

A major feature of this book is its diversity in subject matter and approach. While several chapters do cover similar general topics (especially agency, cognition, and teleonomy), the number of specific applications of these and other aspects of biological complexity is very large. For example, chapter 7 by Eva Jablonka and Simona Ginsburg looks at the evolution of purposeful behavior from unconscious teleonomy in lower animals to conscious expression of goals and desires by human beings. It covers an enormous field of psychological and neurological research.

I am not aware that any of the editors or authors are professing Christians – to my knowledge, none of them are active in international associations devoted to science and Christian faith. Modern movements to reform the dogma of neo-Darwinism are not (as some atheists have claimed) part of a Christian plot to undermine settled science. Every participant in this project affirms the reality of Darwinian evolution. Their purpose is to bring the theory up to date.

Evolution “On Purpose” is a useful resource for Christians invested in describing the harmony of science (biology in particular) with our faith. Given the major impact that it is likely to have, I expect that more books and articles aimed at the general public will be making appearances shortly.

Reviewed by Sy Garte, editor-in-chief of God and Nature magazine, author of Beyond Evolution: How New Discoveries in the Science of Life Point to God, and visiting professor at Rutgers University, New Brunswick, NJ 08901.

HISTORY OF SCIENCE

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THE REINVENTION OF SCIENCE: Slaying the Dragons of Dogma and Ignorance by Bernard J.T. Jones, Vicent Martínez, and Virginia Trimble. World Scientific Publishing Europe, 2024. 492 pages. Paperback; \$48.00. ISBN: 9781800613607.

The “dragons” referred to in the title are the old ideas that are often hard to get rid of as new scientific data come along, in particular things that were invented out of ignorance but apparently thought to be real. This comes from ancient maps that occasionally showed dragons in regions where little or nothing was known. One well-known example is the old idea that everything was made of the elements Earth, Air, Fire, and Water. The dogma and ignorance referred to are scientific, not religious. The authors reveal little or nothing about their personal religious beliefs (if any) and do not push anti-Christian or more generally anti-religion views.

Bernard Jones, emeritus professor at Kapteyn Astronomical Institute of the University of Groningen,

has worked in a variety of areas of astronomy, especially cosmology. Vicent Martínez, professor of astronomy and astrophysics at the University of Valencia, is a cosmologist who earned his degree under Jones at Cambridge. Virginia Trimble, professor of physics at the University of California, Irvine, has worked in various areas of astronomy and has written many reviews of astronomical research.

The book contains nineteen chapters in 361 pages, followed by extensive notes containing references and expansions of the information in the main text, as well as indexes of people and of subjects. It is probably not suitable for use as a textbook, but various sections might be used in courses on history or philosophy of science. One does not need to be an astronomer or physicist to read and benefit from the book, but some knowledge of science is useful, and more specialized knowledge is helpful (though not essential) in a few places. Readers with an interest in history or philosophy of science would probably find it interesting and informative. Those who primarily want the bigger picture may want to skim over some details, but they should take time to enjoy at least some of the many stories of interesting characters and the fun historical tidbits.

The book begins with what the authors call the “most famous failed experiment.” In the 19th century, it was known that light behaved as a wave, and all waves anyone knew about required a medium to move in (e.g., water or air). Therefore, it was believed that light must travel in a medium, labeled as “ether,” that filled all of space. As Earth moves through the ether, one should measure a different speed of light depending on whether one is moving with, across, or against the current. In 1887, Michelson and Morley found that the speed of light was the same regardless of the direction of motion through the supposed ether. This was a serious strike against the ether hypothesis, as well as showing light waves were somehow different from other waves. Some major rethinking was required, leading to Einstein’s theory of relativity. It took some years for the ether dragon to die, and more years for relativity to become well accepted.

Another dragon that many readers of *PSCF* will likely recognize would be the “crystalline spheres” on which stars and planets supposedly rotated around Earth. These were part of the geocentric model of the Solar System that was replaced by the heliocentric model in the decades around 1600. As most readers are probably aware, Galileo’s observations (ca. 1610) played a major role in slaying the geocentric dragon and Kepler’s “laws” of planetary motion a bit later were based on the heliocentric model. It wasn’t until several decades after Galileo and Kepler that Newton’s laws of motion and of gravity were published (1687) to make more quantitative

Book Reviews

sense of the observed motions of planets and to allow predictions, such as the existence of the planet Neptune or when Halley's Comet would return.

A few additional dragons are worth discussing. The authors actually tend to drop the direct mention of dragons in the later sections of the book, but the theme of discussing changes in scientific understanding that required significant rethinking remains strong. A geological and paleontological issue that many readers may be familiar with involves the great extinctions (times when many species died quite rapidly), especially the demise of the dinosaurs about 66 million years ago. Most have probably read articles or seen documentaries blaming an asteroid impact for killing off the dinosaurs, and there was definitely a major impact at the right time. Although that is certainly the best publicized explanation for that extinction, there is another explanation that is less commonly mentioned: very extensive volcanism. This is less dramatic than an asteroid impact and has received less publicity. There were enormous volcanic events in south Asia for an extended period including the time of the asteroid impact, and there is some controversy over how sudden the extinction was. If it was not sudden, then the volcanic explanation fits better. Furthermore, there were other periods of great volcanic activity that match up with the times of other great extinctions. The jury may still be out on this issue. Anyone wanting to know more about this is encouraged to read the book.

Although slightly off the topic of dragons, the authors also discuss people who were not honored with Nobel prizes, but should have been, as well as some who should have been co-authors on significant papers but weren't (or whose work was ignored until far too late). Unfortunately, women have too often been the ones ignored, but men have also been passed over. Among several others, the book discusses the frequently cited case of Jocelyn Bell (now Dame Jocelyn Bell Burnell) and her discovery of pulsars (astronomical objects with short period radio pulses, which she discovered as a grad student in 1967). Two more-senior men received the Nobel prize in 1974 for their contributions to radio astronomy, including specifically this discovery.

The last section of the book contains considerable discussion of modern views of cosmology, including the apparent discrepancy between the results of two different methods of measuring the expansion rate of the universe. The discrepancy between the results may be due to underestimated random errors, or systematic errors in one or both techniques, or new physics yet to be understood (another dragon?). Necessarily included as part of cosmology, the authors discuss dark matter and dark energy. Dark energy is the label given to whatever unknown mechanism is causing the observed

acceleration (discovered ~30 years ago) in the expansion of the universe, and should certainly be considered a dragon, since it is a term invented out of ignorance. Dark matter is a different story. For several decades we have known of rapid motions of and within galaxies that are best explained by something that has gravity similar to that of normal matter, but has not yet been detectable otherwise, hence dark. Some think the observed data require a need for modification of the law of gravity, but no proposed modification has yet been successful in fitting all of the data. A clear discovery of dark matter particles, or a successful modification of gravity, will slay the dark matter dragon. Cosmology, including the dark side, is a very active area of current research.

Why should this book be of interest to readers of *PSCF*? Besides the fact that many of us are interested in history and philosophy of science, we should think about whether there are other dragons to deal with. For example, many of us may think of "god of the gaps" as a dragon that has (mostly?) been slain, though its head pops up occasionally. Readers may want to ponder whether there are other dragons in our own science, or our theology, or how we relate these areas.

Reviewed by Kyle Cudworth, former director, Yerkes Observatory, Williams Bay, WI, and professor emeritus of astronomy and astrophysics, The University of Chicago.

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THE HUXLEYS: An Intimate History of Evolution by Alison Bashford. University of Chicago Press, 2022. 423 pages plus 60 pages of notes, 75 figures, index. Hardcover; \$30.00. ISBN: 9780226720111.

Alison Bashford is laureate professor in history and director of the Laureate Centre for History and Population at the University of New South Wales in Sydney, Australia. She has held prior positions at the University of Cambridge and Harvard, and served as a trustee of Royal Museums Greenwich. Prior publications include a coauthored biography of Thomas Malthus; in 2021, she received the Dan David Prize for her contributions to the history of health and medicine.

The Huxleys represents an ambitious project: an intergenerational history of the Huxley family, 1825–1975, with major emphases on the biologists Thomas Henry Huxley (1825–1895), hereafter, "Thomas"; and his grandson, Julian Sorell Huxley (1887–1975), hereafter, "Julian." Other Huxleys are essential to the narrative, and these include Thomas's beloved wife, Henrietta Heathorn (1825–1914), and their son Leonard Huxley (1860–1933). Leonard and his wife Julia Arnold (1862–1908) were the progenitors of Julian and his acclaimed novelist brother, Aldous Huxley (1894–1963). Many other Huxley children and cousins populate the book. Julia Arnold, as daughter of Thomas Arnold and niece