On Foundations of Seismology: Bringing Idealizations Down to Earth, by James R. Brown and M. A. Slawinski, ISBN 978-981-4329-49-1, 2017, World Scientific, 184 p., US$88 (print), US$70 (eBook).

The first and last philosophy course that I took was as a freshman at the KU Leuven in Belgium. It was a dryly delivered affair from which I now remember not much more than names of the perceived "main" actors in scientific thought, the name of the professor and his habit of carrying a microphone in a harness around his neck, and the sight of a fellow student who came to class only to read a barely concealed newspaper. Reading Russell's *Introduction to Mathematical Philosophy* in the summer prior to starting college had given me more enjoyment — even if I probably understood less of it on the whole. I was not disinterested in philosophical thinking or in thinking philosophically about science. After all, I had been classically educated in the continental tradition of the Jesuits — having parsed Plato's *Allegory* and Socrate's *Apology* in the original. I was busy learning about, doing, and teaching science (geology, geophysics, geodesy, and seismology). I suspect it is the same for most of us: benign indifference —until the right book comes along.

Indeed, among the attractive qualities of the new book *On Foundations of Seismology* is that it made me think it was written specifically for me. And yet, in selfishly thinking of myself as the target audience of the authors' work, I can nevertheless wholeheartedly recommend it to others including students, researchers, college and university science professors, and readers of *The Leading Edge*. I also recommend it to all those who want to enrich their own experience of practicing and teaching science with some carefully considered soul searching on how it all fits together in the human story of "figuring things out."

A book that provides no fewer than four mappings for the words "see also" as a guide to the index (both subject and name indices serve as useful references) and the footnotes (most of them to other books written by Slawinski, for which one might develop a new taste) is concerned with precise and careful language. And indeed so it is written throughout: prudently paced, carefully crafted, eloquently enunciated, and playfully illuminated.

When I teach my various courses, I typically start by rambling on for about an hour on the treacherousness of "truth," the semantics of "certainty," the precariousness of "predication," and the simple-mindedness of "simplicity." I should direct my students to read *On Foundations of Seismology* instead — but they should savor it after they've had the opportunity to practice some science first. Perhaps paradoxically then, I might recommend tackling chapter 2 before chapters 1 and 3. The chapter will remind readers what the scientific method is all about, before expounding on what seismology is all about. After all, sentences like "P and S waves do not propogate in the Earth but are contained in the equation of motion within an abstract medium, which is a Hookean solid, used by seismologists to model the Earth" are not likely to appeal immediately to the impatient empiricist. Chapters 4 and 5 require a bit of mathematical machinery and some prior notions on mechanics (of the classical, quantum, particle, and continuum variety) and elasticity "theory" (I am now hesitant to use the word), which the reader will then find distilled and clarified in a manner that stimulates further thought. Chapters 6 (on forward and inverse problems) and 7 (on intertheory and intratheory relations) feel a little thin, especially for those of us influenced by the thinking of the late Albert Tarantola, whose seminal probabilistic thinking deserves more than a scant few lines.

I found only two typos: a missing title word in the references to one of the author's own papers and in a Greek spelling. I infer that it is indeed impossible to have it all — though *On Foundations of Seismology* comes close.

— Frederik Simons
Princeton, New Jersey

Coasts in Crisis: A Global Challenge, by Gary Griggs, ISBN 978-052-0293-62-5, 2017, University of California Press, 360 p., US$29.95 (print and eBook).

Roughly 40% of the world's population lives within about 100 miles of ocean coastlines, so anything that affects the coastal environment can impact literally billions of people. These numbers are expanding rapidly due to general population growth and the accelerating trend to move to major cities (18 of the world's 25 largest cities are coastal). This excellent book summarizes the many natural and human processes that alter the coasts, usually with negative results for the people who live there.

Natural disasters tend to cluster along coastlines because of the dense populations there and the physical processes that generate them being linked to the land-ocean boundary. Earthquakes and volcanoes are most common along tectonic plate boundaries, hurricanes and cyclones arise only in tropical oceans, and tsunamis are by definition ocean waves that have abnormal (and often catastrophic) "run-ups" when they encounter land barriers. As recent history attests, all of these occur frequently with great damage and loss of life (e.g., the tsunamis in Indonesia [2004] and Japan [2011], major tropical storms almost every year, and destructive earthquakes nearly as often).

While not as individually destructive, human activities may be even more damaging in the long run. Pollution is ubiquitous in the ocean, both from direct sources (ships and offshore oil wells) and discharge from coastal cities, industries, and agriculture. Overexploitation to the point of extinction is unfortunately very often the end result of industrial-age use of resources. Human efforts to modify the coasts or protect shorelines have mixed results at best — for example, beaches that disappear after construction of breakwaters. Sea levels are rising with global warming, which compounds the problem of land subsidence triggered by groundwater or oil extraction, or by damming or diversion of rivers (which reduces sedimentation needed to maintain deltas). On the positive side, coastal sites have considerable potential for generating renewable energy (e.g., from offshore wind turbines or tides).

The book reviews current knowledge on all of these topics in a clearly written, nontechnical, and concise style. A recurring theme

is that the massive population growth of the past century is a major factor in taking the negative aspects of our activities from a series of local problems to a global dilemma. The historical record can make the prospects for the future look gloomy, but the author remains hopeful and concludes each chapter with a "Where do we go from here" section. It is profusely and effectively illustrated with photographs, maps, statistical charts, and occasional schematic diagrams, all in color. The only weakness is a complete lack of external references. A great deal of useful statistical data is scattered through the text; a summary of data sources would be very useful to anyone wishing to dig deeper into the subject. Similarly, I would have liked to see a short list of further reading suggestions for each chapter. That caveat aside, this is a very impressive book on a broad-reaching and increasingly important topic. I would recommend it to anyone who wants a better understanding of the current environmental state of the planet and where it is going.

— William R. Green
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Waves and Rays in Seismology: Answers to Unasked Questions, by M. A. Slawinski, ISBN 978-981-4644-80-8, 2016, World Scientific, 404 p., US$115 (print).

The book *Waves and Rays in Seismology: Answers to Unasked Questions* by Michael Slawinski is a welcome addition to our library of books on seismology. The writing style of the author is unique in that he introduces each chapter with a brief history of the development of theory, including references to relevant areas of physics and mathematics. The title of the book raises our expectations in that detailed discussions of the content in Aki and Richards and Cerveny and Auld are contemplated. Unfortunately, the length of the book is inadequate to cover all of the topics in great detail. What one finds instead are very succinct summaries of different topics related to seismic wave propagation described in a concise mathematical framework. Yes, the author takes an applied mathematician's approach to describing seismology (rightly so) and the book has numerous equations. The author deserves our kudos; I could not find any typographical errors.

The book starts with a description of the historical development of seismology including observations, physics, and the philosophy behind data analysis. Chapters 2–4 provide an excellent summary of continuum mechanics related to seismology. In particular, chapters 3 and 4 will prove useful to those interested in learning about material symmetry and anisotropic systems. Although details on this topic can be found in other books, these chapters provide readers with a strong background to delve into details. Chapters 5 and 6 cover fundamentals of body wave and surface wave propagation in an excellent manner. I liked the descriptions of the variational principle and related topics in chapter 7 the best, although the ray theory portion is too short. Chapter 8 describes gravitational and thermal effects — something that seismology students must be aware of. Finally, chapter 9 describes the author's philosophy about seismology as science.

The book is self-contained; the appendices are very helpful. Anyone with some background in classical physics will be able to follow the developments in the book. Overall, I found the book to be an excellent read and I would recommend it to students and researchers in seismology.

— Mrinal K. Sen
Austin, Texas

Introduction to Energy: Resources, Technology and Society, by Edward S. Cassedy and Peter Z. Grossman, ISBN 978-110-7605-04-6, 2017, Cambridge University Press, 408 p., US$59.99 (print), US$48 (eBook).

A look at the authors' descriptions explains a lot about this book. The late Edward S. Cassedy was an electrical engineering professor at Brooklyn Poly, while Peter Z. Grossman is a former science journalist and professor of economics at Butler University in Indiana. As one might expect then, the economic treatment of energy issues is the strength of the book. It is extremely well done and refreshingly free of bias. In fact, the book refrains from taking any positions at all throughout, leaving that exercise up to the reader. Societal factors affecting energy production and use, including environmental concerns and governmental action, are addressed independently of the economics sections, thus leading to a very readable, useful, and refreshingly honest treatment of energy issues. The book not only doesn't take sides, but routinely points out internal contradictions and internal conflicts inherent in many energy positions, which are often ignored by the media.

The third section of the book includes an excellent treatment of future energy needs and possible developments. Of necessity, the section is speculative but well thought out, evenhanded, and honest. Economic, societal, and governmental issues are, as before, treated separately without resorting to advocacy. A technical strong point is, as expected, the treatment of electrical generation, transmission, electrical technologies, and uses of electricity. Again, it is free from bias and very well done.

This third edition has been brought up to date from the 1998 version but not, it seems, completely. For example, at the outset much is made of the failure of M. King Hubbert's energy predictions, which by now are definitely DOA. Some of the chapter references cite books many decades out of print, and one might like to see these hard-to-find references replaced by more modern and accessible treatments.

It is when the book moves into technologies unfamiliar to either author that things get a bit rough. Then the reader finds misprints, incorrect diagrams, and confusing statements such as the claim that fracking opens up fissures in the earth, parallel to the surface, which horizontal drilling can follow for thousands of feet. These show evidence of a lack of editing, both factual and typographic. However, errors like this belong squarely on the doorstep of Cambridge University Press rather than with the authors. Some of the technology also seems to have been included to justify the title and the inclusion of integrals in the latter part of the book, which seems to argue against its adoption for any classes but those for college-level STEM students.

That is unfortunate because if the reader is willing to forgive the occasional error and ignore the higher math, the book may be one of the best on its subject, as well as one of the most

refreshingly honest and unbiased around. Not only will a reader gain a lot of insight, and a lot of good evidence for their next cocktail party discussion on energy, but this book could readily form the basis for an excellent course on energy, societal issues, and public policy matters. It is a worthwhile read.

— Robert W. Avakian
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