

## Book Reviews

modern manatees and dugongs, during the early Eocene epoch around 50 million years ago, mostly focusing on ancient, four-legged cetaceans called archaeocetes. Here, Berta deftly weaves historical narratives and the work of specific researchers into descriptions of key fossils and their characteristics. This pattern, which continues in subsequent chapters, effectively integrates the scientific process of discovery into the encyclopedic knowledge of marine mammal history. Chapter 3, the longest chapter in the book at 56 pages, continues to focus on cetaceans, discussing many of the trends that arose after cetaceans were living full-time in the water, and elucidating the details of every group of cetaceans that has existed, including both toothed whales and baleen whales. In chapter 4, Berta moves on to discuss her other main area of expertise: the evolution of pinnipeds. She discusses all major groups of pinnipeds, both living and extinct, in a fair amount of detail, as well as highlighting different hypotheses for how all of these different groups are related to one another. Chapter 5 discusses later sirenians, which were first introduced in chapter 2, along with a completely extinct group of marine mammals called desmostylians, which were plant-eating, hippo-sized mammals that were restricted to the northern Pacific Ocean during the late Oligocene to middle Miocene epochs about 10–30 million years ago. Chapter 6 rounds out the roster of marine mammals, including discussion of polar bears, sea otters, and a radiation of extinct marine sloths from South America.

Berta concludes the book in chapter 7 with a discussion of how climate and human activity have affected the diversity of marine mammals through time. Topics include climate-related shifts in geographic distribution, the effects of habitat loss, and changing food webs. She also discusses the impetus for studying the dynamics of marine mammal evolution through time, as this work provides valuable information for helping us to evaluate the ecological changes we see happening in the world's oceans today. Following this concluding chapter, there are 20 pages that provide an exhaustive list of marine mammal taxa, a three-page glossary, 14 pages of references to the primary literature (sorted by the chapter in which they were cited), and a six-page index.

Throughout the book, Berta's expertise is on display, showing an excellent grasp of both older and newer literature for all groups of marine mammals. There are a few minor errors in figures related to labeling phylogenetic trees, but most of the summaries are accurate, fair, and up-to-date. However, the way this book handles contentious issues among marine mammal paleontologists is a bit uneven. For instance,

her discussions of pinniped relationships do a nice job of describing competing hypotheses and areas of uncertainty, whereas interpretations of swimming behavior in some key early cetaceans are presented uncritically despite the fact that there is some debate in the literature.

But these minor quibbles do little to detract from this book's strengths. *The Rise of Marine Mammals* covers the breadth of marine mammal evolution while highlighting the key details. It discusses what we can learn from the fossils within a context that makes the reader feel as if he or she is part of making these discoveries. In exploring the changing ecologies of marine mammals over the past 50 million years, Berta provides insights into the dynamics of our world's oceans, both past and present. This visually stunning, yet informative, book should serve to inspire its readers—not only to give them a sense of awe and wonder at the marvelous diversity of marine mammals in eons gone by, but also to push them to preserve and steward the remarkable creatures that live in our seas today.

*Reviewed by Ryan M. Bebej, Calvin College, Grand Rapids, MI 49546.*



## ENVIRONMENT

**THE CARBON CODE: How You Can Become a Climate Change Hero** by Brett Favaro. Baltimore, MD: Johns Hopkins University Press, 2017. 220 pages. Hardcover; \$22.95. ISBN: 9781421422534.

*The Carbon Code* is a manual for action. Chapter 1, "The Cost of Carbon," gives a quick overview of the indisputable reality of human-caused climate change and its various effects on planet Earth. The rest of the book focuses on what we, mainly as individuals, can do to solve the problem. Chapter 2, "Solutions Start with You," defends the idea that the cumulative impact of many individuals is significant. The middle section covers personal electricity use (chap. 4), transportation (chap. 5), diet (chap. 6), and long-distance travel (chap. 7), with practical tips for reducing one's carbon footprint. The last section is "Sharing the Carbon Code." In "Winning the Conversation" (chap. 8), Favaro gives tips for communicating with friends, family, coworkers, and community members about climate change and what we can do about it, culminating with a case for running for public office in order to advance the cause. Chapter 9, "Policies for a Pro-climate Future," outlines nine policies that climate change heroes should advocate: (1) a carbon tax or cap and trade price on carbon; (2) tougher regulations and the elimination of coal; (3) making climate change a priority in public policy; (4) eliminate fossil

fuel subsidies; (5) subsidize clean energy; (6) divest from the fossil fuel industry; (7) develop infrastructure for bicyclists; (8) promote electric vehicle (EV) infrastructure; and (9) worker retraining for the fossil fuel industry.

Brett Favaro is the academic director of the Fisheries Science graduate programs at the Fisheries and Marine Institute of Memorial University of Newfoundland. Favaro received his PhD in biology from Simon Fraser University in 2013, and was a 2013 Liber Ero conservation fellow at the University of Victoria. His research focuses on designing and implementing sustainable fishing technology to reduce commercial fishing's impact on the world's oceans. He is also interested in science policy. His research puts him face-to-face with the effects of climate change on the oceans.

There are few surprises in *The Carbon Code*. Favaro gives the environmentalist/conservationist party line on every issue, whether it be coal, EVs, nuclear energy, public transportation, reduced red meat/vegan diet, LED lights, less AC use, sweaters instead of the furnace, or cycling (and many more). This is not to disparage the book. It is, unapologetically, an advocacy book. As such it is a useful compendium of state-of-the-art actions that just about anyone can take to reduce one's carbon footprint. If you are a climate change skeptic, denier, or luke-warmist, you will not find any new arguments, but you will find a concise statement of the arguments for human-caused climate change and its impacts. Perhaps reading Favaro's version will convince you. At the same time, the actions that are outlined have benefits other than solving climate change. Some of these will save you money and launch you into a global economy that is embracing renewable energy, public transportation, and electric vehicles. Favaro's tips and policies can give you a head start in this new world even if you do not accept the main arguments for its existence.

Chapter 3, "The Carbon Code of Conduct," is perhaps the most novel. Favaro adapts moral guidelines from live animal research to provide guidelines for managing our carbon use. These guidelines were initially spelled out in 1959 by W. M. S. Russell and R. L. Burch in *The Principles of Humane Experimental Technique*. The four R's are reduce, replace, refine, and rehabilitate. The fourth R (rehabilitate) was added in 1999 as a result of the Indian government implementing policies to guarantee humane and ethical use of animals in research. The idea is that using animals in research is a necessary evil, of sorts, for human well-being. That being the case, we should adopt practices that minimize the suf-

fering of those animals used for such purposes. The comparison with carbon use is, at best, an analogy since the notion of suffering does not really transfer. However, the notion of damage does. If carbon use is damaging the planet, but is necessary for human well-being, we should adopt practices that minimize that damage. As applied to carbon use, the four R's are as follows: "Reduce your carbon use as much as possible"; "Replace carbon-intensive activities with those that use less carbon to achieve the same outcome"; "Refine the activity to get the most benefit for each unit of carbon emitted"; "Rehabilitate the atmosphere by offsetting carbon usage." If you have to use carbon, pay someone, somewhere, to do something to undo your use. Favaro calls us to make the following pledge:

I, \_\_\_\_, am making a personal commitment to solving climate change. I commit to applying the carbon code of conduct to my daily life and will reduce, replace, refine, and rehabilitate my use of carbon. I commit to convincing others to follow this code as well. I do this because of my love for the biosphere, my love for humanity, and my desire to live a healthy and sustainable life.

As we make this pledge, he argues that it will streamline our decisions in the same way that athletes' training and diet regimen streamlines theirs. Going to the gym for regular training is not a daily decision that must be made. You just do it. The carbon code of conduct becomes part of our personal ethic.

Each chapter of *The Carbon Code* has an excellent and very useful summary, usually 5–10 bullet points. *The Carbon Code* contains no graphs or charts. This seems to have been the publisher's decision. If there ever is a second edition, I would heartily recommend that some be included. The 2012 book *Cooler Smarter: Practical Steps for Low-Carbon Living* by the Union of Concerned Scientists, a book with a similar message, was full of helpful charts and graphics. I think such charts and graphs would have significantly enhanced the message of *The Carbon Code*. The copyright date of the book is 2017, but it seems a bit out of date already, especially with the change in the political climate.

While there was some discussion about nuclear energy, it seems that Favaro is ignoring the recognition by some environmentalists—for example, those represented in the 2013 Robert Stone documentary *Pandora's Promise*—that nuclear is a necessary component to a low-carbon future. Problems with solar and wind, such as intermittency, were mentioned but barely acknowledged. Storage and a smarter grid are recognized as solutions but there is little admission of the difficulty of developing these solutions to

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the point where we can move to 100% renewables. Issues of mining are mentioned as disadvantages of renewables, but renewables' dirty secret of toxic manufacturing and the tonnes of ensuing e-waste that will be upon us in a few decades is not mentioned. The problems of nuclear seem fewer and fewer when the big picture is considered. I would have liked to see more discussion of carbon capture, utilization, and sequestration (CCUS) technologies as a way forward. CCUS will allow the continued use of carbon at some level, but eventually will pave the way to a zero net carbon use. CCUS is going to be necessary to undo some of the damage that has already been done; namely, we must not only reduce carbon emissions, but we must also remove some of the carbon already in the atmosphere. And lastly, I think some mention of geo-engineering as a possible way forward would have been helpful.

One technical error worth mentioning is in chapter 2, where it is stated that the average person's carbon footprint globally is 4 tonnes per person. Of course, these numbers are hard to nail down, but with estimates of greenhouse gas levels at 50–55 Gigatonnes of CO<sub>2</sub> equivalents and 7.4 billion people on the planet, you get 6–7 tonnes per person. This makes the US footprint only three times the global average not four (still a disturbingly disproportionate amount).

While Favaro says there is still time to take care of climate change if we act soon, his general message was too apocalyptic for me. I am not sure that falling sky arguments are the best way to motivate the target audience to action. One memorable line from chapter 8 still rings in my head. "We need to be unafraid to react with disgust when someone denies climate change." Such language conveys his passion about the issue. It does little, I think, to move the conversation (and action) forward in a productive way.

*Reviewed by Terry M. Gray, Colorado State University; Front Range Community College; ASA Executive Council.*



## HISTORY OF SCIENCE

**THE GENE: An Intimate History** by Siddhartha Mukherjee. New York: Scribner, 2016. xi + 592 pages, including glossary, notes, selected bibliography, and index. Hardcover; \$32.00. ISBN: 9781476733500.

By now most enthusiasts of science history have at least heard of Siddhartha Mukherjee, whose initial venture into authorship, *The Emperor of All Maladies*, earned him the 2011 Pulitzer Prize for general non-fiction. While in his residency training in oncology, Mukherjee wrote his so-called "biography of cancer" with a voice of authenticity that only seems possible

for someone who is personally immersed in the story he is telling. But as Mukherjee himself admits, the exhausting experience of composing such a vast and personal story seemed to rule out the possibility that he would write another book on the history of scientific discovery. Thankfully, this turned out not to be the case.

Now a practicing oncologist and assistant professor at Columbia University Medical Center, Mukherjee has recently tackled another topic close to his heart, the development of modern genetics. Many of the best aspects of Mukherjee's second book, *The Gene: An Intimate History* (2016), reflect qualities that made his initial work an international best seller. Mukherjee excels at relaying fine detail without losing the broader context of his narrative, masterfully weaving his explanation of complex scientific concepts together with the stories of the people involved in their discovery. As one might expect, prominent figures such as James Watson and Francis Crick feature in this book, but so also do less famous individuals such as Theodosius Dobzhansky, who also contributed key pieces to the puzzle of modern genetics. One cannot separate the history of science from the actors that achieved the discovery, and in this respect the "biography of the gene" that we have today is inseparably connected to the idiosyncrasies of those who studied it over the past two centuries.

This is not to say, however, that Mukherjee's story is simply a celebration of human achievement through the power of science. *The Gene* is punctuated with frequent examples of scientific achievement placed side-by-side with miserable human failure, particularly when the emerging science of genetics was used as a tool to understand—or even engineer—society at large. Mukherjee carefully and honestly acknowledges the incredible evil that emerged alongside genetic science during the twentieth century, linking racism, Nazism, and the eugenics movement to errant interpretations of legitimate scientific discovery.<sup>1</sup> Human depravity is writ large in the history of genetic discovery, serving as a caution to those who want to see only this field as the panacea for humanity's ills.

In between the triumph of scientific discovery and the disaster of social engineering lies a significantly grayer area in which genetics intersects with behavioral psychology. Here the going gets a bit tougher—and more subjective—as the comfortable certainty of Mendelian genetics is blurred by the influence of environmental factors that are much more difficult to quantify. Mukherjee is especially engaging in this context and does not shy away from some of the more controversial aspects of genetics,