

THE COSMIC REVOLUTIONARY'S HANDBOOK

(Or: How to Beat the Big Bang)

For all those who wonder about our bizarre universe, and those who might want to overthrow the Big Bang with alternative theories, this handbook gives you “just the facts”: the observations that have shaped these ideas and theories. While the Big Bang holds the attention of scientists, it isn't perfect. The authors pull back the curtains, and show how cosmology really works, by asking “If you wanted to replace the Big Bang model, how would you go about it? What cosmological evidence would you need to account for?” Only by accounting for these observations – all of them – can you present a viable cosmological theory.

This uniquely-framed tour of modern cosmology gives a deep understanding of the inner workings of this fascinating field. The portrait painted is realistic and raw, not idealized and air-brushed – it is science in all its messy detail, which doesn't pretend to have all the answers.

Luke A. Barnes is a lecturer in physics at Western Sydney University, with a Ph.D. in astronomy from the University of Cambridge. The focus of his research has been the cosmic evolution of matter, and he has published papers in the field of galaxy formation and evolution, and on the fine-tuning of the universe for life. He returned to the University of Sydney in 2011 as a Super Science Fellow, before being awarded a prestigious Templeton Fellowship to expand his research on fine-tuning of the laws of physics for complexity and life. Dr Barnes is an accomplished speaker to professional and amateur audiences, and can speak across the boundaries of cosmology, philosophy, and religion. He has lectured to numerous amateur astronomical groups and to public audiences, including speaking on fine-tuning at the Royal Institution in London in 2017. He tweets @lukebarnesastro.

Geraint F. Lewis is Professor of Astrophysics at the Sydney Institute for Astronomy, part of the University of Sydney's School of Physics. The focus of his research is cosmology and the dark side of the universe, namely the dark matter and dark energy that dominate cosmological evolution. He has published more than three hundred academic papers and is an acclaimed teacher. He also has a significant outreach profile, writing regularly for *New Scientist* and *The Conversation*, as well as regularly speaking publically on all aspects of cosmology and astronomy, including speaking at the Royal Institution in London. He also has extensive experience of interactions with the media, including podcast, radio, and television. He currently is Deputy Director of the Sydney Informatics Hub, developing the infrastructure and knowledge base to support big data, informatics, deep learning, and artificial intelligence at the University of Sydney. He tweets @Cosmic_Horizons.

“Overthrowing all of modern cosmology isn’t easy, but it could happen. Maybe you will be the one to do it! If you’re up for the challenge, Luke A. Barnes and Geraint F. Lewis tell you exactly what you have to accomplish. Even if you don’t topple the stodgy edifice of modern science, you’ll certainly learn some exciting things about the universe along the way.”

Sean Carroll, author of *Something Deeply Hidden: Quantum Worlds and the Emergence of Spacetime*

“If you are looking for a fun rendezvous with the universe, this is the book for you! Barnes and Lewis help you understand the basics of cosmology with simplicity and clarity – quite a feat given the complexity of our universe.”

Priyamvada Natarajan, author of *Mapping the Heavens: The Radical Scientific Ideas that Reveal the Cosmos*

“Are you unhappy with the state of cosmology and think it needs to be revolutionised? If so, cosmologists Luke Barnes and Geraint Lewis have written The Cosmic Revolutionary’s Handbook just for you. [This is] a great starting point for budding astronomers or cosmologists who want to be able answer the ‘but how do we know ...?’ questions they’re likely to get asked. 4/5 stars”

Chris North, BBC Sky at Night Magazine

“In their book, the authors describe the unbiased observations of the Universe that any cosmological theory has to explain. If you already have a basic background knowledge of cosmology and want to learn more about its intricacies (and to argue successfully with the revolutionaries), then this is definitely the book for you.”

Keith Cooper, *Astronomy Now*

“Luke Barnes and Geraint Lewis set out to describe why cosmologists believe in the Hot Big Bang model and all the apparent complications it brings. [In addition] the authors provide a remarkably accurate insight into how science really is done. I feel that many professional scientists would benefit from reading this book! Overall, [this] is a must-read for anyone interested in better understanding why cosmologists believe all those very strange things about the Universe.”

Sunny Vagnozzi, *Nature Astronomy*

“Barnes and Lewis inform the general reader about many fascinating aspects of astronomy, astrophysics, and cosmology. The book is full of scientific facts and clarifying figures. More importantly, it clarifies the routes that led to major scientific results. ... [It] will inform and educate those who respect science and are willing to learn about good science and how it is done. This should be required reading for all college students, regardless of their major.”

V. V. Raman, *Choice Reviews*

“This book is a popular account of modern cosmology, with more emphasis than most similar books on two important aspects: how conclusions are arrived at and which conclusions depend on which observations. I enjoyed reading this book; it's a breezy but careful introduction to where we are in our understanding of the Universe and how we got there.”

Phillip Helbig, *The Observatory*

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Luke
For Bernadette,
who will understandably prefer Terry
Pratchett's version of the big bang theory.

Geraint
To slightly misquote *Rocky Horror*,
this book is for those that rose tint my world
and keep me safe from my trouble and pain.

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PREFACE

This book was born from experience. We are cosmologists: our day job is to unravel the inner workings of our universe (and, occasionally, a few other universes). We have a deep love of our field and have taken many opportunities to spread the message of scientific enquiry beyond our less-than-ivory towers of academia. Writing and speaking, we have explained the view through the latest generation of telescopes, and the astounding and/or confusing theories that describe what is seen.

We genuinely enjoy interacting with the public, especially the barrage of questions that inevitably follow a talk about dark matter or the cosmic microwave background or life in the cosmos. Forced to think on our feet, the simplest questions sometimes need the most intricate answers. Most of all, we have learnt to never underestimate curious children!

We have also met others, either in person, in neatly written letters, or via grammar-optional emails, who don't like what we have said. To them, the universe we portray, the universe described by modern cosmology, just does not seem right. They don't like the reliance on unseen things ("Dark matter? You must be kidding!"). Or they distrust the bendy and stretchy space and time of Einstein's general theory of relativity. Or the weirdness of quantum mechanics. Or the conclusion that there must have been a cosmic birth. Or the thought of a bleak and frigid future ahead. Clearly modern cosmology has been led astray, away from logic and common sense, to something complex and crazy.

Some of these people have been working hard to fix this problem, developing their own ideas about the real universe, based on solid logic, that will revolutionize our understanding of the cosmos. If only scientists would listen. But after mailing

and emailing and trying to talk with cosmologists, they have been met with silence.

We realized that in presenting the wonder and awe of science's picture of the universe, it is easy to lose sight of how we got here. The *act* of doing science was lost in the message. Science is a process by which an idea about the physical world is created, developed, and held up to our observations of nature, the ultimate arbiter.

In particular, we have often explained to aspiring revolutionaries this important principle: you have to explain *all* the data. You can't just pick your favourite and ignore the rest. And in modern cosmology there is a lot of data, and a lot of different types of data, to explain.

So, this book was born. We decided to shine a light on how scientists build and battle-test their ideas. We will focus on the critical observations that have laid to rest many cosmological contenders, as well as the challenges that are yet to be explained.

Keep up to date with further news, updates and commentary from the authors by following [@CRHandbook](#) and their YouTube channel, [AlasLewisAndBarnes](#).