

INTERSECTIONS OF SCIENCE AND SOCIETY

On Trial for Reason: Science, Religion, and Culture in the Galileo Affair. By Maurice A. Finocchiaro. Oxford University Press. (ISBN 978-0-19-879792-0). 289 pp. Hardcover, \$32.95.

As science educators, we experience the intersection of science and culture every time we talk with a student whose personal beliefs conflict with scientific knowledge. Outside of the classroom, we witness politicians and other influential people who doubt, distrust, or even condemn scientists and the knowledge they produce. Conflicts can arise when there is misalignment between science and one's religion, politics, or worldview.

If we consider the history of science, Galileo's trial in the 17th century was certainly not the first conflict between science and culture, but it was

perhaps the most prominent and its effects the most long-lasting. In *On Trial for Reason*, historian Maurice Finocchiaro provides a nuanced and thoughtful analysis of the trail of Galileo, including the issues that preceded it and those that continue today.

In 1633, Galileo was convicted of heresy by the Catholic Inquisition for his empirical defense of the Copernican idea that the Earth rotated on its axis and revolved around the Sun (these perspectives are known as geokinetic and heliocentric, respectively). As a result of the trial, Galileo's published work was banned and Galileo himself was sentenced to house arrest for the remainder of his life.

On Trial is more than a historical retelling. It is a reflection on empiricism and the defense of scientific knowledge. It is about the conflict between innovators and those who cling to the past. It is also a rich historical analysis of an influential event that occurred during the nascent years of the scientific revolution. And yes, it is about the conflict between science and religion. But as Finocchiaro reveals, the conflicts between Galileo and the Catholic Church have since dissipated (more on that below).

On Trial is intended for a general audience, but it teeters between scholarly manuscript and popular nonfiction. The writing style is formal, the arguments sometimes esoteric, and the passages redundant at times. But Finocchiaro does a great job of explaining complexities to a lay audience, clearly with the intent of promoting deeper understanding. Such awareness is required to understand the nuances of Galileo's trial, which involved theological, scientific, and epistemological arguments.

For the most part, *On Trial* is written chronologically. After a brief overview of the entire Galileo affair, it backtracks to an earlier time when a dying Copernicus published his revolutionary model of a geokinetic and heliocentric universe. Copernicus, however, provided no

rigorous empirical defense for his ideas and so they languished. It would be another 89 years until Galileo published his defense of Copernicus, thanks to his telescopic discoveries, and this finally gave the geokinetic and heliocentric model the scientific support it needed.

Finocchiaro dispels the notion that Galileo's trial is a simple conflict between science and religion. For example, the Church was not united in its condemnation of Galileo. Several prominent theologians sided with him, even publishing their own pro-Copernican ideas. Interestingly, prior to his trial, Galileo had a personal and amicable relationship with the very pope who would later condemn him. Additionally, there were many sensible concerns about the scientific details, in addition to novel epistemological questions such as "whether artificial instruments like the telescope have any legitimate role in the search for truth."

On Trial recognizes Galileo as a pioneer in empiricism and critical thinking, a discoverer of astronomical observations and physical laws, and an important figure in the scientific revolution. Finocchiaro writes that Galileo advocated "the principle of autonomy, according to which scientific investigation can and should proceed independently of scripture." Galileo had reverence for scripture and was deeply hurt by his conviction for heresy. In preparing for his trial, he crafted theological arguments for his principle of autonomy. He was condemned for this and for his Copernican ideas that contradicted a literal interpretation of the Bible.

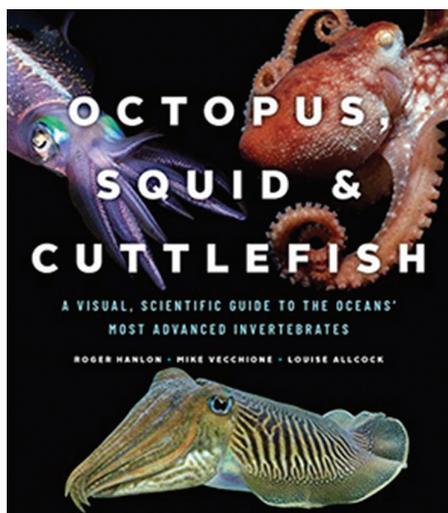
The irony is that Galileo was right on both accounts. The Earth does move around the Sun, and scripture does not have authority on scientific claims. Both were ultimately recognized by the Church. In the 1990s, for example, Pope John Paul II (who was posthumously declared a Saint) voiced support for Galileo's theological arguments, while bemoaning Galileo's trial as an injustice. Finocchiaro writes, "The Galileo affair displays

not only conflicts between science and religion, but also harmonies between them. It embodies the complexity of the relationship between the two, as well as the way in which conflict and harmony can co-occur.”

On Trial is recommended for biology educators, upper-level undergraduates, and graduate students seeking a nuanced case study that demonstrates the complex ways in which science, religion, and culture can intersect.



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MARINE SCIENCE: CEPHALOPODS

Octopus, Squid & Cuttlefish: A Visual, Scientific Guide to the Oceans' Most Advanced Invertebrates. By Roger Hanlon, Mike Vecchione, and Louise Allcock. 2018. University of Chicago Press. (ISBN 978-0-226-45956-1). 224 pp. Hardcover, \$40.

Fascinating, alien, complex, and intelligent, cephalopods are among the most interesting creatures on Earth. Written by an international team of cephalopod experts, *Octopus, Squid & Cuttlefish* presents an informative and visually stunning overview of this amazing group of creatures. Each chapter contains two main sections. The first half of each presents aspects of cephalopod biology covering five overarching topics: “Cephalopod Anatomy,” “Phylogeny & Evolution,” “Peculiar Lifestyles” (reproduction, development, locomotion, migration, and other topics), “Behavior, Cognition & Intelligence,” and “Cephalopods & Humans.” The discussion of

each subject is brief, as is appropriate for a general overview text such as this. The remainder of each chapter is devoted to several double-page spreads of representative species. Beautiful, richly colored full-page photographs provide portraits of each species presented. The text is informative and readable, and generously illustrated with clear and useful diagrams.

Cephalopod biology is so unusual that almost every page of the overview section reveals interesting biology. A discussion of the biochemistry and anatomy of cephalopod skin gives readers an understanding of how squids and octopus can display a vast array of colors and skin textures for communication and camouflage.

A section on “Dwarfs & Giants” presents the vast adult size range, which is greater than that of any other animal on Earth; included in this section are the mysterious and mythic giant and colossal squids. A section on locomotion presents the anatomical adaptations that allow for the many different methods by which cephalopods move through their aquatic environments: walking, swimming, jetting, and even flying. The section on behavior and intelligence is particularly fascinating, highlighting some of the characteristics that make this group of animals particularly unusual and unique. Within this section, readers will learn the details of communication by rapid changes in skin coloration; decision making processes (in mollusks!); the use of mimicry in some octopus species; and mating behaviors, including fights between males and sneaky cheating techniques for mating opportunities in both males and females.

The individual species profiles provide basic information for each group: a world map showing the species' range and a brief description of its classification, typical habitat, feeding habits, and other key behaviors. A full page of photographs gives the reader a look at each animal, often showing details of behavior and habitat as well. Finally, a two-paragraph discussion of each provides some more details about habitat, behavior, ecological niche, conservation status, and more. Here we find the magnificent giant Australian cuttlefish, the charming striped pyjama squid, the breathtaking blanket octopus, the “living fossil” vampire squid, and the rare shelled fuzzy nautilus, among many others.

Octopus, Squid & Cuttlefish provides an excellent overview of the world's cephalopods, detailed enough to be interesting and informative to a reader with a good biology background. Experts will probably want a more in-depth text. Students in biology, ecology, marine science, and animal behavior classes will all find value in this

book. Furthermore, anyone interested in biology, evolution, and adaptation will find perusing the pages of *Octopus, Squid & Cuttlefish* fascinating and rewarding.



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Kay, Ellie and Ari Two Scientific Girls and an Exceptional Bird



FOR YOUNG SCIENTISTS

Kay, Ellie and Ari: Two Scientific Girls and an Exceptional Bird. By Joel Hariton. Illustrated by Kate Hariton. 2019. LuLu.com. (ISBN 978-1-79477-915-0). 32 pp. Paperback, \$8.95.

I just received a copy of this beautifully illustrated book, which I plan to read to my grandchildren. It tells a wonderful, whimsical story that includes important messages and lessons that many young readers, especially girls, will find meaningful and encouraging. In the story, two girls are paying close attention to the wildlife and the natural world around them. They befriend a bird that learns to talk! They set out to learn all they can about why birds mimic sounds, including the words that their new friend has learned to use. The book also focuses on diversity, an important lesson that children should hear over and over. The story encourages young readers to be thoughtful about the mysteries they find around them and to be persistent in finding explanations for those mysteries. I am also impressed with how healthy interactions are modeled between children and adults in the story. I especially like the upbeat ending, but