study. Chapter 5 shows an example of cooperating with a biologist in analyzing blood plasma and brain hypothalamus fluid in rats before and after a rock compression experiment. This is a good start for interdisciplinary study. The bibliography and reading list at the end of the book include many references, not only to macro-phenomena, but also to earthquake-related electromagnetic studies and will be quite useful to readers. The index is helpful for rapid searches.

Although some explanations in this book may not be the most satisfactory ones for the macro-phenomena before earthquakes, I was impressed with the efforts of the author. I expect that this book will be helpful for disaster prevention for lay citizens, who find it impossible to monitor and to analyze the officially nominated precursors. I also expect that this book will encourage more scientists to join this kind of interdisciplinary work.

QINGHUA HUANG
Department of Geophysics
Peking University
Beijing, China
huangq@pku.edu.cn

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When Life Nearly Died: The Greatest Mass Extinction of All Time by Michael J. Benton. Thames & Hudson, 2003. 336 pp. $29.95 (cloth), ISBN 050005116X; $24.95 (paper), ISBN 050028573X.

Gorgon: Paleontology, Obsession, and the Greatest Catastrophe in Earth's History by Peter D. Ward. Viking Penguin, 2004. 257 pp. $27.95 (cloth), ISBN 0670030945; $15.00 (paper), ISBN 0143034715.

Mass extinctions have long captivated scientists and the general public alike. The idea that a giant asteroid slammed into Earth 65 million years ago and caused the extinction of the dinosaurs at the end of the Cretaceous sounds like great science fiction, except that most scientists now accept it as true. Paleontologists and geologists also accept that an even more massive catastrophe happened about 251 million years ago, at the end of the Permian period. According to Douglas Erwin (1996), this "mother of all mass extinctions" boasts estimates of global extinction as high as 95%—but it hasn't produced a proportional impact on the public psyche, or even that of the scientific community.

Two things are probably to blame for the underappreciation of the Permo-Triassic (PT) mass extinction: first, the majority of victims (groups with obscure

names like Burnetiamorpha, Pareiasauria, or Blastoidea) lack the familiarity and charisma of the terrible lizards, and second, and perhaps more significantly, the experts can't seem to decide on its cause. Possible culprits are numerous and varied—gradual climate change, changes in ocean chemistry, volcanoes spewing deadly gas, and the usual suspect—another asteroid—have all been suggested (Erwin, 1993; Benton & Twitchett, 2003; Poreda & Becker, 2003; Becker et al., 2004). Although the cause of the PT extinction has proved tricky to pin down, two recent books provide good reviews of the evidence and offer fresh theories.

Michael Benton's When *Life* Nearly ***Died*** follows the familiar format of many paleontology books geared to tap into the public's interest in the discipline. Although the book's main question is stated early on ("Was the biggest mass extinction of all time triggered by volcanic eruptions or by meteorite impact?" p. 12), it isn't until page 156 in chapter 7 that Benton actually addresses it. The intervening six chapters introduce some general topics (e.g., the roots of paleontology in the Victorian Era, the geological timescale, and a brief history of life on Earth, including other mass extinctions) that form a helpful context for understanding scientific interest in the PT extinction. Though some might criticize the length of this introduction, I found it useful and Benton's writing style engaging. For example, despite a decade studying Permian vertebrates, I knew little about the initial naming of this period in 1841 by Roderick Murchison for rocks he observed outside the city of Perm, Russia (chapter 2).

One person could never become an expert on all of the plants and animals affected by an event as large as the PT extinction, which inevitably leads to research collaborations. In Benton's case, it is a long-standing association with Russian paleontologists at the Paleontological Institute in Moscow and Saratov University. Chapter 10 includes a personal account of Benton's involvement in fieldwork with his Russian colleagues, an enjoyable change from the third-person narrative that otherwise dominates the book. Russia enjoys one of the two major deposits of nonmarine rocks that document the fate of terrestrial plants and animals during the critical PT period. It also hosts one of the major suspects for the PT extinction—huge outpourings of lava known as the Siberian Traps (Reichow et al., 2002). Although he's undoubtedly more familiar with the Russian data, Benton provides an evenhanded appraisal of the evidence for the different causes of the extinction and makes a good case for his favorite mechanism.

In the introduction to Gorgon, Peter Ward makes it clear that his book examines two questions. The first is essentially the same as Benton's—what caused the PT extinction? The second, however, is more personal and lends the book an intimate feel—why do scientists doggedly pursue their research? Not surprisingly, Gorgon reads as a personal journal detailing the author's protracted involvement in studying the PT extinction in the rocks of South Africa's Karoo Basin. He writes about his take on the social and political climate in South

Africa during an early, apartheid-era visit, and how things have changed since. He also discusses how research doesn't always go according to plan, and how new discoveries can lead you to new avenues of inquiry. But the book is most importantly about research collaboration, in this case Ward's work with Roger Smith, a sedimentologist and paleontologist at the South African Museum.

Ward admits to being something of an extinction-chaser. His earlier work contributed to the discussion of evidence for an asteroid impact at the Cretaceous-Tertiary boundary. With that research winding down as the impact hypothesis (Alvarez et al., 1980) became more and more accepted, Ward shifted his focus to the end-Permian event. Some of my colleagues are wary of what they term the "impact mafia"—researchers seemingly bent on recovering evidence for associating mass extinctions with extraterrestrial impacts—but I don't think that this is the case here. Although Ward's book is lighter reading than Benton's, it gives a fair shake to the various extinction mechanisms. Surprisingly, Ward fails to cite his first major contribution to the topic (Ward et al., 2000), although chapter 6 details its emergence.

Gorgon and *When Life Nearly Died* were compelling reads, despite the fact that neither Benton nor Ward would probably claim to be an expert on the PT vertebrates most directly involved with the extinction and subsequent recovery. This lack of firsthand knowledge is evidenced by some minor technical lapses in both books. Hyperbole also creeps into both books, albeit to a greater degree in *Gorgon*. For example, Ward proposes that "the dinosaurs and their descendants, the true birds, came about as a result of low oxygen," postulated for the Triassic (p. 227). Benton's book is also not without the occasional overstatement. He suggests that after the PT extinction (p. 23), "all that remained were literally one or two tetrapod species worldwide." That would really be quite an extinction! But fortunately, this is not the case, as Benton himself has amply documented (Benton, 1993). In both cases, however, the occasional exaggerations can be forgiven and don't take away from the main conclusions of each book.

As a paleontologist primarily interested in the land-living vertebrates of the Permian and Triassic periods, I'm pleased to see that so much interest has been generated in uncovering the cause of the PT extinction. It seems that journal articles about the PT mass extinction are being published with increasing frequency, with new geochemical, extraterrestrial, sedimentological, geochronological, and high-precision biostratigraphic data being added at a faster rate than ever before. Even since the publication of their books, Benton and Ward have published important new findings (Benton et al., 2004; Ward et al., 2005). *When Life Nearly Died* and *Gorgon* will go a long way to popularize the PT extinction, but despite this, I think the mystery still remains about what caused the PT mass extinction.

[Disclosure Statement: About four months after taking this review, I accepted

a position in the Department of Biology at the University of Washington. Peter Ward, author of Gorgon, is a member of that Department. This had no influence on the acceptance of this review or on its contents.]

CHRISTIAN A. SIDOR
Department of Anatomy
New York College of Osteopathic Medicine
Old Westbury, NY 11568
casidor@nyit.edu

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Perilous Planet Earth: Catastrophes and Catastrophism through the Ages by Trevor Palmer. Cambridge University Press, 2003. 522 pp. $75.00 (cloth). ISBN 0-521-819288.

With almost a quarter century having elapsed since the iridium-rich layer at the Cretaceous-Tertiary boundary was generally accepted as the product of the cosmic impact that formed the Chicxulub crater on Mexico's Yucatan Peninsula 65 million years ago, it may be easy to forget the preceding conflict between gradualism and catastrophism that raged in geology (and the sciences in general) and the fact that less than 200 years ago, many scientists, as natural philosophers, believed that Earth was protected from such cataclysms by Divine Providence. Professor Palmer's book, with 129 pages of endnotes, provides a near-encyclopedic survey of the history of our present concern about the threat to Earth from asteroids and comets and the implications for mass extinctions and evolution.

The book is divided into two parts: Part I: "Catastrophism: The story of its decline and fall . . . and resurrection" and Part II: "Catastrophes and the history