

The Failures of Mathematical Anti-Evolutionism

Anti-scientific misinformation has become a serious problem on many fronts, including vaccinations and climate change. One of these fronts is the persistence of anti-evolutionism, which has recently been given a superficially professional gloss in the form of the intelligent design movement. Far from solely being of interest to researchers in biology, anti-evolutionism must be recognized as part of a broader campaign with a conservative religious and political agenda. Much of the rhetorical effectiveness of anti-evolutionism comes from its reliance on seemingly precise mathematical arguments. This book, the first of its kind to be written by a mathematician, discusses and refutes these arguments. Along the way, it also clarifies common misconceptions about both biology and mathematics. Both lay audiences and professionals will find the book to be accessible and informative.

JASON ROSENHOUSE is a professor of mathematics at James Madison University. He is the author or editor of eight previous books, including *Among the Creationists: Dispatches from the Anti-Evolutionist Front Line* (Oxford University Press, 2012).

“If you want to convince an audience of a falsehood, an excellent strategy is to bamboozle them with mathematical jargon that they don’t understand. If your incomprehensible equations seem to prove what the audience wants to believe anyway, you’ll earn a standing ovation. This has been a favorite tactic of anti-evolutionists. Jason Rosenhouse is a good mathematician but, unlike many mathematicians, he is superbly gifted in the art of translating mathematical arguments into words. He mercilessly exposes creationist abuses of mathematics, using language that non-mathematicians can pleurably follow. As a bonus along the way, he is an excellent mathematics teacher, patiently explaining each point before revealing the abuse of it. I especially appreciated his deft use of analogies. He is thoroughly well read in the bogus literature of creationism and ‘intelligent design,’ as well as in the biological literature. We have here a superb book, lucid, knowledgeable, wise, and very necessary.”

**Richard Dawkins FRS, Emeritus Professor of the Public
Understanding of Science, University of Oxford**

“A little mathematics can be a dangerous thing when it is used as a rhetorical weapon in a political and religious battle. In this incisive and crystal clear book, Jason Rosenhouse shows that the arguments of mathy creationists are like the proverbial spherical cow and unflightworthy bumblebee: sophistical, wrongheaded, and out of touch with biological reality.”

**Steven Pinker, Johnstone Professor of Psychology,
Harvard University, and the author of
How the Mind Works and *Rationality***

“Creationists beware! Jason Rosenhouse is here to debunk your perversions of probability theory, your tortured thermodynamics, and your insults to information theory. And the rest of us will learn a lot about evolution, mathematics, and their interrelations from the expert guidance offered in *The Failures of Mathematical Anti-Evolutionism*”

**Glenn Branch, Deputy Director, National
Center for Science Education**

“Written by a mathematician who has paid close attention to mathematical arguments against evolution, this is a beautifully written and careful refutation of those arguments. Jason Rosenhouse covers arguments based on improbability, information, and thermodynamics, and he does so with clear explanations that will be accessible to anyone who takes science seriously. A wonderful achievement.”

Joe Felsenstein, University of Washington

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To my friends at the National Center for Science Education.
Thanks for everything you do.

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Jason Rosenhouse

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Preface

People who work in the life sciences typically regard it as obvious that modern evolutionary theory is essentially correct. They find that there is just too much data that falls right into place if you take evolution as your starting point, and they consistently get good results when they apply the theory to practical problems. There is much to argue about in the details, and new ideas seem to get introduced faster than they can be assessed, but there is near unanimous agreement that the big picture – that modern species are the end result of a lengthy historical process and that natural selection is an especially important mechanism of evolution – is roughly the way Charles Darwin first described it in 1859.

But for as long as there have been evolutionists there have also been anti-evolutionists. There have always been those who *do not like* evolution, and they offer a variety of arguments in support of their views. Many of these arguments are at least superficially scientific, though it is hardly a secret that religious motivations are nearly always lurking beneath the surface. For their part, scientists mostly scoff at anti-evolutionism, and rightly so. Some anti-evolutionists write more compellingly than others, but it never really seems too difficult for a scientifically knowledgeable reader to refute their arguments. Frankly, most anti-evolutionist arguments are based on faulty reasoning, absurd distortions of the scientific facts, caricatures of what evolutionary theory actually asserts, or all three.

Mathematics has long played a role in anti-evolution discourse, but in the past 10–15 years it has become far more prominent than it had previously been. Nearly all of the major anti-evolution books and articles during this time place mathematical arguments front and center. Sometimes it seems like

every other page contains a probability calculation, an invocation of information theory, or a dubious claim about combinatorial search. Scientists have replied piecemeal to these arguments, but there has been no survey of mathematical anti-evolutionism taken as a whole. Moreover, it is only on rare occasions that mathematicians themselves have taken note of this abuse of their discipline. Our training makes us sensitive to points that are likely to be overlooked by scientists, for whom mathematics is mostly just a tool that they use in doing their work. That is where this book comes in.

As I describe in Section 1.3, my interest in this subject began in the early 2000s. I had just completed my PhD in mathematics, and my first job out of graduate school was at Kansas State University. Specifically, my job had much to do with the training of public school mathematics teachers in the state. At that time, Kansas was mired in controversy because a politically conservative state school board had voted to remove scientific topics like evolution and the big bang from the science curriculum. My work brought me into close contact with people on the front lines of this dispute. When I subsequently learned of a forthcoming creationism conference not far from my home, I decided, on a whim, to attend.

Over the next 7–8 years I attended dozens of such conferences, as well as smaller gatherings. Some were devoted to young-Earth creationism, which holds, among other things, that the best available science confirms a literal reading of the creation accounts in the early chapters of the biblical book of Genesis. Others promoted intelligent design, a more modest form of creationism that came to prominence in the early 1990s. Some were large conferences like the one I attended in Kansas, while others were much smaller gatherings held in local churches.

After many years of this I decided I had a story to tell, and I told it in my earlier book, *Among the Creationists: Dispatches from the Anti-Evolutionist Front Line*, published in 2011. The book was mostly about the cultural milieu in which these disputes play out, and it was organized around my personal experiences. It was not

primarily about refuting creationist arguments, though I did address a few of them along the way.

I had intended for that to be my last word on the subject, but the strong emphasis on mathematical arguments in recent anti-evolutionist discourse made me reconsider. I thought about all the times I had seen anti-evolutionists present transparently fallacious mathematical arguments to their audiences, only to be rewarded with cheers and standing ovations as a result. I also thought about all the times when I had seen scientists respond to anti-evolutionist arguments in ways that I thought did not really get to the heart of the matter. It is for these reasons that I decided to write this book.

The first three chapters are mostly stage setting. After providing a general introduction in Chapter 1, I present some of the basics of evolutionary biology and mathematics in Chapters 2 and 3. The evidence for evolution has been presented at length in other venues, but since I wanted this book to be as self-contained as possible, I included some of that material in Chapter 2. Many people hold misconceptions about what mathematics really is since they tend to equate it with arithmetic. I dispel those myths in Chapter 3.

Chapter 4 addresses the famous Wistar conference, held in Philadelphia in 1966. The proceedings were published the following year under the title *Mathematical Challenges to the Neo-Darwinian Theory of Evolution*. The challenges came primarily from Murray Eden and Marcel-Paul Schützenberger, respectively an engineer at the Massachusetts Institute of Technology and a mathematician at the University of Paris. Eden and Schützenberger were both very eminent in their own fields, but their anti-evolution arguments were just bad. Their ideas cut little ice with the assembled biologists, but they remain folk heroes among anti-evolutionists to this day. We will analyze their arguments in considerable detail.

Chapters 5–7 constitute the heart of the book. We consider the major lines of argument in modern mathematical anti-evolutionism, and we explain why they are entirely misguided. It is not only that

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the specific arguments they make contain errors of various sorts, but also that their whole way of thinking about evolution is fundamentally mistaken. Chapter 5 discusses arguments based on probability theory, while Chapter 6 considers arguments drawn from the closely related mathematical theories of information and combinatorial search.

Chapter 7 addresses anti-evolution arguments based on thermodynamics, especially the second law. Thermodynamics would normally be considered a branch of physics, but it has a strongly mathematical character that justifies its inclusion in this book. The second law is a precise, mathematical statement, and a failure to appreciate this fact allows anti-evolutionists to get away with incredibly sloppy argumentation, and it leads evolutionists to not always reply as effectively as they might do. We then close with a short epilogue (Chapter 8), summarizing the discussion and offering a few closing thoughts.

Let me be clear that this is a mathematics book that also discusses biology, as opposed to a biology book that also discusses mathematics. Inevitably, there are places where we must get our hands dirty by digging into the biological details, but my central points are mathematical and not biological. Biologists will rightly criticize me for presenting a simplistic version of modern evolutionary theory. I focus almost entirely on natural selection acting at the level of genes, but everyone understands that there is far more to evolution than this. The geneticists will likewise have reason to complain. In this book, a gene is treated as nothing more than a combinatorial sequence drawn from an alphabet of four letters, thereby ignoring most of the difficult technical details about how genes actually work.

My excuse is that the anti-evolutionists under consideration aim their fire almost exclusively at the question of how complex adaptations arise, and this justifies my narrow focus. I am not writing a general treatise on evolutionary biology. Instead, I am discussing the one small part of the theory relevant to anti-evolutionist arguments. Moreover, I am rhetorically making things more difficult for

evolution by restricting its explanatory options solely to natural selection acting on chance genetic variations. My argument is essentially that even if we take this narrow understanding of evolution as our starting point, we still have more than enough resources to refute any gambit coming from the other side.

My intended audience is anyone who takes an interest in the evolution/creation issue. I have tried to write in as nontechnical a manner as possible, and I have mostly avoided notation and jargon. The handful of places where I did include notation can be skimmed without losing the flow of the argument. For lay audiences, I hope I have managed to provide some food for thought about mathematics, and that I have shown that scientists have good reasons for being dismissive of mathematical anti-evolutionism. For professional scientists, the perspective of a mathematician on these issues might hold some interest.

In the end, this book was written in the conviction that nonsense has to be confronted. The anti-evolutionists are slick and well funded, and their output is just one part of a broader, politically conservative agenda. I have no illusions that one short academic book can really put much of a dent in the anti-scientific parallel universe they have created, but I believe it is important to try.

Several people provided helpful advice and guidance while I was preparing the manuscript. Kostas Kampourakis first suggested that I write this book, and I am very glad he did so. Initially I was skeptical – a whole book on mathematical anti-evolutionism? – but as I immersed myself in the project I came to agree that it was necessary. Glenn Branch, Tom English, Joseph Felsenstein, and Burt Humburg provided invaluable feedback on the first draft of the book. I have greatly benefited from their scientific, historical, and literary expertise, and the final product has been strengthened as a result. Of course, it should go without saying that the fault for any remaining errors lies entirely with me. Finally, let me thank Katrina Halliday, Olivia Boulton, Divya Arjunan and their whole team at Cambridge University Press for supporting this project and for being understanding when I shot past my deadlines.

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