Book review, forthcoming in *Risk Analysis*

Review of: *Global Catastrophic Risks*. Nick Bostrom and Milan Ćirković (eds). Oxford: Oxford University Press, 2008, ISBN 978-0-19-857050-9, pp. xxii + 554.

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Risk is generally defined as the product of probability and magnitude. Global catastrophic risks (GCRs) are risks of the highest magnitude, regardless of their probability. As defined by Bostrom and Ćirković, global catastrophes are events that cause roughly 10 million deaths or $10 trillion in damages or more (p.2). Thus, even if the probability of a global catastrophe is low, it may constitute a substantial risk.

GCR has attracted a modest amount of recent attention, including Leslie (1996), Rees (2003), Posner (2004), Matheny (2007), and Sunstein (2007). The present book is a very welcome addition to this literature. Whereas the preceding writings are all solo-author efforts, the present book brings together 25 authors across 22 chapters covering a near-comprehensive wide range of GCRs as well as a rich section on cross-GCR methodology. GCR is a massively interdisciplinary topic and thus is more conducive to this sort of collaborative effort.

Traditionally, GCRs are studied individually by independent research communities. This book is an effort to redirect research towards more integrated efforts. One might object that quality suffers in the face of such breadth. However, only by studying multiple GCRs together can one consider which might be most pressing. Furthermore, integrated GCR study also reveals many strong parallels that exist between different GCRs. For example, several GCRs stem from technologies that also have substantial beneficial uses and thus face similar regulatory complications. Meanwhile, integrated GCR study highlights basic disagreement between some GCR researchers, such as on whether allegedly dangerous high energy physics experiments should proceed. Integrated GCR study allows researchers to exploit the synergies and assess the conflicts. One can see GCR emerging as its own field of study.

The book is written to introduce the diverse but interrelated GCR topics to an interdisciplinary academic and professional audience. Each chapter is accompanied by a short, annotated "Suggestions for further reading" list. Author's opinions are also mixed in, providing interesting insights into the thinking of a diverse group of intellectuals. Overall, the book is a well-organized and accessible reference for almost all things GCR. While the writing is sometimes flawed- several chapters have missing references and some chapters are clearly more authoritative than others- the book is nonetheless an invaluable resource for anyone working on the topic and will be useful for many others as well.

The book opens with an introduction from Bostrom and Ćirković, explaining why GCRs are important to study, and to study in an integrated fashion. Bostrom, an ethicist, and Ćirković, an astrobiologist, both affiliated with Oxford University's Future of Humanity Institute (FHI), give

the book an interesting and engaging frame. Humanity's possibly-unique position in the universe gives GCR reduction a literally galactic importance.

The next chapters set the stage with a discussion of long time scales. Chapter 2, by physicist Fred Adams, gives a timeline for the fate of the universe. Humanity appears to be eventually doomed, although not for another 10^{40} years or so, when protons decay. Chapter 3 discusses human evolution past, present and future, covering everything from historic mass extinctions to possible genetic engineering and space colonization.

The subsequent chapters focus on factors that can bias GCR assessment. Chapter 4 offers a fascinating sociological discussion of end-of-the-world beliefs across several cultures, including contemporary secularism. Chapter 5 reviews the psychology of bias as pioneered by Daniel Kahneman, Amos Tversky and others. Chapter 6, by Ćirković, discusses the observation selection effect, which suggests that it is easy for us to underestimate extinction events because our past necessarily has never had one- otherwise we wouldn't exist to observe our past. Ćirković, ever the astrobiologist, also includes some discussion of risk from extraterrestrial civilizations.

The next chapters consider methodologies for GCR response. Chapter 7, from former SRA President Yacov Haimes, presents a systems approach to risk management, arguing that quantitative measures of risk can mask crucial complexities. Chapter 8, by Peter Taylor of Lloyd's and FHI, argues that while the insurance industry cannot cover GCR (who would collect the benefits?!?), it can offer helpful risk assessment methodology and experience. Chapter 9, by USA Court of Appeals judge Richard Posner, argues using cost-benefit analysis that even with very weak assumptions about the value (measured in dollars) of humanity's survival, society should be trying much harder to reduce GCR than it currently is.

The rest of the book discusses thirteen GCRs, one per chapter. The risks are divided into three categories: "risks from nature", "risks from unintended consequences", and "risks from hostile acts". As Bostrom and Ćirković note in their introduction, this categorization is fuzzy. Some risks from nature can be mitigated through human action, and risks can often emerge from a combination of intended and unintended acts. However, as an organizing scheme, the categorization is helpful.

Chapters 10 through 12 discuss risks from nature. Chapters 10 and 11 discuss volcanic super-eruptions and large comet and asteroid impacts, all of which occur on the order of once per at least 50,000 years or so. Chapter 12 discusses solar radiation fluctuations, which are not GCRs, as well as supernova explosions and gamma ray bursts which are GCRs but occur less than once per 10^8 years. Thus, while some risks from nature are very real, these risks appear much less likely than those where humans play a causative role.

Chapters 13 through 17 discuss risks from unintended consequences. Chapter 13 argues that climate change is not likely to be a GCR any time soon and that while key uncertainties prevent this from being ruled out, prevailing climate alarmism is unhelpful. Chapter 14 discusses pandemics, whose future is exacerbated by some trends (globalization, drug resistance) and ameliorated by others (vaccine development, public health infrastructure). Chapter 15 discusses

artificial intelligence which, though very difficult to assess, might eventually either destroy us or, if it is "Friendly", protect us from all other GCRs. Chapter 16 argues that high energy physics experiments do not pose a credible risk. Chapter 17 discusses the possibility that social collapse may amplify a small catastrophe.

Chapters 18 through 22 discuss risks from hostile acts. Chapter 18 discusses nuclear war which, despite recent non-proliferation successes, remains an ominous threat. Chapter 19 discusses nuclear terrorism, including the possibility that terrorists might trick nations into launching nuclear war. Chapter 20 discusses biotechnology which, unlike nuclear weapons, can be much easier to produce, harder to detect, and contagious. Chapter 21 discusses nanotechnology which, some speculate, could radically facilitate manufacturing- including the manufacture of weapons. Finally, Chapter 22 discusses totalitarian governments, noting the dynamics between the globalization of politics (such as an emboldened U.N.) and the durability of totalitarian regimes.

One can lament that certain GCRs and assessment methodologies were not discussed. To my eyes, biodiversity seems to be the most glaring GCR absence; techniques for assessing expert opinion such as expert elicitation and Delphi seem the most glaring methodology absence. However, assembling this comprehensive of a collection is a remarkable feat. I am particularly glad that Bostrom and Ćirković included chapters on certain "exotic" GCRs, in particular artificial intelligence and nanotechnology, that lack strong institutional research support. The likelihoods of these technology-based risks are very difficult to estimate; we may ignore them at our own peril.

Looking forward, I would very much like to see a sequel volume, perhaps with a focus on response options. This would keep intact the vibrant community formed for the present book and serve as another important step towards reducing GCR. I strongly agree with the basic message of the present book that nothing is more important today.

Acknowledgments
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