



Book Reviews 4, September 2022

BOOK REVIEWS

PREFACE

The current volume of the Journal of Paleontological Techniques is the fourth number of our yearly series dedicated to the publication of book reviews. We intend to publish a collection of reviews early every year, of books that were published the year before, and which cover any aspect related to paleontology or natural history in general. Due to a number of reasons, the publication of this volume has been delayed considerably, and we want to apologize for this delay.

Deadline for the submissions is generally at the end of the year, but proposals will have to be discussed with the editors beforehand, in order to avoid duplicate reviews on the same books. We also invite publishers to notify us about upcoming books, which we will be happy to advertise among our readers and followers on social media.

The current volume includes reviews for five books published in 2019. The reviews are written by Simone M. Seghetti, Congyu Yu, Abagael R. West, Lukardis C. M. Wencker, and Christophe Hendrickx. The discussed books are about theropods and the origin of birds, dinosaur discoveries, evolutionary rates, snake evolution, and novel ways to paleontological science.

PREFÁCIO [in Portuguese]

O atual volume do Journal of Paleontological Techniques é a quarta edição da nossa série anual dedicada à publicação de recensões críticas de livros. A nossa intenção é publicar no início de cada ano uma compilação de recensões de livros focados em qualquer tema relacionado com Paleontologia e/ou História Natural, que tenham sido editados no ano anterior à publicação do nosso volume. Devido a várias razões, a publicação deste volume sofreu em atraso considerável, pelo qual gostaríamos de pedir desculpa.

A data limite de submissão é geralmente no final do ano, mas as propostas deverão ser discutidas com os editores do volume de modo a evitar receber múltiplas recensões para o mesmo livro. Convidamos todos os autores, coautores e editores deste tipo de livros a notificar-nos relativamente a futuras publicações, para que as possamos publicitar ao nossos leitores e seguidores nas redes sociais.

O atual volume inclui recensões de cinco livros editados em 2019, tendo sido escritas por Simone M. Seghetti, Congyu Yu, Abagael R. West, Lukardis C. M. Wencker e Christophe Hendrickx. Os livros apresentados discutem os seguintes temas: dinossauros terópodes e a origem das aves, descobertas de dinossauros, taxas de evolução, evolução das cobras, e novos métodos científicos para a Paleontologia.

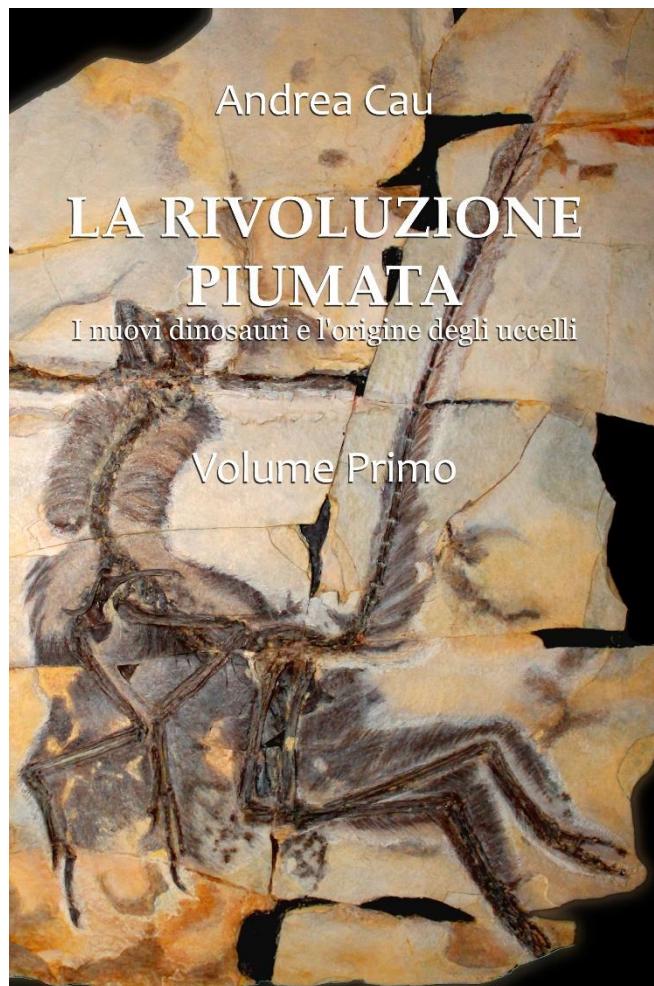
Edited by Emanuel Tschopp, book review editor, Journal of Paleontological Techniques



Copyright (c) 2019 by the authors. This work is made available under the terms of the Creative Commons Attribution 4.0 International License, <https://creativecommons.org/licenses/by/4.0/>.

LA RIVOLUZIONE PIUMATA - I NUOVI DINOSAURI E L'ORIGINE DEGLI UCCELLI

Andrea Cau. 2019. Independently published, available on Amazon. 159 pp. Illustrated. Soft cover. US \$13.91.
ISBN: 9781674701448.



Courtesy of Andrea Cau.

In Italy, there are few books about dinosaurs (and, in general, paleontology), and most of the newest titles published are aimed at children. As an adult, Italian paleontology aficionado, in many cases, you have to look for older publications. Furthermore, many books about dinosaurs have the tendency to tell, more or less, the same thing: a brief history of the early evolution of dinosaurs, a description of families and selected species, hints of their ecology, and extinction. This is probably the reason why Andrea Cau's famous blog, Theropoda, had the attention of many Italian (and not only) readers: in his blog, he talks about specialized topics, with an easy but always scientific language.

And finally, Andrea wrote a book that follows the style he uses for his blog.

The aim of "La rivoluzione piumata" (The feathered revolution) is to tell the evolution of birds, a topic sometimes overlooked in popular books about dinosaurs. But, in order to understand "how birds became birds", it is necessary to understand their history from the beginning. So, Andrea starts from early archosaurs to arrive at non-coelurosaurian tetanurans (Coelurosauria will be the main subject of the second volume), describing the morphological innovations that characterize each group, and their consequences in the evolution of theropods. There are 11 chapters: the first is a prologue, chapters 2 to 6 are devoted to non-dinosaurian archosaurs and the remaining chapters are, of course, focused on dinosaurs.

What makes this book original is the approach: phylogeny, Andrea's scientific field of specialization. Every chapter is dedicated to a particular taxonomic group, and describes the main skeletal features that characterize it, following the cumulative nature of evolution, in which basal features are joined by derived ones. This makes every chapter important for the understanding of the evolution of birds. In addition, every chapter is opened by a partial phylogenetic tree, which introduces the protagonists of the chapter, and they are linked to beautiful reconstructions of selected species drawn by the author himself. Andrea's drawing skills are well known to the readers of his blog, and in fact the drawings contribute to making the reading immersive and help to imagine the various taxa while going through the descriptions.

The information is never trivial. Andrea describes the osteology and biomechanics, and how they influence the lifestyle of the dinosaurs (and other groups) from an ecological perspective, also using living species as a comparison. He also writes about topics that are rarely addressed in popular science books. An example of this is his treatment of the evolution of the forelimbs. The forelimb of dinosaurs, in particular their hand, is both a beloved and ignored part of the body: everyone is familiar with the small arms of *Tyrannosaurus*, and the monstrous "raptors" of Jurassic Park became iconic in parts for their disturbing (and anatomically incorrect), hooked hands. However, I can't remember a popular book that discusses the evolution and function of the forelimb in any detail. This is only one of the surprises of this book (it is a pity that Andrea doesn't talk so deeply

about the tail). Sometimes single species are described, but they are used as a representative to talk about the morphology and evolution of the whole group they belong to (an example is *Saltriovenator*, described to understand the evolution of ceratosaurians).

Everything is told with an easy, fluent, but still rigorously scientific language, and Andrea was able to exhaustively describe difficult and technical topics in few pages. This makes the reading interesting and understandable also for the general public to whom the book is addressed.

The only points to be criticized about the book are the very few images and short bibliography. As mentioned above, the book contains some drawings, but more images, in particular anatomical plates, could have rendered the description clearer, especially for people who are unfamiliar with osteology. Also, the only cited papers are those from which Andrea took inspiration for his drawings. However, both these points are reasonably explained: the decision to insert few images was to contrast the importance generally given to dinosaur reconstructions in most of the popular science books. For the bibliography, I guess a complete list of citations would have increased the pagination, and consequently the cost significantly (in his blog, Andrea is always meticulous about the

bibliography). After all, this book is an independent publication, probably an experiment to test the interest of the public. I am sure that if this book, and the upcoming second volume, will have a good feedback, Andrea will consider a “deluxe” edition full with images, tables and bibliography in future.

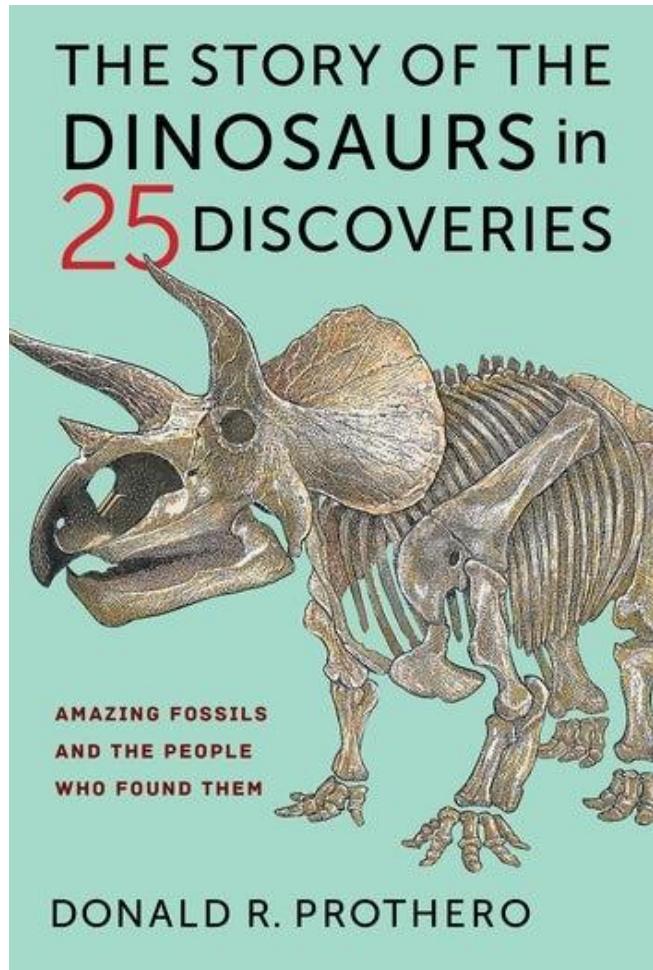
In summary, this is probably the best dinosaur book available in Italian: written with competence, enthusiasm, and a good writing style. It talks about dinosaurs in a non-trivial way, making this book a must-have for any Italian paleontology enthusiast, but also for teachers, museum guides, and for anybody interested in natural sciences. I can't wait for the second part, and I really hope that the project will be carried on, maybe with some volumes about ornithischians, sauropodomorphs and, if not treated in the second volume, fossil avian birds (not just Mesozoic species, also Cenozoic taxa would be interesting). And for non-Italian readers, if you want an excuse to learn Italian, this book could be the right motivation.

Simone M. Seghetti

Dipartimento di Scienze della Terra
Università degli Studi di Torino
Turin, Italy

THE STORY OF THE DINOSAURS IN 25 DISCOVERIES

Donald R. Prothero. 2019. Columbia University Press. 488 pp. Illustrated. Hardcover. US \$35.
ISBN: 9780231186025.



Courtesy of Columbia University Press.

For more than one and a half centuries, dinosaurs have always been an iconic symbol in popular science. Even little kids know considerable numbers of dinosaur names, sometimes also from which geological age they are and their lifestyles. In most paleontological exhibitions or dinosaur-related publications, people see well-reconstructed skeletons and nicely illustrated dinosaurs. However, most people have limited knowledge of the development of vertebrate paleontology and the personality of those famous paleontologists who named famous dinosaurs.

The book "The story of the Dinosaurs in 25 Discoveries: Amazing Fossils and the People Who Found Them" was written by Donald R. Prothero,

an experienced vertebrate paleontologist who has spent considerable time working in the American Museum of Natural History in New York, the same institution where I am a PhD student working on dinosaur fossils from the Gobi Desert now. Since both of us have been educated and are doing research in the museum, I feel really excited about reading this book, especially because some of the most important dinosaur discoveries were made by researchers from here. Some of those paleontologists are still incredibly active in both indoor studies of the museum's collection and harsh outdoor expeditions.

The community of vertebrate paleontologists is small. Although non-researchers can know a lot about dinosaurs themselves, people pay little attention to the scientists who made the discoveries. In this book, readers can not only learn about many famous dinosaurs, but also about the people who found and studied them. Unlike most popular science books introducing dinosaurs, "The story of the Dinosaurs in 25 Discoveries" spends more than half of its pages on paleontologists themselves.

From William Buckland, who named the very first dinosaur *Megalosaurus*, to the Bone Wars between Marsh and Cope in the late 19th Century, from the poor German paleontologist Ernst Stromer, who lost most of his discoveries and two sons during World War Two, to the legendary but less known South American Jose Bonaparte, from Mike Novacek and Mark Norell in the American Museum, who revived the Gobi Desert expedition, to Xu Xing and other Chinese paleontologists and their feathered dinosaurs, there are many stories behind the silent fossil specimens.

It is often taken for granted that dinosaur fossils are out there in the field to be discovered and dinosaur study is simply naming one dinosaur after another. However, no paleontologist would agree with that. A whole chapter of this book discusses the rise and fall of *Brontosaurus*, a large Jurassic sauropod named by Othniel Marsh in 1879. It was soon considered to be a synonym (repeated name of a named taxon) due to its similarity with *Apatosaurus*, but has recently been re-erected based on a more comprehensive study. By discussing the history of *Brontosaurus*, Donald shows how new discoveries change existing dinosaur classification, and more importantly, the differences between paleontologists nowadays and 100 years ago. The establishment of new dinosaur taxa now cannot

Yu 2021: BOOK REVIEW – THE STORY OF THE DINOSAURS IN 25 DISCOVERIES

be based on personal judgement or any degree of morphological differences alone, but on a more testable methodology called cladistics.

On the other hand, dinosaur study has never been pure science that is isolated from any other field. The discoveries of new dinosaurs come with competition over funding, fossil localities, betrayal and loyalty of crew members, recognition from the academic community, etc. Dark sides and awful things unknown to the public are mentioned in this book. By providing detailed stories of fossil discoveries, readers can imagine the personality of each paleontologists, rather than just being a nerd scientist from common popular dinosaur books.

Though dinosaur study may be extremely popular in the most recent three decades, it has largely been ignored in the first half of 20th century, when the old world was crumbling. Indeed, the majority of this book focuses on two time periods, the second half of the 19th century and after 1970s. A long list of 25 different dinosaurs and their close relatives were selected in this book to represent four major groups, which are four sections of this book: the early discoveries, sauropods, theropods, and ornithischians. Though each of the 25 chapters is named after one dinosaur taxon, the content actually deals with more taxa depending on the history of discoveries. The selection of taxa covers a nice variety of time, geographical area, and phylogenetic lineages, however, several very recently discovered lineages are only briefly mentioned in related chapters or totally avoided, such as

the weird Alvarezsauria (a group of bird-like, small theropods with largely reduced forelimbs), many basal members of Marginocephalia (Ceratopsia and Pachycephalosauria) discovered in the last two decades, the feathered ornithischian *Kulindadromeus*, as well as other stem ornithischians. They represent some of the most exciting discoveries in recent dinosaur studies, which show how extreme evolution could shape an animal and how essential evolutionary events appeared way earlier than we thought, for example the appearance of feathers.

I am glad the book discusses some of the most recent advances in dinosaur studies, such as the most comprehensive ecological reconstruction of sauropods from the Morrison Formation and the new phylogenetic hypothesis of dinosaurs that groups the clades Theropoda and Ornithischia together. There is always a gap between any scientific discovery and public awareness. It is good to close this gap by introducing the latest research progress to the public.

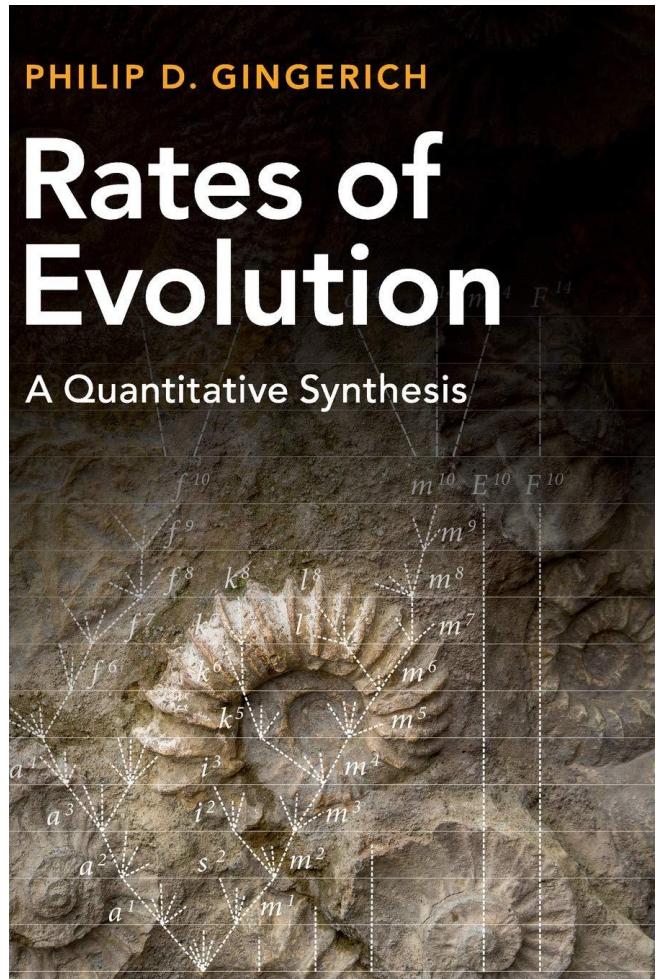
In general, the book may be more suitable for people who already know something about dinosaurs and would like to dig more. The number 25, which I assume to be preset to maintain consistency with the author's previous books, seems to limit the book's coverage, however.

Congyu Yu

School of Dental Medicine
Harvard University
Boston, USA

RATES OF EVOLUTION: A QUANTITATIVE SYNTHESIS

Philip D. Gingerich. 2019. Cambridge University Press. 399 pp. Illustrated. Hardcover. US \$84.99.
ISBN: 9781107167247.



Courtesy of Cambridge University Press.

Rates of Evolution: A Quantitative Synthesis is respected paleontologist Phil Gingerich's latest contribution to modern evolutionary thought. The book opens with a brief history of evolutionary thinking, framing this history as the "thesis" of evolution by gradual change, as conceived by Darwin and Lamarck, versus the "antithesis" of (morphological) stasis. In the rest of chapter one, via a series of concise semi-biographical studies of some major authors of the Modern Synthesis, Gingerich develops a moral equivalence between Linnaeus's fixism, Lyell's uniformitarianism, saltational or quantum evolution, punctuated equilibrium (explicitly as conceived by Eldredge and Gould in 1972), and the modern tendency to dichotomize micro-

versus macroevolution. The chapter summary poses this dichotomy as a question: how can an evolutionary paradigm whose dominant mode is stasis generate species? The answer immediately offered is "a mysterious origin of species," a poetic term for speciation and one which an informed reader expects will be explored in subsequent chapters.

Instead, chapter two explores in dense mathematical terms the history of the normal distribution in anthropometry, before arriving at the book's first central thesis: that measured (morphological) quantities should be log-transformed before analysis. It is reasonable in the contexts of allometry and rate to recognize the distinction between geometric and arithmetic variance around a mean. Concluding from this distinction that measurement error is somehow masking great variation in natural populations, however, is a stretch. Chapter two ends by setting up Adolphe Quetelet's "average man" (1846) as an avatar (straw) for all modern concepts of evolutionary stasis.

Chapters four through six dive further into the mathematics of normal distributions. We are introduced to the idea that a rate (change over time) can be mapped onto time increments as short as a generation and as long as millions of years, and that a rate will be different depending on the interval it is mapped to. Terminology for various time-increment scales is introduced and codified in the contexts of simulated evolutionary random walks. The book's second main thesis, developed around the end of chapter 6, is: if evolution does proceed by random steps, the probability of remaining around the same mean trait value for any large number of consecutive time increments is vanishingly low. We now have two "thesis" statements to one "antithetical" equilibrium: measurement error or arithmetic scaling is hiding change, and change is inevitable if evolution is a time-transgressive process.

The middle of the textbook is a literature review, describing a range of ecological, experimental, and paleontological studies over the last 100 years that found nonzero rates of morphological change, either in a population or in a lineage. The range of topics reviewed is helpful for a student of evolution. Works cited in chapter eight, for instance, contain datasets that nicely illustrate selection gradients, heritability, trait value, and the like.

The final third of the book doubles down on the Lyell-Eldredge-Gould analogy based on a literal

reading of Figure 10 from Eldredge and Gould (1972), via Gingerich (1984), before taking on a subset of relatively non-controversial modern phylogenetic methods. Chapters 12 to 14 investigate in turn the neutral model of molecular evolution, phylogenetically independent contrasts, and Brownian motion, Ornstein-Uhlenbeck, and early-burst models. The mathematics invoked mostly feel more like an obfuscation than an explanation. The final three bullet points of chapter 15 summarize these investigations: neutral evolution is the driver of stabilizing selection (?), phylogeny's influence on trait value is always negligible, and the early-burst pattern of adaptive radiations is either a time scaling artifact, or, if real, at least not the same as the “mysterious” mechanisms we imagine punctuate equilibrium.

Evolution is at times demonstrably rapid. This book should have been a nuanced investigation of how rapid regimes and slow (static?) regimes differ and how they interweave, and of how the temporal and spatial scales on which we observe evolution influence our observations. Instead, it is a brief history of Darwinian thought followed by a fastidiously compiled review of a subset of the ecology and evolution literature, interspersed with bits of calculus. For all the care devoted to this review and mathematical exploration, there are also a handful of

unsettling instances of disregard for precision that seem either careless or worse, intentional. In terms of utility to the advanced student (a selling point touted by the back-cover blurb), it is true that most of the examples and references are current. It is left as an exercise for this hypothetical student to determine whether or not these references actually advance the theses of the author.

References

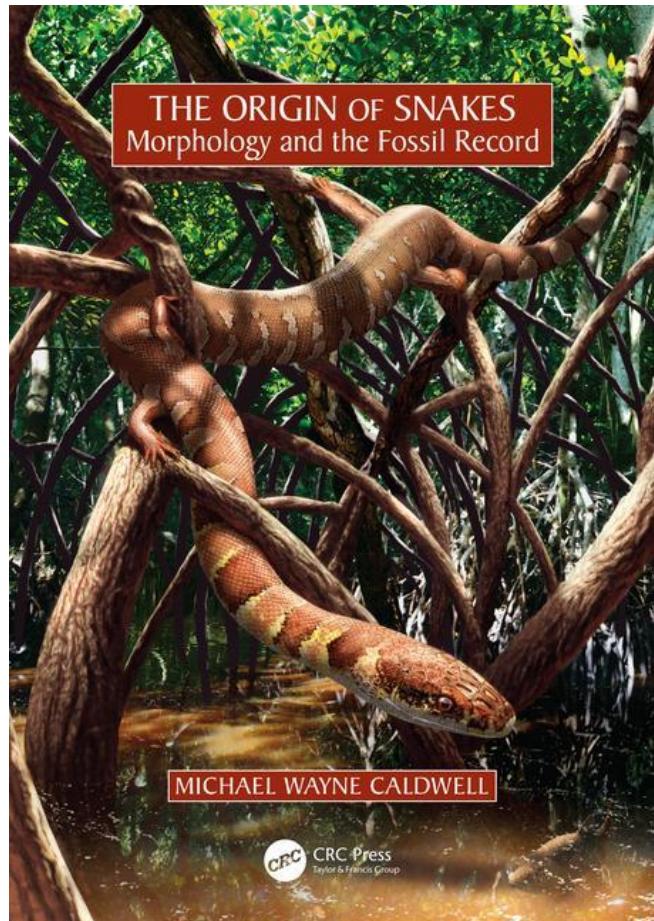
- Eldredge, N., and S. J. Gould. 1972.** Punctuated equilibria: an alternative to phyletic gradualism; pp. 82–115 in F. J. Ayala and J. C. Avise (eds.), *Essential Readings in Evolutionary Biology*. Johns Hopkins University Press, Baltimore, USA.
- Gingerich, P. D. 1984.** Punctuated Equilibria—Where is the Evidence? *Systematic Zoology* 33:335–338.
- Quetelet, A. 1846.** *Lettres Sur La Théorie Des Probabilités, Appliquée Aux Sciences Sociales*. Bachelier, Paris, France.

Abagael R. West

Department of Biological Sciences
University of Pittsburgh
Pittsburgh, USA

THE ORIGIN OF SNAKES: MORPHOLOGY AND THE FOSSIL RECORD

Michael W. Caldwell. 2019. CRC Press Taylor & Francis Group. 300 pp. Illustrated. Hard-cover. US \$69.95.
ISBN: 9781482251340.



Courtesy of CRC Press.

For the past 160 years, research on the origin of snakes has progressed with countless debates and controversies, many which are still ongoing today. In his new book, "The Origin of Snakes", Michael W. Caldwell sheds some light on this history by critically reviewing paleontological and neontological data. He provides an overview of the current scientific knowledge combined with his personal concepts concerning the evolution of snakes. The book is comprised of seven main chapters featured with adequate figures ranging from depicted osteological structures and phylogenetic trees to casual photographs from fieldwork in Argentina.

As the opener for the first chapter, Caldwell deals with the question "what is a snake?" and why we should better use the term snake lizard. He gives an overview of the definitions of

"snakeness" through history. Caldwell sees the skull as the main driver of snake lizard evolution. He proposes four skull types that he identifies as being present in modern species and provides further osteological details on snake lizard skulls.

In chapter two, these skull types are linked to important Mesozoic fossil snake lizard taxa, which he describes and reviews briefly. An overview of published and in-prep data of *Tetrapodophis amplus* is given, although Caldwell does not consider this as a true snake lizard. Concerning the classification of the fossil material into the four skull types, the author points towards the difficulty of creating top-down categories, which are not structured in the same way as evolutionary paths (from past to present).

The following chapter on the anatomy of ancient snake lizards is by far the most extensive one. It is related to concepts of homology at the root of the snake lizard phylogeny. Anatomical features are discussed in detail (e.g. gape size, tooth attachment, cervicals and cervical intercentra) in regard to their role in the phylogenetic debate on the origin of snake lizards. Caldwell critically deals with hypotheses on the anatomical features, highlighting the importance of not letting a hypothesis become a dogma. Eventually, he uses the discussed anatomical features to deduce the expected osteology of ancestral snake lizards.

Chapter four is devoted to paleoecology. Along with general information on the topic, Caldwell revises depositional environmental data and their paleoenvironmental interpretations for the previously described fossil taxa (chapter 2). Those data lead to interpretations of the fossil taxa's ecology. A closer look is given to the Upper Cretaceous fossil Lagerstätten La Buitrera in Patagonia, Argentina (home of the holotype of *Najash rionegrina*). He provides a geological overview and facies analysis with its resulting interpretation of the depositional environments. As a little extra, Caldwell talks about the exciting and joyful time he spent doing fieldwork in La Buitrera.

The subsequent chapter aims to identify and clear up "myths" about the origin of snake lizards focusing on the ecology. It is shown which ancestor scenarios are supported by valid scientific data. Caldwell traces back misinterpretations of written words that led to wrong conclusions, comparing it to the children's game telephone (or Chinese whispers). Once again, he points to the problem of dogmatism.

Wencker 2021: BOOK REVIEW – THE ORIGIN OF SNAKES

Morphological and molecular homology concepts are reviewed in the sixth chapter. A brief overview of the conflicting history of (snake) lizard phylogeny is given, starting with Cope's phylogeny from 1869 ("On the reptilian orders Pythomorpha and Streptosauria"). The conclusion on the state of knowledge shows that there are still existing uncertainties in the snake lizard phylogeny, leading to Caldwell's concept of fossil backbone to improve our understanding. The fossil backbone uses the fossil taxa to form the general tree topology, forcing the extant taxa into the constrained tree structure.

In the last chapter, Caldwell shares some rather philosophical thoughts to conclude the whole book, stating the importance of not allowing science to settle for absolutes and to understand evolutionary processes by starting in the past and moving forward to the present. "Snake evolution is by far more wildly complex, intricate, and chaotic than anyone had ever suspected." But, Caldwell is positive that already existing data and new data are going to lead to more questions to be asked, which will help us to

improve our understanding of the origin of snake lizards.

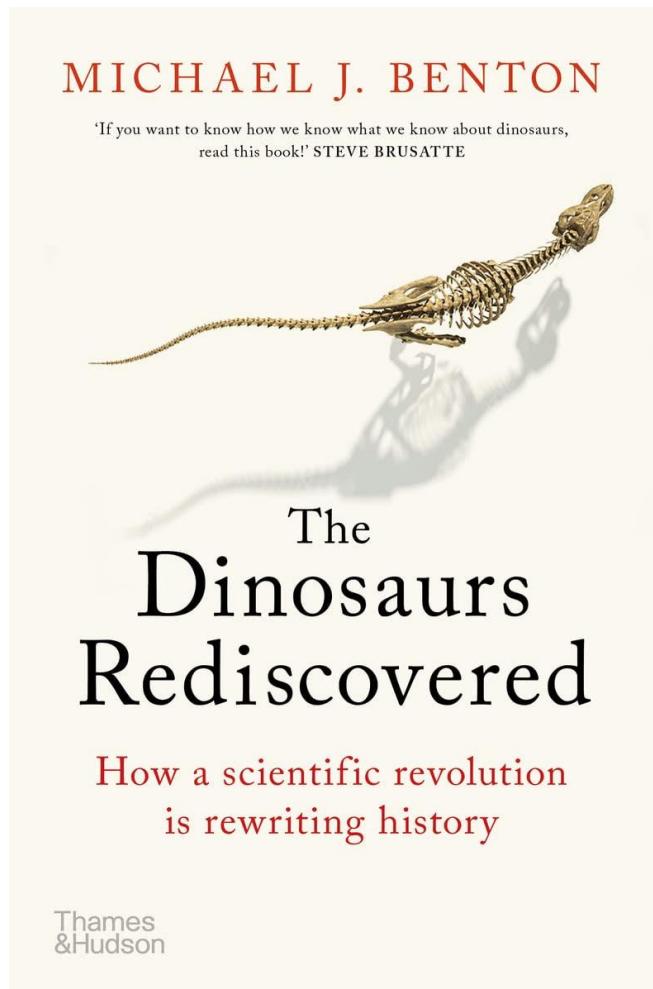
Throughout the whole book, the appeal to not let hypothesis become dogmas and to critically revise all information present is perceptible. The author highlights the importance and inalienability of fossils in understanding an organism's evolution from the past towards the future. His ideas and criticisms on the origin of snake lizards are argued in a coherent way, clearly marked as such and distinguishable from the present state of knowledge. The wide range of primary literature covered and the advice on further readings given makes it a wonderful read for students starting to work on snake lizard evolution, whilst even the interested layperson is going to enjoy the detailed descriptions and thoughts of Michael W. Caldwell.

Lukardis C. M. Wencker

Hessisches Landesmuseum Darmstadt
Darmstadt, Germany

THE DINOSAURS REDISCOVERED

Michael J. Benton. 2019. Thames & Hudson. 320 pp. Illustrated. Paperback. £10.99. ISBN: 0500295530.



Courtesy of Thames & Hudson.

In his book, *The Dinosaurs Rediscovered* published by Thames & Hudson Ltd in 2019, Michael J. Benton invites us on a journey from 1980 to the present day, a time during which dinosaurian palaeobiology has lived an astonishing revolution thanks to the development of computational methods and engineering techniques. As stated in his introduction, Mike Benton has had the good fortune of witnessing this major change that occurred during his scientific career. More importantly, this Scottish paleontologist took part in many of these revolutions, from presenting the first dinosaur tree using cladistic analysis in a conference in 1984 to discovering the first clues on dinosaur colors in 2010. I had a great pleasure reading this book, not only because I share the same passion for dinosaurs and vertebrate paleontology as the author, but also

because the book reads like a fresh breeze of air. I always considered Mike Benton as the "Dumbledore" of Vertebrate Paleontology. He is indeed one of the most cited vertebrate paleontologists from this century and the author of *Vertebrate Palaeontology*, the standard textbook on the subject! Prof. Benton was actually one of my teachers during my Master in Palaeobiology at the University of Bristol in 2007-2008 and I remember very well his enthusiasm in teaching Scientific Communication, Current Controversies, and Archosaur Palaeontology. The same enthusiasm and excitement are perceived when reading this book, which presents the major advances in the different areas of dinosaur paleontology in a captivating way. Mike Benton also shares many personal anecdotes, which give a less theoretical approach than other more conventional books on dinosaurs.

The author starts with one of them in the Introduction, the exciting discovery of melanosomes in the filamentous structure of the theropod *Sinosauropteryx*, which provided information on the color of a Mesozoic dinosaur for the very first time. The author then follows with a reminder of what science is and describes the new testable methods recently introduced to the world of Paleontology, transforming this field from a historical science, mainly relying on Victorian concepts and untestable speculations, to a thoroughly scientific field which answers questions by testable means. In the first chapter, logically dedicated to the origin of dinosaurs, the reader learns about the three-step process of early dinosaur diversification: their origin in the Early Triassic in the maelstrom of recovery from the Permian-Triassic mass extinction, their explosive radiation following the Carnian Pluvial Episode in the Late Triassic, and their diversification in the Jurassic following their survival to the end-Triassic mass extinction. This chapter enables the author to explain how the dinosaurian diversification is dated and ancient climates are identified, and to introduce some computational methods such as morphospace and breakpoint analyses. In the following chapter on dinosaur classification, the reader learns about the cladistic revolution initiated by German entomologist Willi Hennig in 1950 but applied to dinosaurs only in the 80's. This chapter also presents a historical account on dinosaur classification using the pelvis morphology, discusses the major dinosaur faunas from the three periods of the Mesozoic (Triassic, Jurassic, and Cretaceous), explains the concepts of dinosaur supertree and the Cretaceous Terrestrial

Revolution, and talks about the new hypothesis on dinosaur classification (the Ornithoscelida model) presented in 2017. The third chapter is all about how paleontologists find dinosaurs. The author uses his personal experience in Alberta in 1978 to explain how dinosaur bones are found, protected, and extracted from the rock in the field, prepared in the laboratory, and finally mounted to be exposed in a museum. The recent methods to study and visualize dinosaur bones such as CT scanning is also presented in this chapter, as well as the utility of dinosaurs in education using the example of the Bristol Dinosaur Project. In the fourth chapter on dinosaur physiology and ecology, Mike Benton provides answers on several highly debated topics such as whether dinosaurs were warm-blooded or cold-blooded, intelligent or stupid. The author also presents the current knowledge on dinosaur bone histology, bird and feather evolution, and the colors of dinosaurs. In the following chapter, Mike Benton tackles the hypothesis of re-creating dinosaurs using ancient DNA, an idea brilliantly formulated by Michael Crichton in his bestseller *Jurassic Park*. The reader learns about how paleontologists managed to extract blood vessels, skin cells, and portions of nerves in the bones of a 66-million-years-old *Tyrannosaurus* and identified the sex of fossil birds using the presence of medullary bone. Dinosaur growth, dwarfism and gigantism are discussed in Chapter 6, which explains why dinosaurs grew particularly fast and how some of them could reach such an enormous size. In Chapter 7, on the diet of dinosaurs, Michael Benton praises the work of his colleague Emily Rayfield, whose investigation on dinosaur functional biomechanics using Finite Element Analysis (FEA) revolutionized the field of dinosaur feeding ecology. The reader is also introduced to the work on tooth histology and crown microwear, food web reconstruction, and feeding niche division. Chapter 8, on dinosaur locomotion, is an homage to the work of pioneering scientists R. McNeill Alexander and John Hutchinson. The reader learns about how the former succeeded to provide a formula to estimate the speed of a dinosaur from its trackway, and how the latter managed to accurately reconstruct the musculature and locomotion of dinosaurs by dissecting living birds and crocodiles. Mike Benton additionally presents a historical perspective on the posture of dinosaurs, explains the utility of the reduced forelimbs of some theropods, and shows that some dinosaurs were able to swim and fly. This chapter concludes with a discussion on the evolution of flight in maniraptoriforms and the

accuracy of dinosaur reconstruction in film, using his experience as a scientific consultant on the BBC documentary *Walking with Dinosaurs*. Chapter 9, on the extinction of dinosaurs, concludes this book. This chapter tells the captivating story of the theory of the impact of a meteorite proposed by the Alvarez *père et fils* in 1980 to explain the Cretaceous Paleocene Mass Extinction Event 66 million years ago, the discovery of the crater eleven years later, and the acceptance of this extra-terrestrial hypothesis by a highly reticent paleontological community. Mike Benton explains the suddenness of this catastrophic event, why some birds survived this mass extinction, and how mammals took over following this event.

Each chapter is illustrated by several photos, graphics, or technical figures in color, which sometimes cover two pages. Two to five technical fact sheets of the most important archosauromorphs (e.g., *Hyperodapedon*, *Silesaurus*, *Centrosaurus*, *Parasaurolophus*, *Brachiosaurus*, *Anchiornis*), which provide basic information on the age, location, classification, size as well as an illustration and a little-known fact on the taxon in question, also accompany each chapter. Fourteen plates are additionally included in two sections of the book. An appendix with a list of all the published hypotheses for the extinction of dinosaurs as well as a list of the most relevant publications for each chapter, are also provided at the end of the book. This publication is captivating, easy to read, and covers the subject very well, yet, it is not flawless. Some subjects such as those on the evolution of feathers and the physiology and ontogeny of dinosaurs are treated a bit superficially. I, for instance, find regrettable that the book does not mention the extreme ontogenetical changes displayed by some dinosaurs such as *Limusaurus* and *Pachycephalosaurus*, the semi-aquatic habits of other dinosaurs based on isotopic studies and/or anatomical adaptations (spinosaurids, *Halszkaraptor*), the evidence of burrowing in some ornithischians, and the head-butting interaction in adult *Pachycephalosaurus* based on FEA studies. Pachycephalosaurs are also largely omitted in this book, whose author's attention is often focused on saurischians. In the section on forelimb reduction in theropods, the example of the possible myrmecophagous alvarezsaurids would have been a welcomed addition. Likewise, the author explains why some birds survived the Cretaceous Paleocene Mass Extinction Event but omits to do the same for mammals, crocodiles, turtles and lizards. What appears to be an

editorial omission is the fact that the paleomaps accompanying each technical sheet do not provide the precise location of the taxon in question. Other minor flaws include the difficulty of finding some plates when reading the text as the pages of the plates have not received any number and the fact that the dinosaurs from the Morrison Formation of USA (*Brachiosaurus altithorax*, *Allosaurus fragilis*, *Stegosaurus stenops*, *Diplodocus carnegii*) are said to be present in Tanzania, which is incorrect. Finally, as a Belgian paleontologist living in Argentina, I note that the book is very much British-centered. The large majority of the advances in Paleontology presented in this book were being done by British scientists or in the UK. That being said, the book well-covers a subject mastered by its author in a serious, accurate, and entertaining way, and I believe that the text can be well-understood and easily followed by novices in the field of Paleontology. Dinosaurs enthusiasts like

me will definitely enjoy reading this book and most likely learn many new things. I have spent the past ten years of my scientific career studying dinosaurs, which did not prevent me from learning a large amount of information. Learning that the asteroid impact happened in June was, for instance, a nice surprise! Finally, the book is particularly cheap (16.95\$ in paperback in Amazon) for a publication of this size and quality. In summary, if you like dinosaurs and wish to have an excellent overview of the latest research in the field, I would highly recommend you buy this book, which is definitely for you.

Christophe Hendrickx

Unidad Ejecutora Lillo
CONICET-Fundación Miguel Lillo
Miguel Lillo 251
San Miguel de Tucumán
4000 Tucumán
Argentina