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

Reviews

Coordinated by Sven Treitel

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James R. Brown is a professor of philosophy at the University of Toronto, and Michael A. Slawinski is a professor of seismology and the director of The Geomechanics Project at Memorial University at St. John's, Newfoundland. Both have published on the philosophy of science and mathematics. This book could have been titled, "On the Philosophy of Seismology and Other Matters." They discuss the philosophical underpinning of seismology, using as its basis continuum mechanics. The authors state: "The continuum used to model seismic phenomena is an abstract entity that has properties similar to physical bodies. It has mass, and transmits energy and momentum." In the preface they state: "However, it is neither a historical treatise of seismology nor a textbook to study its techniques, but a discussion of it foundations in which we examine the conceptual structure of the theory."

One scientific result discussed is the discovery of the earth's inner core from both seismology and tidal studies. The conceptual structure of seismology is continuum mechanics; however, the scientific method and other related works are discussed, and at times they drift off of seismology and into these other subjects. Other aspects of science and mathematics are also discussed in their realm of philosophy with input from many philosophers both ancient (Plato, Aristotle, and Voltaire) and modern (Penrose, Kuhn, and Truesdell).

This is a philosophical treatise and would be of interest to those with knowledge of the rudiments and vocabulary of philosophy since this is to whom the authors are writing. It may be difficult for a geophysicist to gather any practical knowledge but it may provide a philosophical and/or scientific underpinning to their applied research. Written in an almost conversational manner, it could be read by someone with a moderate scientific background; the volume is reasonably easy to follow, especially if you can read the road signs and some French.

There are 20 or so black-and-white cartoonish sketches, which lighten the text to some extent. Obviously this book is not for everyone but for some it could be an epiphany. On the negative side, I felt that the dialogue tended to drift and occasionally gets off the main theme, and I did not sense a clear beginning, middle, and end; this might be the style for a philosophical volume.

Within the seven-page list of references, there are some traditional seismological ones, e.g., Aki and Richards (2002), Backus (1962), Dziewonski and Anderson (1981), Kennett and Bunge (2008), and others. Among those acknowledged are Klaus Helbig and Albert Tarantola. So the core science of seismology is represented.

I must confess, this is the most difficult book that I have reviewed, but if you can stay with it, you may find an avenue never traveled before that is of great interest and insight. Its literary equivalent would be the end of *The Great Gatsby*.

— Patrick Taylor
Greenbelt, Maryland