BOOK REVIEW

The Accidental Environmentalist: Judge Posner on Catastrophic Thinking

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CATASTROPHE: RISK AND RESPONSE. By Richard A. Posner.** Oxford University Press, 2004. 322 pages.

INTRODUCTION

Richard Posner is not, he tells us on the very first page of his latest book, "a Green, an alarmist, an apocalyptic visionary, a catastrophist, a Chicken Little, a Luddite, an anticapitalist, or even a pessimist."[1] Posner goes on to sprinkle the book with so many negative references to environmentalists—"Greens," as he calls them, are "cranks,"[2] "uncritical[ly] hostil[e] to capitalism,"[3] "ignoramuses,"[4] and "scruffy, rioting left-wingers"[5]—that one is left with little doubt about his opinion of them. Clearly, the man does not want the views he expresses in this book to be confused with any kind of environmentalism.

Yet in *Catastrophe: Risk and Response*, Judge Posner makes a plea for greater attention to catastrophic events—events that, as he defines them, pose a small but plausible risk of extinction for the entire human race.[6] Asteroids, particle accelerators, abrupt global warming, and bioterrorism all make his list of potentially catastrophic hazards. With respect to global warming, Posner ultimately downplays the claims of industry-funded "climate skeptics"[7] and urges action now—*now*—to speed the development and diffusion of climate-friendly technologies.[8] He remains committed, in principle, to using cost-benefit analysis to help us figure out how to deal with these threats, but he recognizes that unknowable probabilities, incalculable benefits, and controversy over the importance of the future make conventional cost-benefit analysis a highly dicey

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1. RICHARD A. POSNER, CATASTROPHE: RISK AND RESPONSE v (2004).
2. *Id.* at 111.
3. *Id.* at 59.
4. *Id.* at 120 (referring to those worried about, among other things, the risks at Love Canal).
5. *Id.* at 138.
6. *Id.* at 6.
7. *Id.* at 53–58 (finding, after a review of sixty-seven articles in top journals concerning global warming, the ratio of "believers" that global warming has human causes to "skeptics" to be 53:2).
8. *Id.* at 253–59 (arguing for, among other things, an emissions tax).

proposition in this context.[9] He concedes that ethical judgments lie at the heart of our response to the threats he identifies.[10]

Each of these views places Posner comfortably within the mainstream of current environmentalist thought. These views also share common ground with the latest critiques of cost-benefit analysis, including my own.[11] Moreover, Posner's observations about the limits of cost-benefit analysis apply to many environmental problems that do not make his rather narrow list of catastrophes. If one wanted to urge greater government attention to, and to purge cost-benefit thinking from, problems of radioactive waste, toxic chemicals, and even conventional air and water pollution, one could cite to substantial portions of Posner's book in doing so.

Just don't tell the Judge. In a contest between his appreciation of scientific and ethical uncertainty and his longstanding commitment to economic analysis, it is clear which would win. Indeed, Posner unfortunately mars what could have been a good, humble, important book with his continued insistence on the central role of cost-benefit analysis and with futile efforts to patch up the holes in the analysis he favors. One could split this book into two and have a very fine book on catastrophic risks and the limits of currently fashionable analytical methods for dealing with them, and a very disappointing book clinging to the very analytical methods the "other" book so convincingly undermines.

Part I of this Review describes Posner's book, Part II identifies the consonance between many arguments in the book and both environmentalism and current critiques of cost-benefit analysis, and Part III explains how Posner's devotion to cost-benefit analysis cannot be squared with his observations about the shortcomings of this methodology in the context of unknowable costs, benefits, and probabilities.

I. *CATASTROPHE*

In defining "catastrophe," Posner turns, for starters, to Webster's dictionary: "a momentous tragic usually sudden event marked by effects ranging from extreme misfortune to utter overthrow or ruin."[12] "Concentrate on the top of the range ('utter overthrow or ruin')," Posner tells us, "and you will have a good grasp of how I use the word in this book."[13] Moreover, Posner says, the

9. *See, e.g.*, *id.* at 144, 153, 175.

10. *See, e.g.*, *id.* at 265.

11. *See, e.g.*, DAVID M. DRIESEN, THE ECONOMIC DYNAMICS OF ENVIRONMENTAL LAW 22–26 (2003); THOMAS O. MCGARITY ET AL., SOPHISTICATED SABOTAGE: THE INTELLECTUAL GAMES USED TO SUBVERT RESPONSIBLE REGULATION (2004); Amy Sinden, *In Defense of Absolutes: Combating the Politics of Power in Environmental Law*, 90 IOWA L. REV. 1405, 1412 (2005) (arguing that absolute standards are more effective at combating environmental problems); Robert R.M. Verchick, *The Case Against Cost Benefit Analysis*, 32 ECOLOGY L.Q. 349 (2005) (reviewing ACKERMAN & HEINZERLING). *See generally* FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING (2004).

12. POSNER, *supra* note 1, at 6 (quoting WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY (2002)).

13. *Id.*

catastrophes that "particularly interest me are those that threaten the survival of the human race."[14] Thus, the "Spanish influenza" of 1918–1919, which killed 20–40 million people,[15] the HIV/AIDS pandemic, which has killed 32 million people and counting,[16] volcanoes and earthquakes,[17] full-scale nuclear war,[18] and worldwide losses in biodiversity[19] do not make the catastrophe cut—either because they do not kill enough people or, as in the case of losses in biodiversity, because they do not kill people at all. Posner also limits his attention, for the most part, to events that might cause the extinction of the human race *within this century*.[20] One important consequence of limiting the concept of "catastrophe" in this way is that gradual—as opposed to abrupt—climate change stays off Posner's list of catastrophes.[21]

In the longest and most heavily footnoted chapter of the book, Posner tests his definition of catastrophe against what is scientifically known about a fairly long list of very bad events—asteroid-earth collisions, pandemics, self-replicating nanotechnology, climate change, exhaustion of natural resources, bioterrorism, and so on. Here Posner dips into and out of the most complicated, cutting-edge scientific issues with the derring-do of an acrobat; one minute we're learning about why we should worry about asteroids and particle accelerators, the next about why we shouldn't worry so much about depleting natural resources or losing biodiversity. Posner has clearly done his reading, across a huge range of fields, and he is clearly anxious to show off what he has learned. (At times, though, Posner's eclecticism is unsettling. In discussing the science of climate change, for example, he cites—twice—to a children's book.[22]) Although many different topics engage his attention in this chapter, asteroids, particle accelerators, abrupt climate change, and bioterrorism are the examples pulled from his analysis to serve as case studies for the rest of the book.

After discussing potential catastrophes and what we know about them, Posner tries to explain why we are doing very little about these risks. He believes that both scientific illiteracy and science worship play a role—the former because

14. *Id.*

15. *See id.*

16. *See id.*; USAID Health: HIV/AIDS, Frequently Asked Questions, http://www.usaid.gov/our_work/global_health/aids/News/aidsfaq.html (last visited Jan. 14, 2006).

17. *See* POSNER, *supra* note 1, at 29–30.

18. *See id.* at 71–75.

19. *See id.* at 65–66.

20. *See id.* at 17.

21. *See, e.g.*, *id.* at 52 ("If global warming is gradual, the costs of adjustment or adaptation or melioration, though stiff, will be bearable and there is no immediate need to impose draconian limits on greenhouse-gas emissions."); *id.* at 46 ("If [climate changes] occur gradually, there will be time either to adapt . . . or apply a technological fix.").

22. *Id.* at 279 n.112, 281 n.137 (citing LAURENCE PRINGLE, GLOBAL WARMING: THE THREAT OF EARTH'S CHANGING CLIMATE 13, 21–22 (2001)). Pringle's book is recommended for children ages nine and up. *See* Children's Literature: Laurence Pringle, http://www.childrenslit.com/f_pringle.html (last visited Jan. 14, 2006).

people misunderstand risks, which allays their fears of catastrophe;[23] the latter because people venerate science and scientists to the point where they do not worry about the risks science might create.[24] Posner also blames science-fiction writers for our failure to respond to catastrophic risks; in a long section reviewing everything from *Brave New World* to *Terminator 2: Judgment Day*,[25] Posner laments the "'boy who cried wolf' phenomenon" he believes is created by science fiction.[26] Also responsible for the lack of action are the "scientific doomsters," such as biologist Paul Ehrlich, whose predictions of catastrophe have not come to pass.[27] The "pratfalls of doomsters," Posner writes, "arm those who have an ideological or economic motive for minimizing estimates of catastrophic risk,"[28] producing an "optimistic backlash" against predictions of disaster.[29]

To evaluate catastrophic risks and choose our responses to them, Posner proposes to use cost-benefit analysis.[30] This choice is not surprising; cost-benefit analysis incorporates both the economic method and the criterion of wealth maximization that have been Posner's stock-in-trade. "At the highest level of generality," Posner has previously written, cost-benefit analysis "is virtually synonymous with the normative use of economics. At the other end of the scale of generality, the term denotes the use of the criterion of wealth maximization to evaluate government projects."[31] Although cost-benefit analysis should not be "*the* decision procedure for responding to the catastrophic risks," Posner says, "it is an indispensable step in rational decision making in this as in other areas of government regulation."[32]

In *Catastrophe*, Posner does not explicitly say what he means by "cost-benefit analysis." However, his applications of what he terms cost-benefit analysis to the catastrophic risks he identifies leave little doubt that he is working with a conventional understanding of this technique: quantify costs and benefits as far as possible, and then translate costs and benefits into dollar terms.[33]

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23. *See* POSNER, *supra* note 1, at 93.
24. *See id.* at 97–98.
25. *See id.* at 100–10.
26. *Id.* at 100.
27. *Id.* at 110–12.
28. *Id.* at 111.
29. *Id.* at 112.
30. *See id.* at 139.
31. RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 396 (6th ed. 2003).
32. POSNER, *supra* note 1, at 139.
33. *See, e.g.*, *id.* at 140–41 (illustrating cost-benefit analysis of catastrophic risk from particle accelerators). Posner also offers an alternative technique for considering costs and benefits which does not involve monetization, and he confusingly refers to this method as both "risk-risk assessment" and "cost-benefit analysis." *See id.* at 186–87. This formulation would mean that any analytical technique that considered costs as well as benefits—including technology-based regulation, the regulatory tool economists most love to hate—would count as "cost-benefit analysis." This would mean, in turn, that virtually all of the analytical techniques now employed in the modern regulatory state would count as

To conduct a cost-benefit analysis of the extinction of the human race (assuming for the moment that such an analysis is possible), one needs several pieces of information. On one side of the ledger, one needs to know the costs of avoiding the catastrophe—a nontrivial step, but not the most complicated one.[34]

The more complicated part is the other side of the ledger—estimating the benefits of avoiding total catastrophe. In calculating these benefits, one needs to know, first of all, what the magnitude of the harm is. Since Posner largely limits his discussion to "extinction events," as he calls them, this step is simplified in his analysis; the harm is the loss of the entire human race. Still, one needs to know the monetary value of this loss, and this calculation is, as Posner recognizes, tricky (to put it mildly). To understand his arguments about why this calculation is difficult, it is necessary to have a grasp of how human life is valued by economists.

The currently reigning method for economic valuation of "human life" involves "determining the value that people place on avoiding small risks of death."[35] Cost-benefit analysts consider, for example, how much workers demand in compensation for on-the-job risks or how much people are willing to pay for enhanced safety features in consumer products. They then divide this dollar amount by the probability of harm, and call the resulting estimate the value of one "statistical life." Thus: if 1 million people are each willing to pay $3 to avoid a risk of one in 1 million, then the value of a statistical life in this setting is $3 million; together, the population in question will pay $3 million to avoid the death of one unidentified—"statistical"—person.[36]

Posner sees several challenges here. First, he believes that the value of avoiding or accepting a risk varies, in nonlinear fashion, with the magnitude of the risk. To take examples at the extremes, a person might "demand an infinite amount of money" to take a risk of death of one in two,[37] while ignoring completely—and valuing at zero—very small risks, such as risks of one in a billion or "even one in several million."[38] This nonlinearity means that one cannot simply take the estimates obtained when the risks are in the range of one in 10,000 to one in 100,000—the risk range embodied in the value-of-life

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"cost-benefit analysis," as very few statutes are utterly cost-blind. This is not the way in which the term "cost-benefit analysis" is conventionally understood, and it is not the way in which I will use the term here; I will reserve this term for analysis using both quantification and monetization.

34. *See, e.g.*, ACKERMAN & HEINZERLING, *supra* note 11, at 37–39. On the challenges of estimating regulatory costs, see Thomas O. McGarity & Ruth Ruttenberg, *Counting the Cost of Health, Safety, and Environmental Regulation*, 80 TEX. L. REV. 1197 (2002).

35. POSNER, *supra* note 1, at 165.

36. For a discussion (and critique) of the concept of "statistical life," see generally Lisa Heinzerling, *The Rights of Statistical People*, 24 HARV. ENVTL. L. REV. 189 (2000).

37. POSNER, *supra* note 1, at 166. Stated differently, a person simply will not strike a deal to accept money in exchange for a 50% probability of death. Most people are not in the market for such a large risk of death.

38. *Id.* at 166.

studies undertaken to date—and import them into an analysis of the (Posner assumes) lower risks associated with extinction events.[39]

Posner does not have any evidence of people's willingness to pay to avoid risks lower than those featured in existing empirical studies. Nevertheless, he hazards a guess. Beginning from a base value for a statistical life of $5 million (which lies within the current range of estimates),[40] reflecting a value of $5,000 for a one in 1000 risk,[41] Posner suggests that perhaps a risk of one in 1 million will be valued at only five cents, rather than the $5 one would expect if the value of risk varied linearly with the magnitude of risk.[42] On this assumption, the value of a statistical life would be only $50,000.[43] To get to the value of avoiding an extinction event, Posner offers a "crude adjustment" to the size of the population, to reflect all of future humanity: he doubles the current population size of 6 billion.[44] Multiplying $50,000 by 12 billion, Posner arrives at a value of $600 trillion for the continued existence of the human species.[45]

The "greatest peculiarity" of this calculation, Posner thinks, is that an event that does not extinguish the entire human race might be valued more highly than one that does, because the value of life might be high enough at higher risk levels to surpass the value of a lower-probability extinction event.[46]

Another challenge to putting a dollar value on extinction events is that individuals' reactions to very low-probability events might, Posner recognizes, be the product of cognitive difficulties in processing probabilistic information or of what Posner calls "the economy of attention," the inability to attend to every possible risky event.[47] If so, then very low (even zero) values for low-probability events might not reveal "actual preferences"[48]—a problem for the cost-benefit analyst whose goal is to base public policy on private preferences.

So here we have a problem: for cost-benefit analysis, we need to translate as many benefits as possible into monetary terms, but we don't have any evidence of what people would be willing to pay to avoid extinction events; and we don't know whether, even if we had such evidence, it would reflect "actual preferences" rather than misunderstanding and inattention.

But that's not all. For a cost-benefit analysis of an extinction event, we also need to know the probability of that event, or at least be able to work within a credible range of probabilities. But how could we estimate, for example, the probability of a successful bioterrorist attack or the probability of abrupt climate

39. *Id.* at 167.
40. *See id.* at 165–66.
41. *See id.*
42. *See id.* at 168.
43. *See id.*
44. *See id.* at 169.
45. *See id.* at 170.
46. *Id.*
47. *Id.* at 169.
48. *Id.*

change? Here, Posner concedes, we are in "the presence of radical, nonquantifiable uncertainty."[49]

Finally, because the costs and benefits of preventing catastrophe may fall in the future, cost-benefit analysis of catastrophic risks requires one to decide how to value future events in relation to present events. In more technical terms, this requires a decision about what the "discount rate" should be. Here, too, Posner acknowledges large difficulties, and here, too, understanding the challenges requires a basic appreciation of the analytical technique in question.

Discounting is standard practice when comparing sums of money to be received or expended over different intervals of time. To figure out whether it is better, in the simplest monetary terms, to receive $100 now or $200 ten years from now, one needs to know how much interest one would receive on the $100 if it were put in the bank for ten years—or alternatively, how much one would have to put in the bank now to have $200 in ten years. This is a straightforward calculation that depends on the interest rate; for example, at 5% interest, a deposit of $122.78 today would grow to $200 ten years from now. In this example, the later payment is more valuable, because $122.78—the "present value" of the future $200—exceeds the value of $100 received today.

People differ, of course, in their impatience to receive and spend money now versus later. One might prefer to have and spend $100 now, rather than $200 in ten years, implicitly applying a discount rate of at least 7.2% (the interest rate at which $200, received ten years from now, has a present value of $100). Thus the discount rate need not be the same for every person and every purpose; in particular, long-term environmental risks may require a different approach to discounting than short-term financial transactions.

Conventional discounting has played an enormous role in analyses purporting to show the foolishness of environmental protection: environmental programs often protect interests in the future, sometimes the remote future, and discounting at any positive rate over any appreciable period of time can make the future benefits of such programs look trivial.[50]

In discussing discounting, Posner finds himself on the horns of a dilemma. Posner recognizes that discounting has the effect I have just described; it greatly reduces the apparent attractiveness of programs that protect against future harms.[51] Yet future harms are the preoccupation of his book; even harms

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49. *Id.* at 175; *see also id.* at 49 (discussing climate change).

50. *See, e.g.*, Lisa Heinzerling, *Five-Hundred Life-Saving Interventions and Their Misuse in the Debate Over Regulatory Reform*, 13 RISK 151, 165–68 (2002) (showing influence of discounting on estimates of costs per life saved of environmental protection, given in Tammy O. Tengs & John D. Graham, *The Opportunity Costs of Haphazard Social Investments in Life-Saving*, in RISKS, COSTS, AND LIVES SAVED: GETTING BETTER RESULTS FROM REGULATION 167–81 (Robert W. Hahn ed., 1996)); Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 YALE L.J. 1981 (1998) (showing influence of discounting on estimates of costs per life saved of environmental protection, as given in John Morrall III, *A Review of the Record*, REGULATION, Nov.–Dec. 1986, at 30 tbl.4) [hereinafter Heinzerling, *Regulatory Costs*].

51. *See* POSNER, *supra* note 1, at 152.

occurring within the next century—his principal subjects—can be rendered trivial through discounting.[52] In addition, discounting is, as Posner says, "a method of maximizing global wealth without regard to its distribution among persons."[53] It is, in the context of global warming, a way of justifying making the poor even poorer; happily, this is not a point Posner counts in favor of discounting.[54]

Still, however, Posner does not want to give up discounting altogether. He believes that doing so would be "absurd," because "then the present value of benefits conferred on our remote descendants would approach infinity,"[55] and we would be required to undertake enormous efforts to avert future catastrophes.[56]

So Posner looks for a way out of this dilemma, citing several possibilities.[57] The alternative approach that seems most appealing to him is what he calls the "time horizons" approach.[58] Under this approach, one accepts future costs and benefits without discounting, but avoids the problem of infinite future values "by shortening the time horizon for the consideration of costs and benefits."[59] For an unchanging stream of future values, there is a simple mathematical equivalence: the present value of an infinite stream of costs and benefits discounted at 1% per year is equal to the undiscounted sum of those costs and benefits for 100 years; at 4%, the time horizon for undiscounted benefits is twenty-five years.[60] Even here, of course, one would need to know the discount rate in order to figure out the undiscounted equivalent time horizon. But Posner reverses the process. He figures out the appropriate discount rate by first identifying the time horizon over which it might be proper not to discount at all. This time horizon, he seems to suggest, is 100 years—a horizon that allows us to "give equal weight to the welfare of everyone living in this century, which will include us, our children, and our grandchildren."[61] Beyond 100 years, under this approach, "we don't care."[62] Stated simply, Posner's preferred approach appears to be to not discount at all over the next century and to discount at a rate of 100% beyond that point.

If one used the simplest algebraic formula (familiar to American law students from the "Hand" formula in tort) to express Posner's cost-benefit calculus, one

52. *See* Heinzerling, *Regulatory Costs*, *supra* note 50, at 2018–24 (discussing the effect of discounting on estimated benefits of regulatory programs where benefits accrue within several decades).

53. POSNER, *supra* note 1, at 152.

54. *See id.*

55. *Id.*

56. *See id.* at 153.

57. *See id.* at 153–55 (noting the possibilities of rate-flattening, time horizons, risk aggregation, and using per capita rate of economic growth).

58. *See id.* at 154, 255–56.

59. *Id.* at 154.

60. *See id.*

61. *See id.*

62. *See id.* Truncating the relevant, undiscounted time horizon to 100 years implies a discount rate, over the infinite future, of 1%. *See id.*

would say that we should undertake precautions to avoid catastrophic risks if $B < PL$, where B is the burden of taking precautions, P is the probability a loss will occur, and L is the value of the loss.[63] Putting Posner's concessions about uncertainty together, it becomes clear that PL simply cannot be calculated for many catastrophic harms, because both P and L are unknown: the probabilities of catastrophic risks are often unknown, and even unknowable; the benefits of averting catastrophe (expressed in dollars) are unknown; and the importance of the future relative to the present is not scientifically determinable. Yet, to his great credit, Posner writes, "[t]o assume that risks can be ignored if they cannot be measured is a head-in-the-sand response."[64]

Thus Posner wants us to do something about catastrophic risks, but he also wants us to use cost-benefit analysis in deciding what to do. The puzzle is to figure out how to conduct a cost-benefit analysis when none of the terms in the relevant equation can be identified. Posner casts about for alternatives to cost-benefit analysis, which, he says, avoid the problems associated with "radical, nonquantifiable uncertainty."[65]

One possible alternative is what he calls "inverse cost-benefit analysis." Under this approach, one divides "what the government is spending to prevent a particular catastrophic risk from materializing by what the social cost of the catastrophe would be if it did materialize."[66] The expected cost (C) is calculated by multiplying the probability of harm (P) by the magnitude of harm (L); thus: $C = PL$.[67] If one knows the value of P and L, one can calculate C. If, instead, one knows the value of C and L, then one can calculate P, simply by dividing C by L. If, to use Posner's example, one estimates that the government spends about $2 billion per year to prevent a bioterrorist attack and estimates that the cost of such an attack would be $1 quadrillion, then one can conclude that implicit in these figures is an estimate that the probability of a bioterrorist attack is 1/500,000.[68]

A second adjustment to cost-benefit analysis Posner recommends in the case of radical uncertainty is the "tolerable windows" approach.[69] Posner writes:

> Suppose the optimum cannot be determined because of uncertainty about costs, benefits, the discount rate, or probabilities. We may nevertheless know enough about the benefits and costs to be able to create [a] "window" formed by the two vertical lines. At the left side of the window frame the benefits of a further effort to eliminate or prevent the catastrophe in question comfortably

63. *See id.* at 13 (describing calculation of expected cost). The "Hand" Formula stems from a discussion by Judge Learned Hand on adequate precautions in tort. *See* United States v. Carroll Towing Co., 159 F.2d 169, 173 (2d Cir. 1947).

64. POSNER, *supra* note 1, at 171.

65. *Id.* at 175.

66. *Id.* at 176–77.

67. *See id.* at 177.

68. *See id.* at 177–78. Posner notes this figure "seems too low." *Id.* at 178.

69. *Id.* at 184.

> exceed the costs, while at the right side the reverse is true. If we stay within the window, although we won't know whether our measures are optimal we'll at least have some basis for confidence that they are neither grossly inadequate nor grossly excessive.[70]

Posner concludes that "the probable costs of the catastrophic risks, when compared with the probable costs of efforts to minimize them, indicate that we are not doing enough."[71] We should be doing more, he says, to try to avert catastrophes associated with asteroid collisions, particle accelerators, abrupt climate change, and bioterrorism. He then turns to a discussion of the concrete steps we might take in this direction.

Here Posner offers a wide array of possibilities, ranging from requiring law students to have a basic competence in the sciences, to establishing a science court, to creating new legal institutions (including an international environmental protection agency), to reviewing new projects for their catastrophic potential.[72] With regard to terrorist threats, Posner entertains a variety of ideas, running the gauntlet from limiting the study of science by foreigners in the United States,[73] to torturing terror suspects and their families.[74] (By the time Posner finishes what looks like a brief in favor of torture, one hardly notices his quiet disclaimer at the end of the discussion stating that he is not in fact advocating torture.[75])

From what I have said so far, I think it is obvious that Posner's *Catastrophe* has, to say the least, a broad sweep. It has many nooks and crannies I have not described here. The book puts on display the traits and skills that made Posner arguably the most influential legal scholar of the last century—the confident assimilation of huge and complex bodies of knowledge outside law; the clear, surefooted writing; the unstinting application of the appealing (to many) framework of economics to any field of inquiry put before him. Less obviously, I will argue, the book also puts Posner squarely in the mainstream of modern environmentalist thought and contemporary critiques of cost-benefit analysis. But because of his unwillingness to let go of the economic analysis he has so long embraced, the book ultimately turns into a frantic attempt to salvage quantitative analysis even in the face of "radical, nonquantifiable uncertainty."[76]

II. THE ACCIDENTAL ENVIRONMENTALIST

I think it unlikely that Judge Posner will ever be a "scruffy, rioting left-winger," or even call himself a "Green," but many of the views he embraces in

70. *Id.* at 184.
71. *Id.* at 197.
72. *See* POSNER, *How To Reduce the Catastrophic Risks*, ch. 4 *of* CATASTROPHE, *supra* note 1.
73. *See* POSNER, *supra* note 1, at 221–24.
74. *See id.* at 234–43.
75. *See id.* at 241.
76. *Id.* at 175.

Catastrophe do place him easily within the mainstream of today's environmentalism. In this Part, I first describe the consonance between Posner's views and basic tenets of environmentalism, and then I explain why *Catastrophe* would have been a better book if Posner had recognized this common ground. To preview the latter discussion: Posner's unexplained aversion to environmentalism leads him to say some foolish things, and his unwillingness to let go of the economic analysis that his "environmentalist" leanings have undermined creates an internal tension in the book that is never resolved.

Turning first to evidence of Posner's implicit environmentalism: first, and most simply, he is concerned with the effect that pollution—in particular, the greenhouse gases—might have on human life and health, and he wants the government to do more about it. Though this sounds like a step most people would be willing to take, it is surprising how many people—academics included—do not regard protecting human life and health through pollution control as any kind of a governmental priority.[77] Some barely regard it as the job of government at all.[78] In this country, at this time, to believe that the government should be doing more to reduce pollution, particularly the greenhouse gases, is to place oneself on the environmentalist side of the public-policy line.

Second, Posner recognizes the difficulty, perhaps even the fundamental indeterminacy, of calculating a dollar value for human life.[79] Although Posner describes the challenges of making these calculations in somewhat technical terms—in discussing, for example, the nonlinear relationship between changes in the value of risk and changes in the magnitude of risk, and the uncertainty about whether monetary valuations reflect individuals' "actual preferences"—in fact the challenges Posner cites cut deeply into the current practice of assigning dollar values to human lives. How, for example, will we ever answer the question whether individuals' valuations of low-probability events are the result of cognitive problems or of "true" preferences? Yet Posner seems to recognize that the monetization of lives will remain problematic so long as this question is unaddressed.[80]

Third, Posner wants the government to take action even in the face of substantial scientific uncertainty, uncertainty great enough that reliably quantifying the probability and magnitude of potential harm is impossible.[81] This is one of the underpinnings of contemporary environmentalism; one of the signal cases in the early history of environmental law embraced just this kind of position in

77. *See generally* Tengs & Graham, *supra* note 50; Tammy O. Tengs et al., *Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness*, 15 RISK ANALYSIS 369 (1995).

78. *See, e.g.*, TERRY L. ANDERSON & DONALD R. LEAL, *Marketing Garbage: The Solutions to Pollution*, ch. 10 *of* FREE MARKET ENVIRONMENTALISM (2001).

79. *See* POSNER, *supra* note 1, at 249.

80. *See id.* at 169 (recognizing the difficulty of identifying "actual preferences").

81. *See, e.g.*, *id.* at 197 (arguing for action on abrupt climate change even though "[w]e do not know what the risk is").

interpreting the Clean Air Act.[82] It is also the basic insight behind the precautionary principle that many environmentalists have endorsed.[83] And indeed, Posner aligns himself with what he calls "a modest version of the precautionary principle."[84] He thinks it is harder to "raise the happiness level" with an increase in income than it is for catastrophic events to reduce human happiness;[85] he credits the importance of risk aversion in our reactions to hazards;[86] and he recognizes that "[p]rogress carries with it all sorts of unanticipated side effects, many negative."[87] These ideas are all shared by the contemporary environmentalist.

Yet Posner also distances himself from the precautionary principle—he calls his version of it "modest," presumably to distinguish it from what he regards as immodest versions—and he criticizes it for its "sponginess."[88] Its "more tempered versions," he says, are "indistinguishable from cost-benefit analysis with risk aversion assumed."[89] It is easy enough to trace the scholarly origins of what appears to be a rather reflexive hostility to the precautionary principle; here Posner cites favorably to the work of Cass Sunstein,[90] who has been an important opponent of the precautionary principle and who has frequently characterized it in the most extreme terms.[91]

But the precautionary principle can be conceptualized in a different way,[92] one that is fully consistent with the views Posner embraces in *Catastrophe*. As Posner acknowledges, many catastrophic risks involve hazards whose probability of occurrence is unknown. Such a situation involves, in the technical lingo, *uncertainty* rather than *risk*. Even in this setting, however, we may have a range of credible forecasts of future outcomes. In work done years ago, and lately revived in the environmental context by Richard Woodward and Richard Bishop,[93] economists Kenneth Arrow and Leonid Hurwicz argued that the best public policy in this setting depends on considering only the *extremes* of the

82. *See* Ethyl Corp. v. EPA, 541 F.2d 1, 14–15 (D.C. Cir. 1976).

83. On the precautionary principle, see ACKERMAN & HEINZERLING, *supra* note 11, at 117–21, 185, 223–29.

84. POSNER, *supra* note 1, at 148.

85. *See id.*

86. *See id.* at 150.

87. *Id.*

88. *Id.* at 140.

89. *Id.*

90. *See id.* at 140 n.3 (citing CASS R. SUNSTEIN, RISK AND REASON: SAFETY, LAW, AND THE ENVIRONMENT (2002)).

91. *See, e.g.*, SUNSTEIN, *supra* note 90, at 103 ("Taken literally, the precautionary principle would lead to indefensibly huge expenditures . . . ."). Sunstein's most recent work is somewhat less negative about precaution and follows in some respects Posner's approach in *Catastrophe*. *See* Cass R. Sunstein, *Irreversible and Catastrophic*, 91 CORNELL L. REV. (forthcoming 2006), *available at* http://ssrn.com/abstract=705323.

92. *See* ACKERMAN & HEINZERLING, *supra* note 11, at 223–29.

93. *See* Richard T. Woodward & Richard C. Bishop, *How To Decide When Experts Disagree: Uncertainty-Based Choice Rules in Environmental Policy*, 73 LAND ECON. 492 (1997).

range of possible outcomes.[94] As Posner himself briefly recognizes, in these circumstances "[t]he only choice is between the extreme positions."[95] The precautionary principle adds to this insight a preference for avoiding the catastrophic outcome, based on a conclusion that the errors potentially involved in acting based on one credible extreme or another are not symmetrical; it is worse to fail to prevent a catastrophe than it is to regulate too aggressively.[96] This is the precautionary principle that Frank Ackerman and I have defended in our book, *Priceless*,[97] and it is fully compatible with the "modest" precautionary principle Posner embraces.[98]

Posner also shares common ground with environmentalists insofar as he cares about what happens in the future. Again, this is a position one might not expect to be controversial, or even to be associated with any particular worldview. But many economists and legal academics have endorsed analytical techniques—in particular, discounting—which essentially trivialize future events.[99] These scholars do not, as Posner does, flinch at the fact that discounting condones an exceedingly myopic and even selfish vision of what the government should do to protect people in the future against harms we set in motion today. One of the great contributions of environmental law has been its regard for the future as well as the present,[100] and *Catastrophe* is in line with this mindset.

Now, admittedly, Posner's concern for the future has its limits. He is unwilling to completely let go of discounting, and he is concerned primarily with catastrophes that could occur within the next century. Close attention to his apparently preferred position on discounting reveals that these two perspectives are essentially the same; recall that under Posner's "time horizons" approach, we would not discount harms occurring within the next century, and we would pay no attention to harms occurring thereafter.[101]

The last part of Posner's approach might sound harsh to many environmentalists; what about persistent chemicals, radioactive wastes, and other hazards that pose risks beyond the 100-year horizon? The answer is that although one might, philosophically, prefer to recognize the importance of harms occurring (and people living) beyond this century, in practical effect declining to discount over the course of this century, while taking no account of longer-term harms, will likely produce the same policy outcomes as refusing to discount at all. First of all, the effective discount rate of Posner's approach—1%—is low in compari-

94. *See id.* at 493 (discussing Kenneth J. Arrow & Leonid Hurwicz, *An Optimality Criterion for Decision-Making Under Ignorance*, *in* UNCERTAINTY AND EXPECTATIONS IN ECONOMICS: ESSAYS IN HONOUR OF G.L.S. SHACKLE 1 (C.F. Carter & J.L. Ford eds., 1972)).

95. POSNER, *supra* note 1, at 58.

96. *See* ACKERMAN & HEINZERLING, *supra* note 11, at 226–28.

97. *See id.*

98. *See* POSNER, *supra* note 1, at 148–50.

99. *See* ACKERMAN & HEINZERLING, *Honey, I Shrunk the Future*, ch. 8 *of* PRICELESS, *supra* note 11.

100. *See* Lisa Heinzerling, *Environmental Law and the Present Future*, 87 GEO. L.J. 2025, 2025–26 (1999).

101. *See* POSNER, *supra* note 1, at 154.

son with discount rates commonly employed now.[102] Even a slightly higher discount rate of 1.5% would produce, for example, a very protective policy on climate change in comparison to the policy implied by analysis using a rate of 3%.[103] In addition, the discounting done over the short term is frequently decisive on the question of whether to act or not act in the face of a risk—even if the discount rate declines in the longer term. Some economists have argued that "hyperbolic" discounting—which employs a declining discount rate[104]—takes care of the problem of discounting's dismissal of the future.[105] But it does not. For example, Frank Ackerman and Ian Finlayson have recently demonstrated that the use of hyperbolic discounting in William Nordhaus's latest version of his economic model on climate change does not change his policy prescriptions; so much work is done, in undermining the case for regulatory action, by discounting in the near term that the addition of a hyperbolic discounting function over the longer term makes no difference to his results.[106] By *declining* to discount over the next century, as Posner suggests, one could reel back the antiregulatory conclusions achieved when one does discount over this period.

Moreover, most regulatory analyses do not extend beyond the current century; the bulk do not even come close.[107] A decision not to discount harms during this century would have profound effects on the conclusions of these analyses. Regulations designed to prevent long-latency diseases such as cancer, or to reduce the release of persistent chemicals into the environment, would fare far better under Posner's no-discounting-for-this-century approach than they fare under current analytical approaches.[108] As Posner gives no reason why one's approach to discounting should depend on the magnitude of the harm threatened by the risk in question, it would not seem to matter that the cancer risks and other harms I have just mentioned are not "catastrophic" in Posner's sense of the term.

Indeed, extending the latter point, none of Posner's "environmentalist" perspectives depends on his definition of catastrophe. Although, as I have said, his interpretation of catastrophe is quite narrow, it does essentially no analytical

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102. The Office of Management and Budget directs agencies to employ discount rates of 3% and 7% in their cost-benefit analyses of proposed regulations. *See* OFFICE OF MGMT. & BUDGET, EXECUTIVE OFFICE OF THE PRESIDENT, CIRCULAR A-4, REGULATORY ANALYSIS 36 (2003), http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf.

103. *See* WILLIAM R. CLINE, THE ECONOMICS OF GLOBAL WARMING (1992); William R. Cline, *Climate Change*, *in* GLOBAL CRISES, GLOBAL SOLUTIONS (Bjørn Lomborg ed., 2004).

104. *See* ACKERMAN & HEINZERLING, *supra* note 11, at 258 n.5.

105. *See* David Pearce et al., *Valuing the Future—Recent Advances in Social Discounting*, 4 WORLD ECONOMICS 121, 139 (2003).

106. *See generally* Frank Ackerman & Ian Finlayson, The Economics of Inaction on Climate Change (September 2005) (unpublished manuscript, on file with the author).

107. *See* Heinzerling, *Regulatory Costs*, *supra* note 50, at 2018–38 (discussing details of regulatory analyses).

108. *See id.* at 2038–39 n.392 tbl.3 (comparing costs per life saved of federal regulations with and without discounting).

work in his book. Nowhere does he say that his perspectives on, for example, the challenges of monetization, the appropriateness of discounting, or the reality of scientific uncertainty would change if we were dealing with noncatastrophic (in his sense) rather than catastrophic events. Many less cataclysmic environmental problems, such as ozone pollution, acid rain, desertification, and so on, are analytically no different from the catastrophes on which Posner focuses.

There are other ways in which Posner's perspectives coincide with those of contemporary environmentalists. Many environmentalists today embrace the creation and use of international institutions to solve global environmental problems; so does Posner.[109] Environmentalists have long used scientific research as a launching point for arguing for enhanced regulatory programs to protect health and the environment; Posner emphasizes the central role of science as well.[110] One of environmentalism's more popular legal products has been the National Environmental Policy Act, or NEPA, which requires before-the-fact analysis of federal actions significantly affecting the human environment;[111] Posner embraces a similar kind of advance analysis for catastrophic risks.[112] One can, in short, find many points of agreement between Posner and many environmentalists.

In *Catastrophe*, however, Posner sticks with his own party line: he is not a "Green." In fact, he takes seemingly every opportunity to criticize environmentalists and environmentalism. For the environmentalist, the book's split personality is confusing: if he agrees with so much of what we say, why does he seem to detest us? In condemning "environmentalism" while embracing its core tenets, Posner appears to have succumbed to a purely political intuition in a book which, on its surface, eschews politics. This leads him astray in two ways.

First, Posner's political hostility to environmentalism sometimes clouds his judgment on empirical matters. Perhaps most notably, Posner places more blame on environmentalists than on industry for our failure to act on climate change. Indeed, he goes so far as to blame *environmentalists* for *industry's* intransigence on this issue.[113] If Paul Ehrlich and others had not overstated environmental problems, Posner suggests, then the industry-funded climate change skeptics would not have been given the kind of attention they have received.[114] Posner also writes:

> [T]here is sufficient doubt about the magnitude of the global-warming threat, given the complexities and uncertainties of climate science, to enable some

109. *Compare* PLATER ET AL., ENVIRONMENTAL LAW AND POLICY: NATURE, LAW AND SOCIETY 1257 (2004), *with* POSNER, *supra* note 1, at 216–18.

110. *Compare* A NEW PROGRESSIVE AGENDA FOR PUBLIC HEALTH AND THE ENVIRONMENT: A PROJECT OF THE CENTER FOR PROGRESSIVE REGULATION 71 (Christopher H. Schroeder & Rena Steinzor eds., 2004), *with* POSNER, *supra* note 1, at 200–15.

111. *See* 42 U.S.C. § 4332(2)(C) (2000).

112. *See* POSNER, *supra* note 1, at 221.

113. *See id.* at 111.

114. *See id.* at 138.

> industries to advance plausible claims that the dangers of global warming are being exaggerated—and exaggerated by scruffy, rioting left-wingers to boot. Think of how, for many years, even slight scientific uncertainty enabled the tobacco industry to issue plausible denials that smoking was hazardous to health.[115]

This passage is arresting for several reasons. For starters, it reveals a stunning lack of appreciation of the coordinated campaign by fossil-fuel industries to foment uncertainty about the risks of climate change. As Ross Gelbspan and others have documented, industries have not just passively taken advantage of existing uncertainties in climate science, as Posner seems to suggest; they have actively campaigned to create the appearance of uncertainty even where scientific consensus has long been reached.[116] While Posner cites Ross Gelbspan's first book describing this campaign,[117] he has not assimilated Gelbspan's core message. Another notable feature of the quoted passage is Posner's continued insistence on holding environmentalists responsible for inaction on climate change. Not only does Posner dislike the politics of environmentalists; he appears to dislike their aesthetics as well. Finally, the passage's apparently nonjudgmental analogy to the tobacco industry is just plain off the wall. It is hard to imagine what Posner has in mind when he refers to "scientific uncertainty" about the health hazards of smoking, and even harder to fathom why he believes the tobacco industry's denials were "plausible."

Posner's anti-environmentalist politics lead him into error in other ways as well. He says (citing the children's book mentioned earlier[118]) that "air pollution . . . has a cooling effect and thus reduces global warming," and appends to this observation a scolding, "Greens, take note"[119]—as if efforts to reduce air pollution, promoted by the "Greens," will increase global warming. But the air pollution Posner is discussing here comes, in its manmade form, from burning fossil fuels—the same thing that causes global warming. In his anxiousness to wag his finger at the Greens, Posner missed this simple fact. Likewise, in asserting that nuclear power is "fully clean" from a climate change perspective,[120] Posner ignores the appreciable greenhouse gas emissions that result

115. *Id.* at 138.

116. *See* ROSS GELBSPAN, BOILING POINT: HOW POLITICIANS, BIG OIL AND COAL, JOURNALISTS, AND ACTIVISTS HAVE FUELED THE CLIMATE CRISIS—AND WHAT WE CAN DO TO AVERT DISASTER 37–61 (2004) [hereinafter GELBSPAN, BOILING POINT]; ROSS GELBSPAN, THE HEAT IS ON: THE HIGH STAKES BATTLE OVER EARTH'S THREATENED CLIMATE 33–61 (1997); Chris Mooney, *Some Like It Hot*, MOTHER JONES, May–June 2005, at 36, 40 (documenting financial ties between ExxonMobil and climate skeptics). In his most recent book, Gelbspan—like Posner—attributes some blame to environmentalists in discussing inaction on climate change, but he—unlike Posner—accuses them of being too timid on the issue, not too aggressive. *See* GELBSPAN, BOILING POINT, *supra*, at 127–46.

117. *See* POSNER, *supra* note 1, at 282 n.162.

118. *See supra* note 22 and accompanying text.

119. POSNER, *supra* note 1, at 50.

120. *Id.* at 51.

from uranium mining and processing, especially uranium enrichment.[121] In accusing climate scientists of being "influenced by Green thought" because a book about climate change asserts (in a single sentence) that communism collapsed partly because it was insensitive to environmental problems,[122] Posner both engages in unintentionally comical innuendo ("influenced by Green thought"? egads!) and, again, makes a factual error in his eagerness to condemn environmentalists. The fall of communism was indeed related in part to environmental concerns: in the former Soviet Union, some of the first citizen protests encouraged by Mikhail Gorbachev's policy of *glasnost* had to do with environmental issues,[123] and in Bulgaria, demonstrations organized by environmentalists helped bring about the resignation of the Communist leader, Todor Zhivkov.[124]

I will not further multiply examples of the false factual notes Posner strikes due to his antienvironmentalist politics. Instead, I turn now to the second way in which Posner's political aversion to environmentalism leads him astray: he fails to see the connection between the environmentalist perspectives he embraces and contemporary critiques of cost-benefit analysis. Most fundamental among these perspectives is the belief in the importance of human health and life (and the effects of pollution on them), the difficulty of translating these effects into dollars, the willingness to endorse government action even in the face of radical scientific uncertainty, and the concern with the future. These are basic tenets of environmentalism, and Posner shares them all. They are also, however, the fundamental underpinnings of contemporary critiques of the cost-benefit analysis Posner endorses.

In my own work, as well as my work with Frank Ackerman, I have argued that there are three basic problems with the use of cost-benefit analysis to evaluate environmental policies. First, the benefits of environmental protection—especially the protection of human health and life—cannot meaningfully be monetized.[125] Second, discounting the future undermines some of the very reasons why we have environmental laws in the first place; it ignores the legislative judgment embodied in these laws that the future is worthy of our attention and protection. Using discounting to undermine the case for environmental protection raises the question of whether environmental protection is a good idea, and gives an answer—"the future is unimportant"—that is at odds

121. On this issue, see Helen Caldicott, *Nuclear Power Still a Deadly Proposition*, BALT. SUN, Aug. 17, 2004, at 9A.

122. POSNER, *supra* note 1, at 53, 282 n.160 (quoting BRUCE E. JOHANSEN, THE GLOBAL WARMING DESK REFERENCE 22 (2002)).

123. *See* MURRAY FESHBACH & ALFRED FRIENDLY, JR., *Facing Facts*, ch. 1 *of* ECOCIDE IN THE USSR: HEALTH AND NATURE UNDER SEIGE (1992).

124. *See* BORIS KOMAROV, THE GEOGRAPHY OF SURVIVAL: ECOLOGY IN THE POST-SOVIET ERA 111 (1994).

125. *See* ACKERMAN & HEINZERLING, *The $6.1 Million Question*, ch. 4 *of* PRICELESS, *supra* note 11; ACKERMAN & HEINZERLING, *An Ounce of Prevention*, ch. 5 *of* PRICELESS, *supra* note 11.

with a large set of the environmental laws in this country.[126] Finally, scientific uncertainty, in particular the frequent inability of science to produce numerical estimates of likely environmental harm, makes the number-hungry cost-benefit analyst starve.[127]

Monetization, discounting, scientific uncertainty—these are at the heart of the case against cost-benefit analysis. Moreover, they pose problems for cost-benefit analysis not only of catastrophes as Posner defines them, but for cost-benefit analysis of a vast array of environmental issues.[128] Posner recognizes all of these things as problems for cost-benefit analysis. Nevertheless, he tries valiantly to rescue his beloved methodology, and here is where *Catastrophe* goes off the tracks.

III. CATASTROPHIC THINKING

Posner makes four principal rescue attempts. First, where he does not have information that would allow him to do even a rough cost-benefit analysis of catastrophic risks, he simply makes it up. Second, he offers "inverse cost-benefit analysis," according to which one calculates the probability implicit in government expenditures on risks.[129] Third, he suggests the "tolerable windows" approach as an alternative to cost-benefit analysis.[130] Last, he suggests that in cases of radical uncertainty, we simply compare the likely harm (not stated in monetary terms) to its likely cost.[131] The first three efforts do not succeed; the last is the approach Frank Ackerman and I embraced in *Priceless*.

Most obviously inadequate are Posner's efforts to patch up the holes in our scientific and social-scientific knowledge by just making up the numbers when they are not available. The book is thick with sentences beginning "Suppose that . . . ," and going on to offer a number—which Posner admits is "a wild guess,"[132] "arbitrary,"[133] etc.—for some crucial variable to be used in a cost-benefit analysis. Sometimes these made-up calculations are even incorporated in fancy-looking tables that give them an air of reality.[134] Sometimes Posner himself seems to forget that the numbers are just made up, as when he refers back to his admittedly "arbitrary" numbers as "estimates," and uses them to

126. *See* ACKERMAN & HEINZERLING, *Honey, I Shrunk the Future*, ch. 8 *of* PRICELESS, *supra* note 11; Heinzerling, *Regulatory Costs*, *supra* note 50, at 2043–56.

127. *See* ACKERMAN & HEINZERLING, *An Ounce of Prevention*, ch. 5 *of* PRICELESS, *supra* note 11; THOMAS O. MCGARITY ET AL., *The Quantification Quagmire*, ch. 3 *of* SOPHISTICATED SABOTAGE: THE INTELLECTUAL GAMES USED TO SUBVERT RESPONSIBLE REGULATION (2004); Heinzerling, *Regulatory Costs*, *supra* note 50.

128. Indeed, this is the crux of the argument Frank Ackerman and I make. *See generally* ACKERMAN & HEINZERLING, *supra* note 11.

129. *See supra* notes 65–68 and accompanying text.

130. *See supra* notes 69–74 and accompanying text.

131. *See* POSNER, *supra* note 1, at 186–87.

132. *See id.* at 140.

133. *See id*. at 141.

134. *See, e.g.*, *id*. at 142 tbl.3.1, 167 fig.3.3, 182 tbl.3.2.

make some further point—as if they had some grounding in reality.[135] Obviously, Posner recognizes that you cannot just make up the numbers for cost-benefit analysis; he makes this point clear in discussing the work of others.[136] But once he has recognized that the challenges of monetization, discounting, and scientific uncertainty preclude the development of numbers in many cases, and once he has said that the lack of numbers is not an excuse for inaction, then either he must admit that the cost-benefit game is up or he must come up with some numbers, quick. In choosing the latter course, Posner gives new material to the critics of cost-benefit analysis who charge (as I have) that this is what cost-benefit analysts do when they don't have a number: they make one up.[137]

Recall his estimate of the value of the survival of the human race: $600 trillion. He calls the estimate "conservative[],"[138] but this perverts the meaning of the word. The estimate is radical, outlandish, I dare say loopy. There is not a single actual data point supporting Posner's critical assumptions that the value of a risk of one in 1 million is five cents and that the underlying risk is one in 1 million. If this is cost-benefit analysis, bring it on. But I'll bring my own numbers, if you please. Thus: "Suppose that the value of a risk of one in 1 million is $100 . . . ." If we're just making it up, can each of us give a different answer?

Posner's alternatives to cost-benefit analysis do not escape this fundamental problem of a lack of numerical information. As I noted in Part I, the first alternative—what he calls "inverse cost-benefit analysis"—entails dividing the government's present expenditures on avoiding a catastrophic risk by the social cost of the catastrophe if it occurred. The social cost (*C*) is calculated by multiplying the probability of harm (*P*) by the magnitude of harm (*L*).[139] If one knows the value of *C* and *L*, then one can calculate *P*.

Using this formula, Posner calculates the probability implied in the government's expenditures on bioterrorism. Here is Posner's analysis on this score:

> The federal government is spending about $2 billion a year to prevent a bioterrorist attack . . . . Suppose the most destructive biological attack that seems reasonably possible on the basis of what little we now know about terrorist intentions and capabilities would kill 100 million Americans. We know that value-of-life estimates may have to be radically discounted when the probability of death is exceedingly slight. But there is no convincing reason for supposing the probability of such an attack less than, say, one in 100,000; and we know (well, think) that the value of life that is derived by dividing the cost that Americans will incur to avoid a risk of death of that magnitude by the risk is about $7 million. Then if the attack occurred, the

135. *See, e.g.*, *id.* at 143, 169, 180, 181–82, 187, 191.
136. *See id.* at 175.
137. *See, e.g.*, ACKERMAN & HEINZERLING, *supra* note 11, at 94–98, 113.
138. POSNER, *supra* note 1, at 141.
139. *See id.* at 177.

> total costs would be $700 trillion—and that is actually too low an estimate because the death of a third of the population would have all sorts of collateral consequences, mainly negative. Let us, still conservatively however, refigure the total costs as $1 quadrillion. The result of dividing the money being spent to prevent such an attack, $2 billion, by $1 quadrillion is 1/500,000. Is there only a 1 in 500,000 probability of a terrorist attack of that magnitude in the next year? One doesn't know, but the figure seems too low.[140]

The only number in this entire string of thought that Posner has not simply drawn from thin air is the amount of government expenditures on preventing a bioterrorist attack. Posner believes that the value of lives saved depends on an estimate of probabilities that he admits he does not possess; indeed, this entire exercise is undertaken precisely because the probabilities are unknown. But even if we knew the value of life without knowing the probability of the loss of life, the exercise would still be awkward. For the point of the exercise is to calculate the probability implied in our expenditures on bioterrorism; or, in other words, assuming that the government has based its expenditures on a cost-benefit analysis, what probability has it assumed in deciding the level of expenditures? But remember that the exercise was necessitated by the fact that the probabilities in this context are unknowable. In that case, how do we know whether the "implicit probability" calculated via this exercise suggests that our expenditures are too low, too high, or just about right? If we don't know the actual probability of an event, then analysis of "implicit probability" helps us not at all, as Posner elsewhere seems to concede.[141] We are left with Posner saying something like: "One doesn't know, but the figure seems too low." Or perhaps: "One doesn't know, but the figure seems too high."[142]

The third adjustment to cost-benefit analysis Posner recommends is the "tolerable windows" approach.[143] But this approach applies only when one cannot determine the *optimum* policy due to "uncertainty about costs, benefits, the discount rate, or probabilities."[144] Notice, again, that this approach requires information about costs, benefits, probabilities, and discount rates; it cannot be undertaken in the situation of "radical, nonquantifiable uncertainty" that Posner has described.[145]

Only one of Posner's alternatives to cost-benefit analysis is left standing. Where probabilities are unknown and benefits are not monetized, Posner suggests that the government simply provide information about (1) the economic costs of the technology and other inputs that might be used to prevent catastro-

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140. *Id.* at 177–78.

141. *See id.* at 172.

142. *Cf. id.* at 169 ("[T]he $50,000 estimate of the value of life that I suggested might be supported by the analysis underlying Figure 3.3 may be much too low.").

143. *See id.* at 184.

144. *Id.*

145. *Id.* at 175.

phes and (2) the death rates that can be expected from a variety of different outcomes.[146] "The government and the public would then have the information required," Posner asserts, "for rationally deciding whether the nonmonetized benefits of the statistical lives saved . . . were worth the costs of saving them."[147] Here, Posner is discussing defense against asteroids, but his conceptual apparatus would apply whenever probabilities are unknown and benefits are not monetized.

In *Priceless*, Frank Ackerman and I have argued for just this kind of framework, calling it a "holistic" approach to weighing the advantages and disadvantages of government action.[148] The "holistic" approach—as opposed to what we call the "atomistic" approach of traditional cost-benefit analysis—would entail consideration of much of the information included in a cost-benefit analysis. Scientific information on harms to humans and the environment and economic costs that are naturally stated in monetary terms would be incorporated into the holistic evaluation of the pros and cons of adopting one public policy over another.[149] But the holistic approach would not take the further step of translating benefits, such as the saving of human lives, into dollars,[150] and it would not be paralyzed in the absence of quantitative information about the probabilities of harm. The holistic approach, moreover, is consistent with the way we make decisions all the time:

> To those who respond that we are lost without a formula, we would point out, first, that many important decisions are made on the basis of rights and principles, not costs and benefits; . . . major resource allocation decisions are repeatedly made, in the area of military spending and national security, with little or no concern for costs. Second, in the cases where costs and benefits are the basis for decisions, something like what we are calling holistic evaluation occurs all the time in the market itself. Businesses and individuals continually make decisions that depend on multiple quantitative and qualitative factors, frequently based on the bottom-line impact of a choice, rather than on detailed exploration of its disaggregated components. In short, a holistic assessment of one's options in the market leads to an either-or choice: to buy or not to buy.
>
> Nothing more than that is required, from society as a whole, for evaluation of policies: assessment of overall impacts, not warring over minutiae, is what is needed to make a decision to "buy" or not to "buy" a proposed regulation. A holistic approach to the arsenic problem, for example, encourages us to ask whether it is worth the price of one or two bottles of water per person per year to ensure that everyone has tap water with the lowest possible level of arsenic. The atomistic approach would send us back to the mall to ask people about the monetary value of avoiding a nonfatal case of bladder cancer. For regula-

146. *See id.* at 174.
147. *Id.*
148. *See* ACKERMAN & HEINZERLING, *supra* note 11, at 210–16.
149. *See id.* at 212.
150. *Cf. id.* at 213.

> tions to protect fish from power plants, the holistic approach would make us think about our willingness to pay a penny a day to avoid an underwater massacre, while the atomistic approach leads to unending technical disputes about the many ways of valuing a dead fish.[151]

Thus, when Posner says that all that is needed for "rationally deciding" whether it is worthwhile to prevent deaths through government action is information on the economic costs of the necessary technology and estimates of the number of fatalities that will occur in the absence of government action,[152] he is embracing an approach I find very appealing. But it is not cost-benefit analysis.[153]

The holistic approach is necessarily subjective. Different people will give different answers to the question of how much we want to spend on removing arsenic from drinking water or saving fish from cooling water towers. This is true of cost-benefit analysis as well; the range of results made possible with this analysis, depending on the subjectively determined assumptions used, is remarkable.[154] The difference is that subjectivity is obvious in the kind of holistic analysis I have been describing. Cost-benefit analysis, in contrast, pretends to be objective, and that is where it becomes not just a bad idea, but a dishonest one.

The holistic approach also differs from cost-benefit analysis insofar as it does not insist upon translating the benefits of regulation into dollars, where those benefits—such as protection of life, health, and nature—are not sold in markets. One major advantage of this approach is that, by declining to provide contrived dollar values in place of descriptions of concrete benefits, the holistic approach actually offers *better* information to decision makers. Posner himself hints at one point that people can perhaps think more clearly about trade-offs in the absence of monetization:

> [A] person who is trying to decide whether to pay $100,000 for a new Mercedes-Benz is, if rational, making an implicit cost-benefit analysis. But he is not comparing two money prices. He is comparing the money price with the nonmonetized utility of owning the Mercedes. More precisely, he is comparing the nonmonetized utility of the various uses to which he could put the $100,000.[155]

It is more than a little ironic that, as Posner here recognizes, our decisions in the market typically take the form of comparing monetized costs to nonmonetized benefits—yet, in the name of mimicking private markets, cost-benefit analysis

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151. *Id.* at 213–14.

152. *See* POSNER, *supra* note 1, at 174.

153. *See supra* text accompanying note 33.

154. *See, e.g.*, Cass R. Sunstein, *The Arithmetic of Arsenic*, 90 GEO. L.J. 2255, 2255 (2002) (finding that the benefits of reducing arsenic in drinking water could plausibly range from zero to half a billion dollars).

155. POSNER, *supra* note 1, at 187.

insists upon creating artificially monetized values for the benefits we "buy" through regulation.

Perhaps the largest advantage of our approach is that it avoids the technical and moral dilemmas associated with monetization. Given the radically unmoored character of Posner's $600 trillion estimate of the value of the human race, it is startling that he regards the "greatest peculiarity" of his calculation to be the "paradoxical reversal" that leads to the avoidance of a less-than-catastrophic event being valued more highly than the avoidance of a catastrophic event.[156] Sure, paradoxical reversals are (by definition) weird—but weirder than valuing the extinction of the entire human race in dollar terms, and by plucking a number out of thin air? I think not.

Moreover, Posner's "greatest peculiarity" is not even very peculiar. Avoiding events with huge costs but tiny probabilities often will be valued less highly, before the fact, than avoiding events with smaller costs but high probabilities. If my child is sick and I drive her to the doctor's office in my gasoline-powered automobile, I increase trivially the chances of catastrophic climate change, while increasing appreciably the chances that my child will get well sooner. Here, the peculiar thing would be to decline to take my child to the doctor because of the trivially small contribution I might be making to catastrophic climate change.

Even so, there is wisdom lying just below the surface of Posner's claim that valuing the avoidance of noncatastrophic events more highly than the avoidance of catastrophic ones is awkward. Recall Posner's point about nonlinearity in the value of life. The idea is that the expected-value formula, PL, is highly nonlinear in P when L is held constant and reflects something as important as the death of a person; as P approaches 100%, PL approaches something like infinity—or the complete refusal to participate in the market for risk.[157] In thinking it awkward for catastrophic events to be valued lower than noncatastrophic ones, Posner is implicitly saying that the importance of L also grows nonlinearly with its magnitude. Or, in other words, the expected-value formula is also highly nonlinear in L, holding P constant, where L is the extinction of the human race. The expected-value approach thus becomes useless not only as the probability of death approaches 100%, but also as the number of deaths approach total extinction. Unfortunately, however, Posner does not see that his instinct about the peculiarity of valuing the avoidance of noncatastrophic events more highly than the avoidance of catastrophic ones shows, ultimately, the uselessness of expected-value analysis in evaluating catastrophic risks.

The point can be deepened. Posner's entire book is a brief for why we should take catastrophic risks especially seriously, yet he fails to see the logical implications of the special nature of these risks for the expected-value analysis he embraces. If one takes expected-value analysis seriously, then one would not

156. *Id.* at 170.

157. *See supra* text accompanying notes 37–46.

distinguish between the following two kinds of risks: (1) a risk that out of a population of 1000 people, one person will die—if this risk materializes in harm, one person will die; (2) a one in 1000 risk that all of the 1000 people in the population will die—if this risk materializes in harm, everyone will die. These risks are numerically identical; in each scenario, the "expected value" is one death. But in the second case, we know that "one death" is the wrong number; the number will be either zero or the whole population. "Expected value" is a huge misnomer in this situation.

Moreover, the two kinds of risks I have identified are very different from each other in qualitative ways as well. The scenario involving a one in 1000 risk that an entire population of 1000 people will be wiped out might be especially bad because it is harder to recover from this kind of concentrated loss.[158] On the other hand, there is a kind of surprising equity to risks of concentrated losses; they put us all in the same boat, so to speak.[159]

When it comes to catastrophic risks of the kind Posner worries about—risks threatening the future of the whole human race—one can also see reasons why such risks might be thought either better or worse than (but certainly not the same as) more diffusely distributed risks. One reason they might be thought less serious is that if everyone dies, there will be no one left to feel the loss. Posner briefly refers to this idea, but quickly dismisses it. While admitting that there would be "no *perceived* loss" if "everyone dies at once and without warning," Posner notes that people want to continue to live even if they know they won't experience a sense of loss if they die, and he thinks most people "would be happier if they thought the human race, particularly their own loved ones, would survive their own death."[160] But this is just to say that the *prospect* of the loss of the entire species is, for many people, a bad thing; it is not to say that the actual loss of the entire species would be a loss. For who would experience it? And what sense can it make to say there is a loss—especially in the economic sense Posner prefers—if it is not "perceived"?

Ultimately, I believe cost-benefit analysis of catastrophic risks fails not so much for these reasons as for the profound bizarreness of attaching a dollar value to the continued existence of the species. Here, I want to return to Posner's figure of $600 trillion as a "conservative" estimate of the value of the human race. Let us suppose, for the moment, that this number was not made up, but was instead derived from the most careful, most sophisticated studies of individuals' willingness to pay for reductions in risk to themselves. And let us suppose that $600 trillion has the kind of meaning cost-benefit analysts shoot for in determining such numbers—which is that it is the point at which the subjects of the economic analysis are indifferent as between the money and the

158. *See* J.M. Griesmeyer & D. Okrent, *Risk Management and Decision Rule for Light Water Reactors*, 1 RISK ANALYSIS 121 (1981).

159. *See, e.g.*, Donald T. Hornstein, *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 COLUM. L. REV. 562, 596–98 (1992).

160. POSNER, *supra* note 1, at 170.

commodity in question. Pay less than $600 trillion to save the humans, and you have not spent enough; pay more, and you have spent too much.

I believe that the greatest peculiarity in this number is not, as Posner says, the paradoxical reversals that might happen due to the nonlinearity of the relationship between the value and magnitude of risk (which, as I have said, aren't in every case peculiar at all). I believe the greatest peculiarity is the very idea of developing such a number. What could it mean to say that the human race is worth $600 trillion?

Imagine two different worlds. In one, the earth's human inhabitants proceed with their lives; they have avoided the big asteroid, shut down the particle accelerators, prevented a huge bioterrorist attack, and even averted abrupt climate change. In another, the humans are dead, but they have $600 trillion in a highly secured bank vault (designed to launch automatically into orbit at the first sign of a really big asteroid). Is anyone indifferent between these two results? Double the dollar amount, then double it again. In fact, just go ahead and keep doubling it as long as you want. Is there any amount of money, however high, that would make us indifferent between the money and the world?

In offering this figure, however much he surrounds it with qualifications about its being "conservative," Posner has, perhaps unwittingly, engaged in the ultimate *reductio ad absurdum* of cost-benefit analysis: with his estimate, we have finally reached the point where money—or the things we can buy with money—are as important as our own continued existence. I'm not sure even Marx would have predicted that the fetishization of commodities could become so complete.

CONCLUSION

Richard Posner is that rare individual who is willing to change his mind based upon what he has learned. I believe something of this sort happened when he was researching *Catastrophe*; risks that he might previously have dismissed—or at least not thought much about—became important to him, based on what he learned about them. I have argued here, however, that Posner did not take this learning to its logical conclusion, which would have been the rejection of cost-benefit analysis as a means of evaluating catastrophic risks. In recognizing the insuperable challenges of monetization, discounting, and scientific uncertainty, he set himself up perfectly for a declaration that there are times when cost-benefit analysis just won't do the trick. He also came within a whisper of embracing a precautionary, holistic approach to catastrophic risks. Unfortunately, having come this far, he backed off, and returned to the economic habitrail. Nevertheless, his book sounds an important cautionary note for those who would argue that doing nothing is just the thing when it comes to catastrophic risks.