

## EVOLUTION

***The Cambrian Explosion: The Construction of Animal Biodiversity.*** By Douglas H. Erwin and James W. Valentine. 2013. Roberts and Company. (ISBN 9781936221035). 406 pp. Hardcover. \$60.00.

*The Cambrian Explosion* reviews the current state of research on the earliest forms of metazoan life. Chapters on geological and environmental “contexts” set the stage for thorough treatment of the fossil record, especially from Ediacaran and Cambrian formations known throughout the world. These are followed by more detailed examinations of the evolution of the earliest metazoan ecosystems and earliest metazoan genomes. The penultimate chapter covers current theories regarding ancestral lineages and relationships connecting Cambrian, Ediacaran, and earlier phyla. Finally, the authors present their best integration of all the evidence to tell the story of a critical and exciting time in our planet’s history, roughly from 640 mya to 500 mya.

Erwin is Curator of Paleozoic Invertebrates at the Department of Paleobiology of the National Museum of Natural History (Smithsonian), and Valentine is Professor Emeritus in the Department of Integrative Biology, UC Berkeley. Although these two are true specialists in Cambrian paleontology, they have nonetheless written with great clarity. One gets the impression that it was a personal and professional challenge to see whether they could summarize, for a wide readership, just where things stand in their field. The exposition is calm, logical, and not jargon bedeviled. The illustrations are profuse, wisely placed, and clear.

Although the phrase “Cambrian Explosion” is never likely to disappear, it’s too catchy and convenient, there’s ample evidence that tens of millions of years were involved.

Erwin and Valentine delineate many, many long, intertwining threads that detail the best ideas of what was happening over this period on a planet that would be quite unrecognizable to us. The continents, of course, were completely differently distributed, but even more unfamiliar to us would have been a world where niches themselves were alien and rapidly evolving. The evidence that genomes and genomic architecture were changing rapidly, partly in response to each other, giving rise to the establishment of disparate phyla early in the history of metazoan life, matches the excitement of new fossil discoveries.

Understanding of the Cambrian animals is exploding because of the integration of paleontology, comparative anatomy, developmental biology, and comparative genomics. This integration is leading to the following picture of the late Proterozoic: “The relative importance of changes in protein-coding genes to the evolution of *cis*-regulatory elements began to change at this time because morphological changes were increasingly underpinned by the evolution of *cis*-regulatory networks. The morphological differences between different early bilaterians increased faster than differences in gene composition” (p. 326). And, as good scientists, the authors report about this same period: “We do not, however, have fossils to tell us how disparate the body plans of these preexplosion bilaterian clades were; indeed, it is not clear that paleontologists have even appropriate search images for fossils of this interval” (p. 325).

“It is to the explosion, and not to the origin of phylum-level clades, that we are indebted for the body plans of living phyla, those familiar morphological themes that are still with us.... Those body plans have – so far, at least – proven robust to very severe environmental perturbations over geological

time. An important caveat to our reading of the explosion is that we have learned about it by peering through newly opened taphonomic windows that have surely made the explosion appear to be more abrupt than was actually the case” (p. 328).

To close this masterful account, the authors choose their words carefully, epitomizing the processes of science: “Complex patterns of causality, the importance of contingency, and the interaction of many different processes are the norm. Clearly, the biosphere has promoted its own evolutionary trajectory, and the Cambrian explosion was a once-in-an-era happening; it could hardly have been more complicated and could hardly be more tantalizing. In addition, there can hardly be more of a challenge to paleobiologists, evolutionary biologists and many other scientists than to describe and interpret the confluence of history and process responsible for events during that remote and critical time in life’s history” (p. 342).



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## INTELLIGENT DESIGN

***Darwin’s Doubt: The Explosive Origin of Animal Life and the Case for Intelligent Design.*** By Stephen C. Meyer. 2013. Harper-Collins. (ISBN 9780062071477). 498 pp. Hardcover. \$28.00.

*Darwin’s Doubt* claims to review research on the earliest forms of metazoan life. Part One presents a history of discovery and interpretation of the Cambrian animals through both paleontology and genetics; Part Two, research on protein evolution, *evo-devo*, and epigenetics; Part Three, ideas