

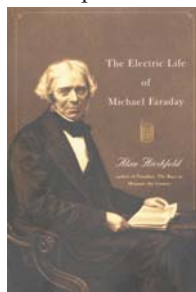
## An experimental physicist extraordinaire

### The Electric Life of Michael Faraday

**Alan Hirshfeld**  
Walker, New York, 2006. \$24.00  
(258 pp.). ISBN 0-8027-1470-6

Reviewed by Cyrus Hoffman

Ask people on the street to name some important physicists, and I doubt many would include Michael Faraday (1791–1867). Probably very few have even heard of him, which is unfortunate. Not only was Faraday one of the most productive and influential scientists who ever lived,



but the fairy-tale story of how he rose from an impoverished, uneducated beginning cannot fail to fascinate and inspire readers. Thus the appearance of an engaging, eminently readable account of

Faraday's life and accomplishments is most welcome.

Alan Hirshfeld, a professor of physics at the University of Massachusetts Dartmouth and the author of the popular *Parallax: The Race to Measure the Cosmos* (W. H. Freeman, 2001), is well suited to telling the story. In *The Electric Life of Michael Faraday*, Hirshfeld chronologically traces Faraday's life, from his humble beginnings—he was the third child of a poor blacksmith—to his death; he is arguably the greatest experimental scientist of his time—or perhaps of any time.

The book begins by drawing us into the world of an early 19th-century bookbindery, where Faraday was apprenticed; the author explores the scientist's insatiable thirst for understanding the natural world. Fortunately, George Riebau, the bookbindery's proprietor, encouraged Faraday's inquisi-

tiveness. It is also fortuitous that Humphry Davy, the preeminent chemist of his day and a luminary at the Royal Institution in London, recognized both the mind and energy of the young Faraday and took him under his wing. Under Davy, Faraday rose from bottle washer and valet to trusted assistant to, ultimately, peer. Hirshfeld is particularly effective at examining the evolving relationship between the flamboyant Davy and the reserved Faraday.

The field of Davy's expertise and Faraday's initial work was electrochemistry, the interaction of electrical currents and chemical compounds to uncover the underlying structures of those compounds. The faraday, a unit of electrical charge, is a testament to the impact of Faraday's contribution. Hans Christian Oersted's 1820 observation that an electrical current flowing through a wire caused a nearby compass needle to rotate encouraged Faraday to begin his seminal experimental studies on the connections between electricity and magnetism.

Hirshfeld reveals how Faraday turned his lack of understanding of mathematics and theoretical physics into an asset, leaving him free from preconceptions and allowing him to explore a wide variety of physical phenomena. Faraday was a methodical and creative experimenter; however, what set him apart from his peers was his fertile mind, which constantly sought a deep understanding of the underlying physics of each observation and ways to test his ideas. Faraday invented the concept of magnetic lines of force so he could visualize magnetism, because he could not understand the detailed mathematical description of it. I suspect that every college freshman physics student is deeply indebted to Faraday's ingenuity. The young James Clerk Maxwell studied Faraday's *Experimental Researches in Electricity*, published in three volumes between 1839 and 1855. The work is totally devoid of mathematics, and it eventually led Maxwell to his highly mathematical laws of electromagnetism. It is fascinating to read the contrasts between the interactions of Faraday and Davy and those of Faraday and Maxwell.

Hirshfeld also discusses at some length Faraday's passion for educating the general public, especially children. Faraday strongly believed in education, as he was mindful of how Davy's public lectures fired his own imagination.

The book has a few flaws, in addition to a somewhat silly title. The author occasionally fails to distinguish between our present understanding of a phenomenon and what was believed in the 19th century. Hirshfeld also provides several just-plain-wrong explanations of physics phenomena. For example, on page 74, in describing the magnetic force, the author writes that "were you to grasp the [current-carrying] wire in your fist, your fingers would curl in the manner of the magnetic force." I also wanted to learn more about the suspected causes of the debilitating headaches and loss of memory that plagued Faraday in his later years.

Nevertheless, *The Electric Life of Michael Faraday* discusses an intriguing and influential person. More important, it provides superb examples of the scientific method at work. The fact that Faraday was deeply religious leads to detailed discussions on the relationship between science and religion, a topic that remains of great interest. Hirshfeld's award-winning writing style makes the book approachable to scientists and nonscientists alike, and the extensive references render it useful to scholars.

### Civilized Life in the Universe

Scientists on Intelligent Extraterrestrials

**George Basalla**  
Oxford U. Press, New York, 2006.  
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ISBN 0-19-517181-0

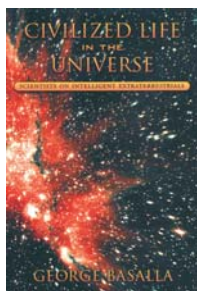
George Basalla's *Civilized Life in the Universe: Scientists on Intelligent Extraterrestrials* is a curious book. It appears to be a history of the extraterrestrial (ET) life debate, yet Basalla offers much less detail than other histories on the subject written over the last two decades—for example, Michael Crowe's *The Extraterrestrial Life Debate, 1750–1900: The Idea of*

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a *Plurality of Worlds* from Kant to Lowell (Cambridge U. Press, 1986) and *The Biological Universe: The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* (Cambridge U. Press, 1996), which I wrote. Basalla adds little new historical information, but his book has other purposes, which become increasingly apparent as one proceeds through it. First, the author attempts to show that belief in extraterrestrials and the search for them are irretrievably contaminated by anthropocentrism. Second, he tries to demonstrate that such belief is a secular religion. The first argument is hardly surprising; the second, highly questionable.

Throughout history, proponents of extraterrestrial intelligence (ETI) have projected terrestrial culture onto extraterrestrials. Basalla cites examples from Johannes Kepler, Christiaan Huygens, Percival Lowell, and others. Undoubtedly some, including two of the 20th century's leading advocates, Frank Drake and the late Carl Sagan, have projected onto ETs godlike qualities such as immortality and omnipotence. However, those facts do not constitute proof, as Basalla implies, that the entire search for extraterrestrial intelligence (SETI) is doomed to failure a priori. At no point does he allow that the search for life in the universe, with all its anthropocentric shortcomings and purported motivations, might be a scientific enterprise of considerable importance in which researchers are attempting to answer one of the greatest riddles of the day in light of what they now know about the cosmos and its evolution. Even the US National Academy of Sciences has proclaimed several times that the endeavor is worthwhile.

Rather than taking the subject seriously, Basalla uses dubious inferences to build a case against SETI. He harshly criticizes the Drake equation, which is sometimes used for estimating the number of technological civilizations in the galaxy, yet he fails to point out that almost all SETI scientists, including Drake himself, stated long ago that the equation is nothing more than a heuristic device, a way of organizing our ignorance. It is not at the center of empirical SETI searches. Basalla also excoriates Sagan for some of his more imaginative ideas and takes NASA to task for indulging them. He accuses Sagan of hyping the possibilities of extraterrestrial life to gain public support and government funding (page 101) and believes that NASA tried to second-guess the Viking



results (page 97) in 1976 and hyped the claims of fossil life in the ALH84001 Mars rock in 1996 for budgetary reasons.

In scientists' attempts to study the possibilities of life in the universe, Basalla seems to see conspiracy everywhere. SETI and astrobiology in general stir great interest among the public; that Sagan and NASA have used that interest to their advantage is apparent. But isn't such excitement understandable, when the subject remains one of the great questions of science?

Basalla's claim that extraterrestrials constitute deities for those who reject traditional religions is dubious. In the 18th century, many natural philosophers filled the heavens with extraterrestrials at a time when Newtonian mechanics precluded the need for God's action in the heavens. But their extraterrestrials were certainly not a replacement for God or traditional religion. For the modern era, Basalla cites only the backgrounds of Drake and Sagan to make his point (page 12), and if that isn't small-number statistics, I don't know what is. I would be more impressed if a scientific sample of thousands of people around the world showed some correlation between atheism and SETI supporters.

There is certainly room for skepticism in the ETI debate, as demonstrated, for example, in the type of scientific arguments advanced in Peter Ward and Don Brownlee's *Rare Earth: Why Complex Life Is Uncommon in the Universe* (Copernicus, 2000) (see the review in *PHYSICS TODAY*, September 2000, page 62). Such arguments must be and, in my experience, have been taken seriously by SETI proponents in the same way the Fermi paradox (the contradiction between the high probability of the existence of ETs and the lack of evidence of their existence) was taken seriously when it was debated in *PHYSICS TODAY* 26 years ago. The discussion was incited by Frank J. Tipler's article, "Extraterrestrial Intelligent Beings Do Not Exist," (*PHYSICS TODAY*, April 1981, page 9), which prompted a series of letters to the editor (see *PHYSICS TODAY*, March 1982, page 26) and an article by Drake, "Will the Real SETI Please Stand Up?" (see *PHYSICS TODAY*, June 1982, page 9). If the SETI community did not engage in such debate, it would indeed be practicing a secular religion. The point of SETI proponents is that evidence must exist one way or another—and they continue to look for it, although no longer with government funding. But

by invoking anthropocentrism and claims of secular religion, Basalla aims to undermine the enterprise. His arguments take on a polemical and, one might say, almost religious tone. I am not convinced and prefer to await the evidence.

Some of Basalla's points are well taken. His penultimate chapter, "Mirror Worlds," is worth reading because of the questions he raises about the universality of science, alien morphology, communication, and technology. In the realm of epistemology, asking whether science is universal when extended to alien minds is legitimate. A few philosophers have taken up the problem, and some have concluded that science would not be universal.

In the realm of alien morphology, most evolutionists have concluded that extraterrestrials would not resemble us. Moreover, it is highly unlikely that any alien message would be easily decipherable, if recognizable. As the late Philip Morrison and others have argued, decoding such a message would likely occupy many scholars for generations, if the message could be deciphered at all. And Basalla, himself a distinguished historian of technology, speaks from his own strength and knowledge about the history of our species when he points out that technology may develop in many directions on other planets and may not include radio telescopes.

Nevertheless, if everyone followed Basalla's logic that philosophical and cultural predispositions must be excised before we begin to do science, the scientific enterprise would never have gotten off the ground. Although the author argues the obvious, that we cannot escape our own minds and thus our conceptions of other worlds mirror our own, that fact does not preclude a search of the skies in the hope that we may someday come to an objective conclusion about life and intelligence in the universe.

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## Imaginary Weapons

### A Journey Through the Pentagon's Scientific Underworld

Sharon Weinberger  
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\$26.00 (276 pp.).  
ISBN 1-56025-849-7

Good science fiction must rest upon plausible science. Sharon Weinberger's