It would take us too far afield to consider each individual chapter. Let me begin with some general comments. Many historians of science have considered the relationships between science and religion. David Livingstone, for example, has identified four relationships: conflict, competition, cooperation, and continuity. John Brooke highlighted three in his insightful book, *Science and Religion: Some Historical Perspectives*: warfare, separation or complementarity, and intimacy. And there are many other descriptions, including Ian Barbour's familiar quartet: conflict, interdependence, dialogue, integration (referenced by Lightman, p. 80). Indeed, there is a broad expanse of relationships on offer: conflict, compatibility, complementarity, harmony (even "discordant harmony"), integrality, and a more holistic model. The first four relationships find expression in one way or another in this book. The latter two are hinted at by Gundlach in his discussion of Bernard Ramm's position regarding the direction of a person's heart in its response to God (p. 179). [For a further delineation describing the gesture of Christian scholarship as complementarity, integrality, and holistic, see Robert Sweetman, *Tracing the Lines: Spiritual Exercise and the Gesture of Christian Scholarship*; Wipf & Stock, 2016, reviewed in *PSCF* 70, no. 2 (2018): 133–34.]

As one examines individual chapters, we encounter increasing complexity in the science/religion relation: The Galileo affair (according to Finocchiaro) "displays various conflicts between science and religion, but also various harmonies between them" (p. 39). English Victorians in Lightman's interpretation often held different conflict theses and frequently opted for a discordant harmony. He also warns us to be sensitive to nuances: John Tyndall pitted theology but not religion against science, a partial philosophical reconciliation not present in Draper's thinking (p. 76). Brooke gives us a superb survey of the past 50 years of historians' accounts of science and religion. Harrison draws on the "neo-harmonists," Rodney Stark, Denis Alexander, and Francis Collins, to display the difficulties in properly describing and understanding a person's take on the science/religion relation. In their chapter, Numbers and Hardin conclude that the new atheists display a remarkable lack of historical analysis in their arguments for the conflict between "organized religion" and science (p. 233). One of the salient contributions of *The Warfare* is to trace what occurred in various communities, including Jewish, Muslim, Eastern Orthodox, Roman Catholic, liberal and evangelical Protestant. In the last chapters in the book, sociologists analyze the response to and perpetuation of the warfare thesis by professional scientists (in different international contexts), by social scientists (particularly sociologists and anthropologists), and by "people on the street."

A final observation: One needs to be concerned about the conflation of religion, theology, and faith that is present in some of the chapters. Clearly, they are not the same. But that is not always clear in the accounts presented. If one holds that religion is a way of life that people engage in with their full existence and at all times, while faith is one of a number of fundamental modes of being religious, a different way of telling the story follows. The socio-cultural endeavor of science can be religious. But could it ever be irreligious? If not, then the question becomes what religion or religions does scientific activity and practice bear witness to. That manner of relating science and religion is much different than seeing religion solely lived out in theology, ecclesiastical and parachurch organizations, or cultic groups. Perhaps there is an opportunity to go beyond trying to live in two worlds at once?

For readers of *PSCF,* this is a book worthy of reading, digesting, and emulating in its close analysis of science and religion. *The Warfare* will give the reader a trustworthy account of the most recent scholarship about the religion science nexus. As Livingstone and Noll conclude in their introduction, *The Warfare* may help "clear the smoke of a battle that has never really existed so that meaningful work can proceed" (p. 5).

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THE GENE: From Genetics to Postgenomics by Hans-Jörg Rheinberger and Staffan Müller-Wille, trans. Adam Bostanci. Chicago, IL: University of Chicago Press, 2017. 147 pages, including contents, acknowledgments, bibliographical references, and index of names. Paperback; $25.00. ISBN: 9780226510002.

Each year, while preparing to teach a course in genetics, I pause when I reach the definition of "gene" in my lecture notes, wondering if the definition accurately captures the concept of the gene as it is currently understood. In *The Gene: From Genetics to Postgenomics*, science historians Hans-Jörg Rheinberger and Staffan Müller-Wille demonstrate that our understanding and characterization of genes is evolving and, furthermore, that "a simple and universally accepted definition of the gene never existed" (p. 4).

The changing concept of the gene is a common theme in genetics, frequently featured as a thread woven throughout textbooks and serving as a source of vigorous discussion among scientists. As a result, many

have noted the multitude of definitions associated with the term "gene"—a heritable unit factor that determines observable traits, a DNA sequence that carries instructions for making a protein, to name just two. This book is unique in its placement of these shifting concepts in a robust historical context. Readers are challenged to consider the ways that contemporary theories and technologies influenced conclusions drawn about the nature and function of genes at different moments in time.

Rheinberger and Müller-Wille describe their book as "a historical survey of the century of the gene." Indeed, readers are taken on a chronological journey that begins in the nineteenth century with Charles Darwin's theories about inheritance and ends in the data-rich postgenomic present. Along the way, the authors summarize the key findings of scientists that have challenged prevailing gene concepts, and they reference prominent science historians and philosophers of science as they consider the context of these findings and their influence on understandings of the gene. Throughout the book, the authors highlight techniques and technologies that were instrumental in advancing the field of genetics. From Mendel's hybrid crosses, to cloning toolkits, to databases that enable storage and retrieval of entire genomes, technological innovations have made it possible for scientists to interrogate and uncover new aspects of the character of the gene.

In the opening chapter of *The Gene*, Rheinberger and Müller-Wille present the primary aim of their book: to reframe the potentially unsettling lack of clarity that characterizes our current understanding of the gene by examining the history of the gene concept and the dynamism that has surrounded this concept throughout the history of genetics.

Chapter 2 describes the various theories of inheritance proposed by nineteenth-century scientists that laid the foundation for the development of the field of genetics. In the next three chapters (chaps. 3–5), Rheinberger and Müller-Wille turn their attention to classical genetics. They describe Mendel's elegant experimental system and findings and explore why their significance was not realized until many decades later. A review of the ways that the rediscoverers of Mendel's work interpreted the result of crossing experiments, indicates that, even among the first generation of geneticists, a uniform gene concept did not exist.

Chapters 6 and 7 describe the transition from classical to molecular genetics and the technological advances that made this shift possible. Biophysical and biochemical techniques were used to identify the chemical nature of the genetic material, decipher the genetic code, and uncover the cellular processes responsible for gene expression. The authors note that while the "molecularization" of genetics initially simplified the definition of a gene, it ultimately added layers of complexity to the gene concept. These chapters also explore the characterization of genes and technical objects and commodities as a result of the introduction of gene-editing technologies.

Chapter 8 examines the relationship between genetics, development, and evolution. Viewed through the lens of molecular genetics, critical linkages are found among these fields of study. Chapter 9 is devoted to a discussion of the postgenomic gene concept. Rheinberger and Müller-Wille suggest that in an era of epigenetics and complex systems biology, the role of the gene as the sole determinant of inheritance and its status as the fundamental unit of life have been deflated.

The book concludes in chapter 10 with a thoughtful discussion of the value of the gene concept in the postgenomic era. Though highly dynamic and lacking definitional clarity, the gene concept will continue to serve an important role as a device that prompts experimentation and thereby advances knowledge.

The last chapter is followed by a 20-page bibliography of history of science and philosophy of science references that will serve as an excellent resource for readers interested in further study. An index of names, found at the end of the book, enables readers to quickly locate mentions of individual scientists in the text.

The authors of *The Gene* assume that readers are familiar with genetics terminology and have a foundational knowledge of genetic mechanisms. Familiarity with ontological and epistemological considerations as they relate to the life sciences are also assumed. As a result, this book would not be appropriate for a general audience. [For a comprehensive and entertaining review of the history and future of genetics that is suitable for general audience, I recommend Siddhartha Mukherjee's book, *The Gene: An Intimate History* (New York: Scribner, 2016)].

For those with an interest in the ever-changing field of genetics, Rheinberger and Müller-Wille's book, *The Gene: From Genetics to Postgenomics*, provides a well-researched account of the history of the gene, and of the scientists and technologies that have continued to challenge and expand our understanding of the term "gene." This book will also serve to inspire awe as readers have the opportunity to consider the ways

that "each new meaning of the gene created an additional dimension along which life could be imagined to vary and unfold" (p. 4).

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Origins

THE TANGLED TREE: A Radical New History of Life by David Quammen. New York: Simon & Schuster, 2018. 461 pages. Hardcover; $30.00. ISBN: 9781476776620.

Many ASA members have spent years and spilled metaphorical blood over this or that detail of the story of evolution and the origin of life, which we all agree is God's marvelous creation. Well, wouldn't it be good to have a book that highlights the debates not among onlookers to the field of biology, but among those actually working and publishing in the field? We now have such a book. *The Tangled Tree* covers humanity's place in the created order of cellular life forms, stretching from the premolecular days of Ernst Haeckel to modern times, when we can quite literally read the instruction book of any and every kind of cell. David Quammen's book is of interest to ASA members as it tackles one of the very biggest questions in biology: "What is the shape of the tree of life?" Such trees have been produced over the years, but the central character of this book, Carl Woese, claimed that he had discovered a more correct, truer tree than had been ever produced before, to the surprise of many in the field. Many believe that Woese deserved a Nobel Prize for his discovery, and yet, most people have never heard of him.

Quammen's skill comes in bringing together key players and voices in the topic at hand and extracting revealing and key quotes in his clear paragraphs and short chapters. We are permitted to go behind the scenes with Quammen as he recollects his own learning experience. The fact that Quammen trained as a writer and not in science helps him render these insights in ways that not only are comprehensible to nonscientists, but are also helpful to biologists (such as me) who have significant background knowledge.

I recall teaching on the relationship between bacteria, archaea, and our own types of nucleated cells, and referencing Carl Woese (pronounced "woes") and his colleague Norm Pace, who first identified the third branch of life now known as archaea, previously assumed to be bacteria based on appearance. It is no surprise within the life science field to be teaching material that was totally unknown during one's own training, and this book serves to highlight the pace of change. The 1970s seem like ancient history, and in a sense they are. However, it is still possible to interview primary players in the field, and so Quammen does a great service in stirring up these waters. As far back as I can remember, I have always emphasized to my students that the group that textbooks call "prokaryotes" is really not a "true" group, being made up of bacteria and archaea; that the archaea are in many key ways more closely related to humans than to bacteria. And so, using "prokaryote" is directly analogous to grouping butterflies, birds, and bats into a single group. Sure, it might at times be useful to have a group called "flyers," but that name tells nothing of their true relationships, which is what biologists and scientists should strive to ascertain. Further, it creates new problems. Where do penguins fit? What about flying squirrels? Another topic of great interest to my undergraduate students is the concept of endosymbiosis: mitochondria once existed free-living in the bacterial branch of life's tree; and at a time in the impossibly distant past they became symbiotically, irreversibly associated with another cell. As many biologists know, Lynn Margulis is credited with this big hypothesis, which was quite controversial at the time and was not readily accepted by the mainstream of scientists who favored other explanations.

So, what a pleasure it has been for me to peek behind the curtain and learn that it was not Lynn Margulis who originally had the idea of endosymbiosis, and to learn much more about the central character of the book, Carl Woese, who doggedly pursued the big questions of biology without getting lost in the minute details. Quammen spends the first third of the book setting the stage for Woese's entry by a concise retelling of the discovery of the gene by Watson and Crick, and of Crick's prescience in speculating that the sequences of long molecules (DNA, RNA, protein) might provide insights into ancestral relationships among living organisms. Yes, from the earliest days of obtaining sequence information, some forward-thinking scientists realized that the order of subunits within our long molecules, since they are inherited, provide a window on the past—a remarkable insight.

And so Quammen's book is actually a book about molecular phylogenetics. It is a book about a field which provides, many would argue, a truer picture of how living species are connected to each other, based on inherited sequence information. It relates the story of how Woese and colleagues selected one particular molecule to focus on, and based on that choice, produced what Woese argued was the true tree of life with three ascending branches: bacteria, archaea, eukarya. And yet, this is a scientific