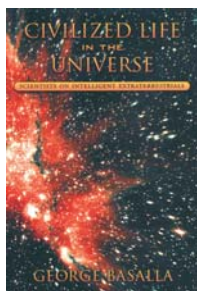


a *Plurality of Worlds* from Kant to Lowell (Cambridge U. Press, 1986) and *The Biological Universe: The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* (Cambridge U. Press, 1996), which I wrote. Basalla adds little new historical information, but his book has other purposes, 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.

Steven J. Dick
NASA
Washington, DC

Imaginary Weapons

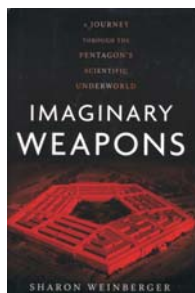
A Journey Through the Pentagon's Scientific Underworld

Sharon Weinberger
Nation Books, New York, 2006.
\$26.00 (276 pp.).
ISBN 1-56025-849-7

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

Imaginary Weapons: A Journey Through the Pentagon's Scientific Underworld tells a real-life story that relied on implausible science. The book is a shocking reminder of how, in a time of hyper-inflated defense budgets, sanity can be tossed aside and real money can be squandered beyond belief in the false name of "scientific promise."

Weinberger's story is about the government's pursuit of an allegedly new kind of powerful weapon envisaged by scientist Carl Collins, who hyped the results of a bad 1998 experiment and, over the course of several years, doggedly sold his dream to people in the defense community for untold money. It was, at best, a case of selling "snake oil." The hafnium bomb project involved gullible weapons enthusiasts who had more spending authority than good sense. Steve Younger, a senior weapons specialist in the US Department of Defense, typified this characteristic. Despite unsuccessful attempts by numerous federal agencies to replicate the original bad experiment, which involved a dental x-ray machine, word of the potential to build a Hf explosive spread quickly throughout the defense community.



The subject matter became classified, which, unhappily, made it more difficult for the project to be examined by the scientific community. Classification can protect vital information from misuse, but—and here's the lesson—it can also protect bad ideas (such as Star Wars, the space-based missile defense system) from the scrutiny of objective evaluation.

In a nutshell, the Hf proponents urged federal officials in the Pentagon and the US Department of Energy to produce gram quantities of the isotope ^{182}Hf and excite it into a high-spin isomer $^{182}\text{Hf}^m$, which has a relatively long half-life of about 30 years (see *PHYSICS TODAY*, May 2004, page 21). The advocates of the project then proposed to have x rays trigger rapid de-excitation of the isomer, thus causing a massive cascade of gamma rays as the isomer relaxes to the ground state. Little analysis is required to show that production of the needed quantities of the Hf isomer would be horrendously expensive. And a trigger mechanism such as an x-ray laser was only a wispy dream.

Despite the physical facts, the dream of producing a Hf explosive prevailed and was repeatedly sold to inept deci-

sion makers. Even the once-heralded Defense Advanced Research Projects Agency seemed to fall prey to the idea. Peter Zimmerman, then chief scientist of the US Arms Control and Disarmament Agency and a born skeptic but capable scientist, asked the famed JASON group of elite scientists to evaluate the Hf proposals. The group dismissed the idea as not remotely feasible, but that still didn't stop the proponents. Only several years later did a series of experiments and tests finally discredit the original report of success.

So why did it take so long and millions of dollars to dispel the rumor? Through her persistent tracking of the events and people, Weinberger shows us the veracity behind Mark Twain's statement that a lie can make it halfway around the world before the truth can even get its shoes on. Her highly readable account underscores the wisdom that "a little knowledge can be a dangerous thing." Her important story reminds us that the government must support and use highly credible analysis groups, such as the National Academies; the congressional Office of Technology Assessment, which was dismantled in 1995 during the Republican Revolution led by Newt Gingrich, former speaker of the US House of Representatives; and

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professional groups, such as the American Association for the Advancement of Science and the American Physical Society. Needless to say, snake oil finely dressed up is always going to be available for sale.

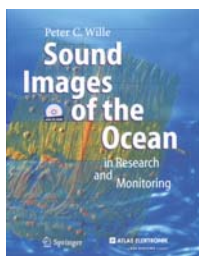
For me, the hero in *Imaginary Weapons* is Zimmerman, who quietly used his scientific training and experience in Washington to nudge the fable of a Hf bomb into a deservedly deep hole. Sadly, his nudge took several years to complete.

John H. Gibbons
Resource Strategies
The Plains, Virginia

Sound Images of the Ocean in Research and Monitoring

Peter C. Wille
Springer, New York, 2005. \$129.00
(471 pp.). ISBN 3-540-24122-1

The use of sound to study the seafloor and ocean has revolutionized our understanding of the planet and the forces that have shaped it over the ages. Ocean



acoustics can now provide unprecedented views of the seafloor's features, both natural and artificial, and help us to understand critical processes in the sea. Peter C. Wille's

Sound Images of the Ocean in Research and Monitoring is meant to provide the nonexpert with an overview of the uses of acoustical measurements in the sea. Through the extensive collection of imagery and associated explanatory text, the book provides a unique and comprehensive perspective on the use of sound in the study of the ocean and seafloor. Unfortunately, poor editing and an inconsistent writing style detract from the book's worthwhile and partially accomplished goal.

The book contains 400 sound images contributed by 120 experts from around the world. The graphics are accompanied by detailed explanations and provide excellent examples to accompany chapters on the seafloor, the ocean, and manmade matter. Introductory text gives background information on the use of acoustics and echo sounding. Woven throughout the book are explanations of plate tectonics and other processes that generate many of the fea-

tures seen in the imagery. The juxtaposition of images derived from satellite altimetry and gravimetric methods with those from high-resolution, multi-beam echo sounding is particularly enlightening.

Although the graphics and supplemental text are excellent, the main text just doesn't do the topic justice. It is often difficult to read because of run-on sentences, misused words, and misspellings. The text is also highly repetitive. In one section I found four sentences specifying the depth of the Mariana Trench and explaining that it is the deepest point in the ocean. In places the author attempts to go from a technical and straightforward style to more flowery wording that just doesn't work. Terms such as "peerless," "decisively supporting," and "ideal diagnostic tool" are used repeatedly to convince the reader of the importance and unmatched capabilities of undersea acoustics. The graphics and explanatory text undeniably show the contributions of acoustic imagery, so continually hitting the reader over the head with unnecessary adjectives and phrasing is distracting.

As a marine scientist and author, I have focused much of my time on translating science for the nonexpert. Thus I may be overcritical of the editing. I also consider myself to be within the target audience of Wille's book, having expertise in marine geology, with some knowledge of ocean acoustics and an interest to learn more. Nevertheless, I found it very difficult to get through the book—notwithstanding the fascinating images.

A CD accompanying the book provides six excellent globe relief images. I was disappointed, however, that more images from the book were not made available on the CD. Only 47 of the 400 appear on the CD, but many more would be an excellent resource for anyone teaching about the oceans, marine geology, and sedimentology.

Sound Images of the Ocean in Research and Monitoring brings together a spectacular set of high-resolution and informative images that showcase the utility and contribution of sound to image and study the ocean. Wille's expertise in the field of ocean acoustics is unquestioned: He is a professor at the University of Hamburg, was the director of the NATO Undersea Research Centre, and is considered an international statesman in the field. Along with his own experience, he brings together a group of renowned contributors. Their combined knowledge is well evident and showcased by the amazing collection of im-

ages, but poor editing has rendered the book less than compelling.

Ellen Prager
Earth2Ocean, Inc
Tierra Verde, Florida

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