

human impacts, the need for restraint, the sacredness of the sea, chaos and order, vulnerability, consumerism, and poverty. The book does not attempt to be exhaustive and some problems which are presently a very hot topics, such as plastic pollution, are given little attention. Yet the main effects of humans on the sea – overfishing, climate change, and pollution – are all examined in sufficient detail and clarity for non-scientists to understand.

One of the key themes of the book is summarized in the concluding chapter:

Our exploration of the Bible has revealed that a key aspect of God’s perspective on the ocean is his delight in his creation apart from any role we as humans may have in it. It has intrinsic value to him and was not created by him solely for the benefit of humanity.

This is an important truth that needs to be taught to both Christians, who can easily see the created world as the stage on which humans act and which provides for humanity, and to the professional conservation community which is increasingly framing nature conservation in instrumental terms. The ocean has value to God, irrespective of all it provides for us. A Rocha, a Christian conservation organization whose Marine Conservation program I direct, is seeking to live out this truth in caring for the ocean. I look forward to many discussions with volunteers, interns, and other scientists after passing them a copy of this book.

If we have a Blue God, how then are we as Blue People to live? The final pages of the book are an important call to action. In light of the science and the Bible, now what? The authors do not give easy answers, as there are none. As much as we should, except in special circumstances, get rid of plastic straws, this will not solve our ocean’s problems. Their approach mirrors that of our work with A Rocha, in which both science and theology inform our praxis. The call is to a radical lifestyle that rejects consumerism, moves forward humbly, and is led by Christ’s example of a life of self-sacrifice and love.

We need to live in harmony with God’s purposes for his creation, mindful of the “sacredness” of the sea, and seeking not to overstep the limits set for us. It also means recognizing that there is no neutral ground: not making the lifestyle and attitude changes required is an active decision, entailing responsibility (and, yes, guilt), not a passive one. By doing nothing, we are directly contributing to the ruin of God’s good earth.

Challenged yet?

Reviewed by Robert Sluka, Lead Scientist, A Rocha Marine and Coastal Conservation Programme, Titusville, FL 32780.



HISTORY OF SCIENCE

A HISTORY OF TECHNOSCIENCE: Erasing the Boundaries between Science and Technology by David F. Channell. New York: Routledge, 2017. 286 pages, index. Hardcover; \$155.00. ISBN: 9781138285545.

This is an important book for anyone who is interested in philosophy of science and technology. Although not an easy book to read, it deals with how technology has changed science in the last 150 years into something quite different from what it was before. David Channell is well qualified to write on this subject. He has a BS degree in physics and a PhD in the history of science and technology from Case Western Reserve University. He has received funding from the NSF for research in this area and two Templeton Foundation grants, including a joint Templeton-ASA lecture grant in 1998. Channell is currently a professor of historical studies at the University of Texas at Dallas.

There have been many different attempts to describe a scientific method, but relatively few attempts to describe an engineering method. Many practicing engineers and practicing scientists view their disciplines as being rather different. One of the aims of *A History of Technoscience* is to understand how engineering and science interact today.

Channell’s opening paragraph describes the theme of the book:

In the twenty-first century science and technology are coming to be seen as indistinguishable activities, often referred to by the term technoscience. It is difficult to characterize many of the developments that have come to form the basis of the modern western world as either purely scientific or purely technological. (p. 1)

For someone not familiar with the topic, the most important chapters are Chapter 1: Introduction, and Chapter 11: Epilogue, in which Channell shares his final conclusions. The vast majority of the book is historical, showing how technoscience has developed over the last 150 years. In the introduction he analyzes several different approaches to the relationship between technology and science. These perspectives, in the general order of their historical development include technology as dependent upon science; science and technology as independent; science as dependent upon technology; science and technology as interdependent; and, erasing the boundaries between science and technology.

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Channell considers “technology as dependent upon science” to be the oldest approach. He writes, “Since at least the second half of the nineteenth century there has been the widespread view, particularly among scientists and the public at large, that technology is simply applied science” (p. 7). I do not believe this attitude is common among engineers. A practice-based engineering (based on trial and error) has been around long before modern science was developed. It is fair to state that much of modern engineering is now taught using a strong science base. Channell does comment that

even if one accepts that technology is simply applied science, there is still considerable debate concerning what aspect of science is being applied ... to many engineers, applied science meant not the application of scientific theories, but rather the application of a scientific method to the useful arts. (pp. 8-9)

The approach that technology and science are independent of each other is based on historical observations concerning the differences between the cultures of practicing scientists and practicing engineers. A more modern approach is that science is dependent upon technology. The author expands upon this thesis in his historical chapters, which describe the development of what he calls “big science.” The interdependent approach accepts the idea that both science and technology have affected each other. Channell writes:

While the communities of science and technology share many of the same values, those values are reversed in their rank order. The natural sciences rank abstract, general mathematical theories in the highest position and rank practical applications lower; the engineering communities place practical designs in the highest position and rank theories lower. (p. 18)

He then describes a related perspective, which uses the term “engineering science” and an older meaning of science. “These engineers saw science as generalized facts gained through induction based on observation and experimentation rather than deduction based on abstraction and a priori idealization” (p. 18). This approach is consistent with the approach taken by ABET, which accredits engineering programs. They require each program to have a specific number of science/math classes and a specific number of engineering science classes.

The main thesis of the book is that many of these models of how science and technology interact are now outdated. Thus, “by the second half of the twentieth century the long-held distinctions between science and technology were beginning to disappear and, in the place of two individual disciplines, there emerged the new concept of a single integrated

realm of knowledge that some have labeled technoscience” (p. 21).

The author then develops this thesis through a series of historical chapters, with chapter titles displaying how Channell develops his thesis. The historical part of the book is divided into two parts: part one addresses the roots of technoscience; and part two, the era of technoscience. Chapters included are as follows:

Part 1: The roots of technoscience:

- Chapter 2 – From science-based industry to industry-based science
- Chapter 3 – Setting the stage for the military-industrial-academic complex: World War 1
- Chapter 4 – Setting the stage for big science: the interwar period
- Chapter 5 – The emergence of the military-industrial-academic complex and big science: World War II

Part 2: The era of technoscience

- Chapter 6 – The nuclear arms race
- Chapter 7 – The space program
- Chapter 8 – Electronics
- Chapter 9 – Material science
- Chapter 10 – Biotechnology

The historical chapters are quite detailed, and some portions of them may be difficult for some readers to follow. As a materials scientist, I most enjoyed the historical chapter about the creation of this discipline in the past 70 years. Materials science grew out of a combination of chemistry and metallurgical engineering. Channell makes an important point when he describes how materials science is different from earlier work:

Unlike earlier work in mechanical engineering, which focused on dealing with materials from the macro-level, the new materials science approach dealt with designing materials based on knowledge of behavior at the microscopic level. (p. 225)

I have lived through these changes in my career and agree with this conclusion.

In his epilogue, Channell argues that with the development of what he calls “the military-industrial-academic complex,” science and technology have merged into technoscience. We have moved beyond the traditional perspectives on science and technology.

It also goes beyond the old linear model in which universities provide basic scientific knowledge which is then applied by industry. The new model is an interactive model. An important element ... is

that the intertwining of universities, industry and government leads to situations where each one of the threads can take on aspects of the other threads. This can lead to a major transformation of the university ... At the same time universities are taking on the role of industry by capitalizing research ... the government is taking on the role of both private industry and universities by encouraging certain directions in research through funding and the creating of a regulatory environment conducive to certain types of research needed by industry. (p. 259)

While providing an excellent history of this issue, the author deliberately does not draw any conclusions as to whether

these changes will have positive or negative consequences and whether efforts should be made to encourage or discourage such changes. While the aim of this book has not been to answer such questions, such answers will not be forthcoming without some knowledge of the history of technoscience. Hopefully this book will provide a historical context in which a debate about the consequences of technoscience can take place. (p. 261)

I am disappointed that the author did not provide us with conclusions about whether the development of technoscience is good or bad. However, he has provided the ASA community with excellent background material about this topic. Hopefully future ASA conferences and *PSCF* papers will delve into the many faith-related aspects of the rise of technoscience.

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THE WARFARE BETWEEN SCIENCE AND RELIGION: The Idea That Wouldn't Die by Jeff Hardin, Ronald L. Numbers, and Ronald A. Binzley, eds. Baltimore, MD: Johns Hopkins University Press, 2018. 358 pages. Paperback; \$39.95. ISBN: 9781421426181.

As the teacher in Ecclesiastes declares: "Of the making of books there is no end and much study wearies the flesh." This word of wisdom applies doubly to the genre of books describing the interaction of science and religion. Religion and science matter and they seem to matter ever more in our current tribal society. Each month seemingly presents us with a new exemplar. *The Warfare between Science and Religion* is only the latest, but it is one of the more important and timely additions.

This book stems from a three-day conference held in 2015 at the University of Wisconsin, devoted to the so-called warfare thesis that pits religion and science in an interminable conflict. Twenty-two distinguished scholars, mainly historians and sociologists,

contributed to this volume: an introduction by David Livingstone and Mark Noll is followed by seventeen chapters, authored by some of the leading scholars in the religion/science discussions. The book is ably edited by Jeff Hardin, Ronald Numbers, and Ronald Binzley. One reviewer, Edward J. Larson, describes *The Warfare* as the "best single-volume collection of separate-author essays about the history of science and religion in the major modern monotheistic Western traditions" (back cover).

Approaches to this subject have been marred both by polemical intentions surrounding the warfare or conflict thesis and by an inability to grasp and cope with the complexity of the issues involved. What is clear is that a variety of interpretive frameworks have been utilized to depict the historical relations between science and religion. Despite various readings, the conflict model is by far the dominant one, both in the public's mind and for many professional scientists as well. For many hard-nosed proponents, science and religion reflect a tribalism that is set in stone. While fundamentalists cast science as a misguided or even malicious source of information, polemicizing scientists argue that religion is not just wrong or meaningless but also dangerous.

The Warfare is centered on the warfare thesis as classically formulated by Andrew Dickson White and John William Draper in the nineteenth century (chap. 1, "The Warfare Thesis," by Lawrence Principe). What follows is a close analysis of the viability of the warfare thesis as an adequate account of the relation of science and religion in many different historical and social-cultural contexts. First, we look back in time to the most celebrated warfare account, "The Galileo Affair" (chap. 2 by Maurice Finocchiaro). This is followed by an analysis of nineteenth-century developments in the United States, "Rumors of War" (chap. 3, Monte Harrell Hampton), by English "Victorians" (chap. 4, Bernard Lightman), and in "Continental Europe" (chap. 5, Frederick Gregory). Then, successive chapters describe the perspectives of different religious communities on the warfare thesis: "Roman Catholics" (David Mislin); "Eastern Orthodox Christians" (Efthymios Nicolaidis); "Liberal Protestants" (Jon Roberts); "Protestant Evangelicals" (Bradley Gundlach); "Jews" (Noah Efron); and "Muslims" (M. Alper Yalçinkaya). The last six chapters (chaps. 12-17) describe more-contemporary events and persons: "New Atheists" (Numbers and Hardin); "Neo-Harmonists" (Peter Harrison); "Historians" (John Brooke); "Scientists" (Elaine Howard Ecklund and Christopher Scheitle); "Social Scientists" (Thomas Aechtner); and "The View on the Street" (John Evans).