

¹¹⁷ Scott Streater, “Climate Change, Water Shortages Conspire to Create 21st Century Dust Bowl,” *New York Times*, May 14, 2009.

¹¹⁸ Juliet Eilperin, “Dust Storms Escalate, Prompting environmental Fears,” *Washington Post*, April 23, 2009.

¹¹⁹ Streater, “Climate Change”

¹²⁰ Eilperin, “Dust Storms Escalate.”

¹²¹ “Climate Change Threatens Lebanon’s Legendary Cedars,” *Agence France-Presse*, February 5, 2009.

1
2 Q. CAN YOU PROVIDE AN ON THE GROUND EXAMPLE ABOUT THE WARMING
3 OF OUR PLANET AND ITS IMPACT ON OUR WAY OF LIFE?
4 (Coalition of Arizona/New Mexico Counties' witness Balgord at 1-4; City of Farmington's
5 witness Kappelmann at 24-28.)
6

7 A. Sometimes the loops are almost comical. Versace is building a new hotel in Dubai, for
8 instance, but the beach sand now gets so hot that guests burn their feet. Solution: "a
9 refrigerated beach." As the hotel's founder explained, "We will suck the heat out of the
10 sand to keep it cool enough to lie on. This is the kind of luxury top people want."¹²²
11

12 Sometimes its not shake-your-head funny but almost unavoidable. As more and more of
13 Australia desertifies, the country could find itself "using 400 percent more energy to supply
14 its drinking water by 2030 if the policy trend towards seawater desalinization were to
15 continue."¹²³

16 And often—usually in the poor world—it's simply tragic. "Drinking water in Bangladesh is
17 often full of salt as rising sea levels force water further inland," a Dhaka newspaper reporter
18 wrote recently. That means women have to trek ever farther for a pitcher of clean water—
19 sometimes several trips of several miles a day. "Some reports claim women and adolescent
20 girls no longer have enough time and energy to carry out household duties like cooking,
21 bathing, washing clothes and taking care of the elderly and infirm. It is even affecting their
22 marriage prospects and family lives. Families who struggle to get clean water don't want
23 daughters to leave their homes and marry elsewhere." Adolescent girls forced to drink
24 increasingly saline water found their skin was "turning rough and unattractive," and "men
25 from outside the area had no interest in marrying them."¹²⁴
26

27
28 Q: IN THE ABSENCE OF FEDERAL INACTION ON CLIMATE CHANGE, DO YOU
29 HAVE AN OPINION ABOUT WHAT IS TO BE DONE? (PNM's witness Darnell at 4-7)

30 A: With the recent demise of federal climate legislation and the lack of progress at the
31 international level, there should renewed attention on local, state, and regional climate
32 programs. We should be taking every possible step to reduce emissions and help avoid
33 triggering dangerous feedback loops and runaway climate change. The states can be leaders
34 in this effort.
35

36 Q. ONE OF THE OPPOSITION CRITICISMS OF NEW ENERGY ECONOMY'S
37 PETITION IS THIS IDEA THAT NEW MEXICO SHOULD NOT UNDERTAKE
38 "UNILATERAL" ACTION WHAT IS YOUR RESPONSE (City of Farmington's witness
39 Kappelmann at 10, 29)?

40 A. Given the magnitude of changes we are already witnessing and severity of changes that
41 will occur with unmitigated global warming, we need an "all hands on deck" approach to
42 begin reducing emissions.
43

44 New Mexico will be applauded for taking a leadership role at this critical time and for
45 providing a model that other states can adopt. These efforts – especially coming from an oil

¹²² James Kantner, "Global Tourism and a Chilled Beach in Dubai," *New York Times*, January 2, 2009.

¹²³ Peter Ker, "Water Plant to Guzzle Energy," *Age*, August 30, 2008.

¹²⁴ Moslem Uddin Ahmed, "Water Everywhere, But Not a Drop to Drink," *New Nation*, (Dhaka), October 27, 2008.

1 and gas producing state – also will help show the international community that Americans
2 are getting serious about solving climate change. Even though Congress has backed away
3 from its responsibility, other states are stepping up to the plate.

4

5 Q. WHAT IS YOUR UNDERSTANDING OF “CLIMATE-GATE”? (Coalition of
6 Arizona/New Mexico Counties’ witness Balgord at 1; City of Farmington’s witness
7 Kappelmann at 25.)

8 A. As a number of independent investigations have now confirmed, the controversy over
9 emails from East Anglia University did not shake scientific confidence in the conclusions of
10 researchers regarding global warming.

11

12 Q. IS THERE ANYTHING ELSE?

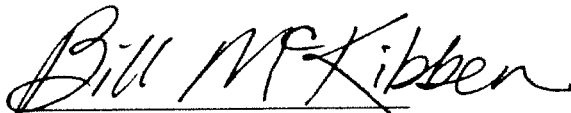
13 A. Yes, much of my testimony herein can be found in my book, Eaarth.

14

15

16

17



Bill McKibben

[Bracketed/Underscored Material] - New
[Bracketed/Strikethrough Material] - Deletion