

Book review

Billions and billions
of bad tomorrows

Pincelli Hull

The Worst of Times

Paul B. Wignall

(Princeton University Press, Princeton, NJ; 2015)

ISBN: 9780691142098

"I can't think about that right now. If I do, I'll go crazy. I'll think about that tomorrow."

-Scarlett O'Hara in *Gone with the Wind*

Had Scarlett O'Hara faced life in the aftermath of the Capitanian mass extinction, 260 million years ago, rather than the chaos of life in a war-stricken land, a better tomorrow sure would have been a long time in coming. In *The Worst of Times*, Paul Wignall marshals the most recent paleontological and geological evidence to argue that life on earth faced its roughest patch yet during a vast eighty million year-long interval spanning from ~260 to ~180 million years ago.

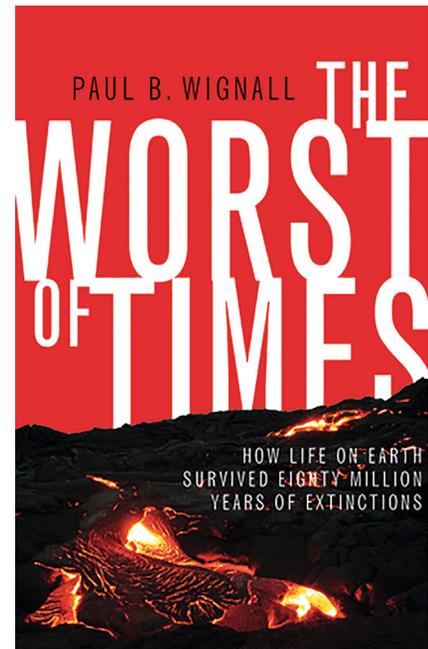
Eighty million years is a terrifically long time, and at the heart of Wignall's book is his case for the existence of this prolonged worst of times. To put the enormity of eighty million years into perspective, just consider that eighty million years ago today, dinosaurs were the unquestioned rulers of land. Eighty million years ago, the first primates, horses, and ancient whales still lay more than 25 million years in the distant future. Even a million years is a tremendous amount of evolutionary time. A mere million years ago, giant sloths roamed the Americas, polar bears had yet to evolve, and written history lay roughly 995,000 years (or about ten ice ages) in the future. Even as a paleontologist, the idea of an eighty million year-long worst of times, or billions and billions of bad tomorrows, is staggering and hard to reconcile with our very human experience of time.

Wignall builds his case one biotic crisis at a time. Starting with the Capitanian extinction roughly 260 million years ago and ending with the Toarcian extinction roughly 180 million years ago, the 80 million year-interval

in question includes two of the greatest mass extinction events in the history of life (the Permian–Triassic and Triassic–Jurassic) and four lesser biotic crises. As a popular science account by a leader in the field, this book provides an up-to-date overview of six of the largest biotic crises in earth's history with enough scientific and personal detail to be both enlightening and engaging.

Bookending the litany of biotic woe is a discussion of why so many extinction events, including the largest mass extinction of them all, might have occurred during the late Permian and early Mesozoic. From Wignall's perspective, the environmental conditions engendered by the super-continent Pangea allowed massive volcanic episodes (which have occurred throughout the history of life) to have outsized biotic effects during this time interval. So to be more accurate, rather than arguing for 80-million bad years, Wignall makes the case for 80 million years during which the earth system was particularly prone to perturbation. Wignall clearly favors a subset of mechanisms, including the super continent as a key conditioner and (often) temperature as a proximal kill mechanism, but his coverage of alternative hypotheses is even-handed and inclusive.

Wignall's *The Worst of Times* is the most recent of a series of paleontological books that reach across the yawning divide separating the world as we experience it from the history that shaped it. In doing so, it drives home, through detailed examples, major paleontological insights of general relevance to all biologists. Among them is the fact that the dynamics of life may not be the same in all times — some periods in earth's history appear to be relatively prone (and others, resistant) to extinction. In this, background conditions including the geography of land masses, existence of oceanic gateways, and presence of key ecologies are critical for understanding past, and predicting future, biotic responses to environmental perturbation. What's more, some of the most relevant processes, like the formation and break up of super continents or the eruption of large magmatic provinces, are beyond our direct experience of the world — an important reminder for those who study the dynamics of ecosystems alive today.



Second, there is a growing canon of examples suggesting that life has become more resistant to perturbations through time. If life has become relatively resistant to perturbation, or even if it simply appears to be so due to the background conditions of our time, this is certainly a note of hope in the face of mounting anthropogenic change.

Third, the time scales of the great biotic events of worlds past is far longer than those readily understood, or prepared for, by human societies. The field of mass extinctions is currently split along disciplinary lines. Conservation biologists study changes in modern ecosystems on scales of days to centuries and paleontologists study mass extinctions at a resolution of often tens to hundreds of thousands of years, over millions of years. These two perspectives are also divided along organismal lines, with many of the most intensively studied taxa today relatively poorly preserved, if at all, in fossil deposits. Alone, neither perspective spans the range of time scales and mechanisms necessary to understand how global biotic crises unfold. Instead, bridges are needed to draw together modern and paleontological perspective, and this book provides one such bridge, reaching out from the depths of time.

Department of Geology and Geophysics, Yale University, New Haven, CT, USA.
E-mail: pincelli.hull@yale.edu