Secret Chambers: the Inside Story of Cells and Complex Life.

Author: Zhaxybayeva, Olga

Source: BioScience, 62(11) : 997-998

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1525/bio.2012.62.11.12

recommended for undergraduate students just learning, for example, the difference between crown and stem groups. Even specialists who may lack a firm grasp of the evolutionary history of marine mammals can find space on their bookshelf for this volume. Given that marine mammals are one of the most widely used examples of major evolutionary transitions—with numerous intermediary fossils bearing now-lost limbs and other former features—most biologists and educators will view this evidence-based book to be as useful as it is stimulating.

Return to the Sea covers a lot of ground. Lessons are presented on the biology of seals, whales, sea otters, polar bears, and other marine mammals living and extinct, with excellent coverage given to basic anatomy, physiology, ecology, and behavior. Lavish illustrations of long-gone species, especially Carl Buell's softly shaded yet detailed paintings of fossil reconstructions and James Sumich's crisp line drawings, are compelling. The highlight and theme of the book, however, is the discussion of the many factors involved in the origin and radiation of various marine mammal lineages. Berta's expertise in paleontology substantiates her accounts of the different species through time, which ties the expansive material in the book together.

It is Berta's presentation of these lineages that directs the book toward the fundamental concepts of evolution within speciation, exaptation, and extinction. She uses marine mammals as the cast of characters with which to demonstrate such ideas as paedomorphosis (in porpoises), mating leks (in walruses), and regulatory *Hox* and *PITX1* genes (presumably relating to the loss of limbs). There is also a heavy dose of oceanography, including upwellings, the deep scattering layer, and marine sanctuaries, but the marine mammals take center stage. Berta moves briskly through the anatomical descriptions of these creatures, from lobed kidneys to compartmentalized stomachs, then onto their vocal communications (e.g., pops, clicks, and whistles).

Although a bibliography is absent, the book ends with a slim list of recommendations for further reading, which contains excellent online sources. The book is not without errors, including some mistaken figure captions. One switches the families of whale and megamouth sharks; another misidentifies an ancient giant dugong. Readers unfamiliar with all of the living marine mammals described in the text would have been well served by a table (or an appendix) listing extant species or by additional evolutionary tree diagrams. Most of all, I found myself wanting richer descriptions, and especially more illustrations, of lesser-known fossil species, including desmostylians and aquatic sloths. These are minor quibbles, however, particularly for such a wide-ranging, readable survey.

In some ways, Berta's book is reminiscent of Carl Zimmer's equally recommended *At the Water's Edge: Fish with Fingers, Whales with Legs, and How Life Came Ashore but Then Went Back to Sea* (Free Press, 1999), although Zimmer's book delves into many asides, has few figures, and is now a bit outdated. The information in *Return to the Sea* is admirably up to date, in terms of both paleontological findings and current research methods, which range from satellite telemetry to DNA barcoding and fingerprinting. An entire chapter is devoted to fossil dating techniques and other key elements of paleontology; another is focused on conservation issues, especially those involving human impacts (e.g., anthropogenic sound, fisheries bycatch, strandings, military sonar). This last of six sections reveals many recent discoveries, some of which are optimistic (e.g., whales may play a key role in marine nitrogen recycling) and some alarming. Sea lions are now threatened (from overfishing) by a junk-food diet that lacks fatty fish. Climate change threatens ice-bound algae that feed krill, which, in turn, feed many whales and other marine mammals.

Berta explains that the first marine mammals likely turned to the sea in search of food. It would be a shame if a lack of food now doomed these remarkable creatures. Then again, perhaps resources might now lure some species back onto land, continuing—with a new twist—the long and enthralling evolutionary story of marine mammals.

ALEXANDER J. WERTH
Alexander J. Werth (awerth@hsc.edu) is Venable Professor of Biology at Hampden-Sydney College in Hampden-Sydney, Virginia.

doi:10.1525/bio.2012.62.11.11

THE MYSTERY OF EUKARYOTIC CELL ORIGIN

Secret Chambers: The Inside Story of Cells and Complex Life. Martin Brasier. Oxford University Press, 2012. 298 pp., illus. $29.95 (ISBN 9780199644001 cloth).

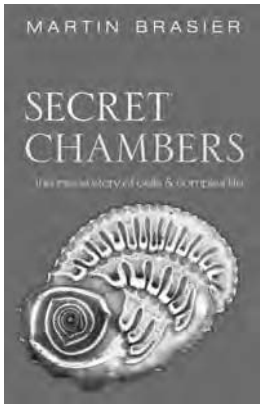
A scientific question can be viewed as a puzzle, and a book about a scientific discovery can be written as a puzzle revealed. Martin Brasier's new book, *Secret Chambers: The Inside Story of Cells and Complex Life*, is presented as a detective's quest for answers to one of the great scientific mysteries: How did a complex compartmentalized (i.e., eukaryotic) cell originate and evolve into the many diverse life forms that we see today? In this search, the book uniquely takes both the reader

and the author to evolutionary events that occurred billions of years ago.

Time travel is a usual pastime for Brasier, who is a professor of paleobiology at the University of Oxford and a global hunter of fossils that span the Archaean and Proterozoic eons. Entertaining autobiographical notes of his field trips add to the adventurous mood of the book's narrative.

As with any good mystery novel, *Secret Chambers* entices its readers with multiple parallel and, at first, seemingly unrelated stories: surveys of coral reefs in the world's oceans, a close examination of algal and foramineran cellular structures, and a study of mass extinction patterns throughout Earth's geological history. After a brief historical foray into England during the Age of Enlightenment and later, during the Victorian era, to meet Robert Hooke, Charles Darwin, Robert Brown, and Charles Lyell, we are teleported aboard the HMS *Fawn* in the Sargasso Sea, where Brasier served as the ship's naturalist in 1970s. Here, we are introduced to a complex cell's internal structure, and we are faced with questions pertaining to its origin: Which events led to the creation of cellular compartments? When and where did it happen? Why did it happen only a few times, and why only in the distant past? What fossil evidence supports our conjectures? Answers to these questions eventually converge from the multiple threads of the narrative, although, as with many scientific investigations that are still in progress, we are left with only a partial and speculative understanding.

I applaud Brasier's attempts to explain complex topics with poetic and vivid metaphors, but I take note of some oversimplifications and mistakes that crept into these analogies. For example, when the author compares a mitochondrion to a ship's engine, he describes the burning of adenosine triphosphate (ATP)—the cell's "fuel"—as taking place within the organelle to release energy. In fact, the opposite happens there: ATP is made to trap the energy that is created from the oxidation of carbohydrates, fats, and amino acids. In the analogy of the Tree of Life using a mangrove, living entities are presented in a progression from bacteria (i.e., the roots of the mangrove) to animals and plants (i.e., the branches of the mangrove). Although the analogy helps to illustrate the multiple bacterial contributions to the eukaryotic cell, the Mangrove of Life has a greater resemblance to the genealogical view of eukaryotic ancestry than to contemporary visions of the Web of Life (Ragan 2009).



Another misstep of the book is that although the origin of chloroplasts is thoroughly covered, the origins of the mitochondrion and the nucleus are mentioned only in passing. It is the origin of the mitochondrion, however, that is at the crux of the ongoing eukaryogenesis debate, because many eukaryotes do not have chloroplasts, but they virtually all have mitochondria. The book's focus on chloroplasts leads to Brasier's failure to present the differing sides of the argument, a point of contention fueled in part by genomic and phylogenetic data and involving two rival models—the phagotrophy model, in which a protoeukaryote engulfs a bacterium, and the syntrophy model, in which an archaeon and bacterium merge to form a new type of cell (O'Malley 2010). Without mentioning this ongoing rivalry between two conceptually different eukaryogenesis propositions, Brasier inadvertently hides part of the history of the eukaryotic cell from the reader.

All flaws aside, *Secret Chambers* achieves what the author intended. It is a lively, partly historical, and mostly personalized account of the quest to understand the evolutionary history of the eukaryotic cell. Designed for the lay reader, the book also can be inspirational to high school and undergraduate students. Brasier weaves side discussions throughout his book about the usefulness of knowing how various approaches can be employed by scientists in order to find solutions to the puzzles of scientific queries. It is most likely Brasier's hope that students of various majors will read *Secret Chambers* and learn how the combined fields of paleontology, biology, evolution, and mathematical modeling contribute to the investigation of the origin of the eukaryotic cell.

doi:10.1525/bio.2012.62.11.12

Acknowledgments

J. Peter Gogarten (University of Connecticut) is thanked for his comments and suggestions.

References cited

O'Malley MA. 2010. The first eukaryotic cell: An unfinished history of contestation. Studies in History and Philosophy of Biological and Biomedical Sciences 41: 212–224.

Ragan MA. 2009. Trees and networks before and after Darwin. Biology Direct 4: 43.

OLGA ZHAXYBAYEVA

Olga Zhaxybayeva (olgazh@dartmouth.edu) is an assistant professor of biological sciences at Dartmouth College, in Hanover, New Hampshire. She leads a research program that is focused on the characterization of microbial evolutionary processes through comparative genome analyses.

A MARKETING TOOL KIT FOR SCIENTISTS

Marketing for Scientists: How to Shine in Tough Times. Marc J. Kuchner. Island Press, 2011. 248 pp., illus. $19.95 (ISBN 9781597269940 paper).

Ever wonder why automotive engineers design car doors to produce a particularly solid-sounding