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**Forewarned is Forearmed: Review of *Curbing Catastrophe: Natural Hazards and Risk Reduction in the Modern World* by Timothy H. Dixon (2017)**

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## Forewarned is Forearmed: Review of *Curbing Catastrophe: Natural Hazards and Risk Reduction in the Modern World* by Timothy H. Dixon (2017)

### Abstract

Timothy H. Dixon. 2017. *Curbing Catastrophe: Natural Hazards and Risk Reduction in the Modern World*. (New York, NY: Cambridge University Press) 300 pp. ISBN 978-1108113663.

*Curbing Catastrophe* for the most part lives up to what is claimed in the foreword: "...a compelling account of recent and historical disasters, both natural and human-caused, drawing on common themes and providing a holistic understanding of hazards, disasters, and mitigation for anyone interested in this important and topical subject." This is a pretty thorough treatment of an extraordinarily complex subject, and the gaps identified in this review should be considered explications more than criticisms.

### Keywords

natural hazards, relative risk, risk reduction, environmental numeracy

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### Cover Page Footnote

Jason Makansi is the author of *Painting By Numbers: How to Sharpen Your BS Detector and Smoke Out the Experts*, a quantitative literacy resource featured in the previous issue of this journal, and was a featured speaker at the 2017 National Numeracy Network Conference. He earned his BS in Chemical Engineering from Columbia University; is an independent consultant in the electricity industry; and is the author of four nonfiction books, hundreds of articles in professional and academic journals, numerous short stories, and, most recently, *The Moment Before: A Novel* (Amphorae Publishing Group, March 2018).

I could spend a week writing about *Curbing Catastrophe*. Reading it was like imagining a video retrospective of my career at my retirement dinner. I am a chemical engineer by education and degree, with a career that evolved into what I've often described as communicating about complex engineered systems, concepts, and technologies to people who, for all practical purposes, have no earthly ability to comprehend what I am telling them. This includes such varied situations as explaining all sides of environmental issues to 8<sup>th</sup> graders, convincing venture capitalists to invest in my client's tech-venture startup, and urging elected officials (and more importantly their staff) to champion legislation that could transform the electricity industry through the adoption of new technology and more supportive regulatory frameworks.

Every author surely hopes they convince at least one person to change as a result of what they've put to paper. So I'll start with this: Professor Dixon has convinced me to forego permanently my weekly six-inch tuna fish sandwich at Subway. I mean, I've known peripherally about the dangers of mercury accumulation in predator fish (such as tuna) at the top of the oceanic food chain. But the idea that they "can have mercury concentrations in their flesh that are millions of times higher than ambient seawater..." will cause me to choose chicken salad instead...Oh, but wait. Then I'll be supporting the poultry industry and their horrendous treatment of living species that are the raw material for the sandwich factory that is Subway.

Beyond my attempt at humor, this conundrum gets to the heart of what Professor Dixon covers: relative risk. A chain smoker may understand that the CO<sub>2</sub> belched out of the power plant down the road is less of a risk to his health than lung cancer, but that doesn't mean he will quit smoking OR forego meetings of the local environmental chapter trying to shut that plant down.

Relative risk is at the heart of how society determines where to put its resources. While scientists and engineers have quantitative methods to estimate relative risk using statistics, we also need to acknowledge, as Dixon so aptly does, that most of the people who are ultimately going to make those decisions don't have a hope in hell of understanding those statistics and therefore will decide based on gut reaction, historical precedent, personal experience, testimony from experts they "trust," and emotional factors.<sup>1</sup>

One of my earliest projects as a practicing engineer was to analyze the saltwater cooling network for an aging, major petroleum refinery on the east coast. The facility experienced a near-catastrophic loss of cooling one summer five years prior. That incident led to an edict from the top brass: we shall not experience this again!

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<sup>1</sup> Editor's footnote: Readers interested in a discussion of the psychology of why people tend to forego rigorous analysis of uncertainty might consider consulting the two reviews of Kahneman's *Thinking Fast and Slow* found in *Numeracy*, Vol. 10, Issue 2.

Suffice it to say that the relative risk of a loss of coolant was negligible before that fateful day, but such a loss was quickly elevated to a dire threat in the days and years after. Memory, whether personal or institutional, plays a strong role in how relative risks are perceived. Statistical analysis will always have difficulty confronting that aspect of the human condition.

The other primary theme of *Curbing Catastrophe* is communication. Dixon states, as many others have in books sitting on my shelves, that scientists are not good at communicating to non-scientists and non-scientists are not receptive to the scientific information, nor are people typically trained to digest such information. I give the author much credit for hitting this theme early and often. It's even more critical in this "post-fact" phase [I hope it's just a phase anyway] America seems to be living in. He hits the hot buttons like increasing STEM-based education; pushing for greater transparency; clearer writing to audiences other than peers; proliferation of media outlets, which seem great at amplifying and propagating bad information so that it crowds out the good, formal "lessons learned" activities; greater use of independent boards; and many others.

Dixon misses one key issue, though. Sadly, most of what passes for objective communication in our society is anything but. I can't tell you how many professional meetings I attend every year where it is clear that the presentations aren't designed to communicate to me, but instead to show me how much smarter the presenter is than his or her audience, to explain why I should buy or fund what the presenter is selling, to deliver support for an ideological position, or to cover the company's figurative ass when something bad has happened.

Rare is the Richard Feynman who in front of the television cameras drops a rubber O-ring into an ice bath to unequivocally demonstrate why *Challenger* exploded shortly after takeoff. More typically, we get the NASA scientists struggling to protect their institution through obfuscation.

Truth is the first casualty of war, so the slogan goes, but it also tends to dissipate quickly when catastrophe strikes. Fortunately, you'll learn a great deal of "truth" about an impressive list of catastrophic events Dixon elaborates on to illustrate his points and arrive at his recommendations. Among them:

- The Triangle Shirtwaist Factory Fire of 1911
- Various earthquakes in modern times
- The Tsunami that destroyed Japan's Fukushima Daiichi nuclear plant
- The Hindenburg explosion
- The toxic legacy of lead
- Mercury in the environment
- The Galveston hurricane of 1900
- Global warming
- San Francisco's 1906 earthquake.

At first, I was wondering why Fukushima takes up so much of the “oxygen” in this book. Then I got it. Fukushima is an especially poignant example because it involves a *natural disaster* which precipitated a *man-made catastrophe*. There’s much to learn from here. I hope professionals in my industry, electric power, find their way to this book for this section alone.

One of the most useful chapters in *Curbing Catastrophe* is the summary at the end, “recommendations by chapter.” I wish this section was placed at the beginning. Managing risk, like safety, is a process of continuous education, refreshers, adjustment, and improvement. Professor Dixon’s recommendations are excellent reminders for professionals in all walks of life and career.

One glaring omission is curbing catastrophes induced by cyber security issues. This problem appears to be the seminal challenge of the coming decades as complex infrastructure like power stations operate with more and more automation and remote diagnostics and fewer and fewer people on site. The concept of relative risk rears its ugly head here as well with respect to trade-offs regarding resources, economics, etc.

I think the author achieves what is claimed in the foreword: “...a compelling account of recent and historical disasters, both natural and human-caused, drawing on common themes and providing a holistic understanding of hazards, disasters, and mitigation for anyone interested in this important and topical subject.” Given that Professor Dixon is a geosciences expert, it is perhaps not surprising that his analyses of natural disasters come across to this reviewer as a bit stronger than of man-made ones.

In some areas, the narrative is uneven. For example, Chapter 2 begins by describing recent and historical disasters, but then kind of veers off into a lengthy treatise on how earthquakes, volcanic eruptions, and other natural catastrophes occur. This is excellent supporting information but I think better organized as an appendix to keep the main themes moving along. On page 63, a reference to the music industry appears somewhat out of nowhere as an example of the economist Joseph Schumpeter’s concept of “creative destruction.”

There are a few areas where I think the author is on thinner ice, so to speak. I was surprised that a geoscience expert would express support for long-term carbon capture and storage (CCS) for coal-fired power plants. Now, the author does disclose that he has received funding from the Department of Energy to investigate aspects of CCS (keeping true to his transparency edict), but I’ve been evaluating CCS against other options for two decades. Unless you’ve got no choice but to keep burning coal, it’s a dubious alternative, at best a stopgap lifeline to allow existing coal plants to keep running. But talk about a future catastrophe when that underground storage dome is breached – accidentally (earthquake?) or deliberately (terrorist event?) - releasing all that CO<sub>2</sub> back into the environment and displacing

oxygen for those living nearby. The challenge with a CCS site is it has to be managed *forever*.

Dixon also refers to the magic of markets as a solution to manage catastrophe. First of all, markets are magical (e.g., spurring quick innovation) only at the very beginning of a new product or technology cycle, such as the personal computer in the late 1970s and 1980s, cell phones in the 1990s, or automobiles and electricity service in the first decades of the last century. They quickly become constructed and conscripted to favor large players, keep newcomers out, and eventually consolidate into a handful of oligopolies. I don't want to dwell on this because I'm not an economist, but neither is Dixon.

Finally, I'll add a bit of insight to two graphs Dixon has on pages 8 and 9 (and some evidence for my statement regarding markets above), which show the rise in frequency and cost of weather-related disasters in the US. The graphs begin at 1980. It's a fascinating demarcation because that's around when deregulation (allowing "markets" to work their magic, according to advocates) got going in earnest in the US and energy prices were peaking in the US. That's also when the nuclear power industry began its long slide to what now appears to be oblivion. Of course, I'm not going to claim a correlation or even an association – it's all too ambiguous for that – but it is an interesting thing to think about.

If the US and the world had proceeded along the trends evident in 1980, we'd likely be at 50% nuclear power for electricity production, displacing that amount of coal and CO<sub>2</sub>, at least in "Western" economies. Further, if prevailing energy prices of the time had remained high, consumers would have been forced to cut consumption or industry would have been driven to develop non-fossil alternatives far more quickly.

One thing markets and dominant market players don't care much about is future catastrophes, as long as the costs stay off of their profit and loss statements. Dixon rightfully points out that such "externalities" are a major culprit in seeding catastrophic events but does less to point out that protected markets, through dominance, lobbying, standards development, etc. ensure that this behavior continues. I'm not criticizing Dixon's approach so much as reinforcing the complexity of the issues he confronts.

Quite obviously, Dixon's book has animated me in a good way to think through some of these issues. I think the same will happen for other readers with similar backgrounds. But I really hope those without four decades of experience with these issues will be the ones to pick up *Curbing Catastrophe* and read it carefully. You can't ever know enough about how to plan ahead and avoid future catastrophic events.