

## MEDICINE

# Powerful Opinions, Capable of Harm

Donald M. Marcus

“Science is the father of knowledge, but opinion breeds ignorance.”—Hippocrates

Paul Offit’s lively *Do You Believe in Magic?* provides accounts of how uninformed opinions generate enterprises that bilk the public and cause needless suffering and deaths. Offit, an infectious disease specialist at the University of Pennsylvania, has written several books for the public on vaccines, including refutations of claims that they cause autism [e.g., (1–3)]. Here he examines various factors that motivate people to turn to alternative medicines.

Among these are the unfounded belief that “natural” remedies such as herbals are fundamentally different from synthetic drugs and the opinion that the government, pharmaceutical companies, and the medical establishment conspire to suppress information about inexpensive, effective remedies. In “Little Supplement Makers Versus Big Pharma,” Offit describes how the supplement industry in the United States maneuvered to get Congress to pass legislation that renamed herbal medicines as “dietary supplements,” effectively removing them from regulation by the Food and Drug Administration. He also devotes a pair of chapters to the cruel deceptions of cancer quackery. Although Offit provides short summaries of the hazards of alternative remedies and the lack of supporting evidence for therapies such as herbals and megavitamins, his emphasis is on analyzing how health frauds arise and prosper.

As Offit notes, the advocates for alternative remedies include alternative practitioners, distinguished scientists, physicians, nurses, pitchmen who lack medical or scientific training, movie stars, media personalities, other celebrities, and elected officials. Among the book’s strong points are his detailed accounts of how such advocates sway public opinion. In particular, the section “When the Stars Shine on Alternative Medicine” recounts the impact of such advocates in the areas of menopause, autism, and chronic Lyme disease.

After actress Suzanne Somers received surgery and radiation for breast cancer, she rejected conventional treatment with tamoxi-

fen in favor of a natural herbal remedy. The rise of her commercial health empire began with her promotion of “natural bioidentical hormones” as a safe alternative to conventional synthetic estrogen for treatment of menopause symptoms. In fact, conventional and bioidentical estrogens have the same potential benefits and risks, and there are no clinical trials of the efficacy or safety of bioidentical hormones. As Offit notes, the main difference between conventional and bioidentical hormones is that the latter are sold by compounding pharmacies, “an unsupervised industry.” The recent outbreak of severe fungal infections caused by contaminated products sold by a compounding pharmacy demonstrates the need for concern about the lack of supervision. Through her appearances on television programs, endorsements by celebrity talk-show hosts such as Oprah Winfrey, and support from gynecologist Christiane Northrup, Somers’s claims received widespread coverage. She later extended the purported power of bioidentical hormones to prevention of

aging and subsequently embraced claims for antiaging effects of a remarkable number of herbals, vitamins, minerals, and other products. Such alternative remedies are available for sale through her website, which also offers food, cooking utensils, and weight loss and detoxification products.

Appearances on Winfrey’s show also helped actress Jenny McCarthy publicize her belief that vaccines cause autism and fuel an antivaccine movement that caused outbreaks of infectious diseases in unvaccinated children.

Advocates of chronic Lyme disease, both lay people and “Lyme Literate doctors,” claim that chronic infection by *Borrelia burgdorferi* causes a long list of problems, including autism, chronic fatigue syndrome,

homicidal behavior, and multiple sclerosis. To treat the supposed infection and subsequent conditions, Lyme literate doctors recommend therapies such as vitamins, supplements, herbals, special diets, homeopathic remedies, machines that electrocute Lyme bacteria, and long-term, high-dose intravenous antibiotics. Scientists who speak out against these unfounded beliefs have received threats. Offit uses this example to spotlight “political shenanigans.”

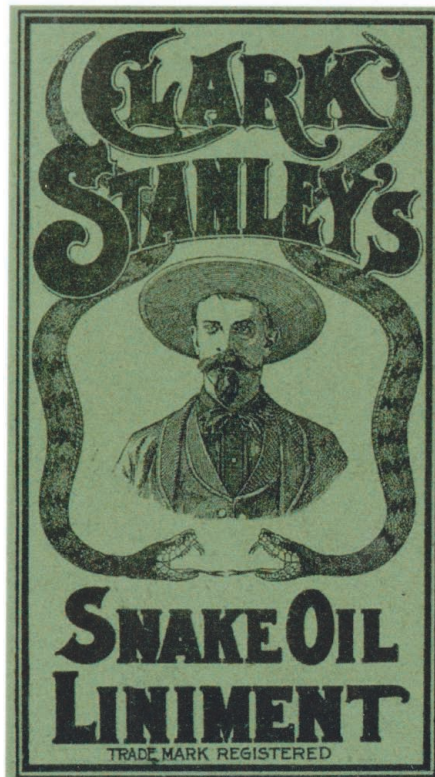
Many people, including some physicians, believe that although alternative remedies may not be effective, they are harmless. While there are no large systematic studies of the adverse effects of alternative remedies, evidence of their hazards has accumulated as their popularity has increased. For example, *Aristolochia* plants, a popular source of herbals worldwide, have been found to contain potent mutagens that cause renal failure and cancer of the upper urinary tract (4).

*Do You Believe in Magic?* achieves Offit’s aim of taking “a critical look at the field of alternative medicine” and separating fact from myth. Informative and well-written, the book deserves a wide audience among the general public, scientists, and health care professionals. Many alternative remedies are self-prescribed, and the information provided by the extensive page-by-page references and bibliography will enable people with open minds to make more informed choices about their health care.

One-hundred and fifty years ago, physician and author Oliver Wendell Holmes Sr. commented, “Quackery and idolatry are all but immortal” (5). In this age of celebrity health gurus, quackery and idolatry have merged.

## Do You Believe in Magic? The Sense and Nonsense of Alternative Medicine

by Paul A. Offit  
Harper, New York, 2013.  
335 pp. \$26.99.  
ISBN 9780062222961.



The reviewer is at the Department of Medicine, Baylor College of Medicine, One Baylor Plaza, BCM 285, Houston, TX 77030, USA. E-mail: dmarcus.bcm.edu

## References

1. P. A. Offit, *The Cutter Incident: How America's First Polio Vaccine Led to the Growing Vaccine Crisis* (Yale Univ. Press, New Haven, CT, 2005).
2. P. A. Offit, *Autism's False Prophets: Bad Science, Risky Medicine, and the Search for a Cure* (Columbia Univ. Press, New York, 2008).
3. P. A. Offit, *Deadly Choices: How the Anti-Vaccine Movement Threatens Us All* (Basic Books, New York, 2011).
4. A. P. Grollman, *Environ. Mol. Mutagen.* **54**, 1 (2013).
5. O. W. Holmes, *The Medical Profession in Massachusetts* (Wilson, Boston, 1869).

10.1126/science.1244006

## SCIENCE AND RELIGION

## When Prior Belief Trumps Scholarship

Charles R. Marshall

The power of scientific reasoning derives from the complex interplay between the desire to know, the ability to reason, and the ability to evaluate ideas with data. As scientists, we have learned how to make ideas dance with reality, and we expect them to be transformed in the process. We typically add to what we already know, often showing along the way that old ideas are incomplete or, occasionally, wrong. And so we collectively build an understanding of the world that is accurate, reliable, and useful.

In *Darwin's Doubt*, Stephen Meyer (who runs the Discovery Institute's Center for Science and Culture) also tries to build. He aims to construct the philosophical and scientific case for intelligent design. I am not a philosopher, so I will not attempt to evaluate his philosophical argument that in principle it might be possible to recognize the action of a designer in the history of life. But I am willing to evaluate his scientific case for the participation of such a designer. It centers on one of the most remarkable events in that history, the relatively rapid emergence of animal phyla in the Cambrian.

Meyer's scientific approach is negative. He argues that paleontologists are unable to explain the Cambrian explosion, thus opening the door to the possibility of a designer's intervention. This, despite his protest to the contrary, is a (sophisticated) "god of the

The reviewer is at the Department of Integrative Biology and Director of the Museum of Paleontology, University of California, Berkeley, CA 94720-4780, USA. E-mail: crmarshall@berkeley.edu



**Scree slope site.** Walcott quarry in the Burgess Shale, which beautifully preserves soft-bodied animals from shortly after the Cambrian explosion.

gaps" approach, an approach that is problematic in part because future developments often provide solutions to once apparently difficult problems.

*Darwin's Doubt* begins with a very readable review of our knowledge of the Cambrian explosion. Despite its readability and a plethora of scholarly references, however, there are substantial omissions and misrepresentations. For example, Meyer completely omits mention of the Early Cambrian small shelly fossils and misunderstands the nuances of molecular phylogenetics, both of which cause him to exaggerate the apparent suddenness of the Cambrian explosion.

I like to read the arguments of those who hold fundamentally different views from my own in the hope of discovering weaknesses in my thinking. And so even after reading the flawed first part of his

book, I dared hope that Meyer might point the way to fundamental problems in the way we paleontologists think about the Cambrian explosion.

However, my hope soon dissipated into disappointment. His case against current scientific explanations of the relatively rapid appearance of the animal phyla rests on the claim that the origin of new animal body plans requires vast amounts of novel genetic information coupled with the unsubstantiated assertion that this new genetic information must include many new protein folds. In fact, our present understanding of morphogenesis indicates that new phyla were not made by new genes but largely emerged through the rewiring of the gene regulatory networks (GRNs) of already existing genes (*1*). Now Meyer does touch on this: He notes

that manipulation of such networks is typically lethal, thus dismissing their role in explaining the Cambrian explosion. But today's GRNs have been overlain with half a billion years of evolutionary innovation (which accounts for their resistance to modification), whereas GRNs at the time of the emergence of the phyla were not so encumbered. The reason for Meyer's idiosyncratic fixation with new protein folds is that one of his Discovery Institute colleagues has claimed that those are mathematically impossibly hard to evolve on the timescale of the Cambrian explosion.

As Meyer points out, he is not a biologist; so perhaps he could be excused for basing his scientific arguments on an outdated understanding of morphogenesis. But my disappointment runs deeper than that. It stems from Meyer's systematic failure of scholarship. For instance, while I was flattered to find him quote one of my own review papers (*2*)—although the quote is actually a chimera drawn from two very different parts of my review—he fails to even mention the review's (and many other papers') central point: that new genes did not drive the Cambrian explosion. His scholarship, where it matters most, is highly selective.

Meyer's book ends with a heart-warming story of his normally fearless son losing his orientation on the impressive scree slopes that cradle the Burgess Shale, the iconic symbol of the Cambrian explosion, and his need to look back to his father for security. I was puzzled: why the parable in a book ostensibly about philosophy and science? Then I realized that the book's subtext is to provide solace to those who feel their faith undermined by secular society and by science in particular. If the reviews on Amazon.com are any indication, it is achieving that goal. But when it comes to explaining the Cambrian explosion, *Darwin's Doubt* is compromised by Meyer's lack of scientific knowledge, his "god of the gaps" approach, and selective scholarship that appears driven by his deep belief in an explicit role of an intelligent designer in the history of life.

## References

1. D. H. Erwin, J. W. Valentine, *The Cambrian Explosion: The Construction of Animal Biodiversity* (Roberts and Company, Greenwood Village, CO, 2013); reviewed in (*3*).
2. C. R. Marshall, *Annu. Rev. Earth Planet. Sci.* **34**, 355 (2006).
3. C. J. Lowe, *Science* **340**, 1170 (2013).

10.1126/science.1244515

CREDIT: MARK A. WILSON (DEPARTMENT OF GEOLOGY, WOOSTER COLLEGE)/WIKIMEDIA COMMONS