

Book Review

The Universe in a Nutshell

Reviewed by Steven G. Krantz

The Universe in a Nutshell

Stephen Hawking

Bantam Books, New York, 2001

ISBN 0-553-80202-X

\$35.00, 216 pages

Along with Andrew Wiles and Linus Pauling, Stephen Hawking is one of the very few modern scientists whose name is a household word. Hawking, the Lucasian Professor of Mathematics (Isaac Newton's chair) at Cambridge University, has an insight and an imagination that soar across the cosmos, devising dreams and schemes of how the universe works. The legend of Hawking is of course immensely augmented by the fact that he is afflicted with motor neurone disease (commonly known in the U.S. as "Lou Gehrig's Disease"). In fact he has known that he had the disease since the age of twenty-one (Hawking is now sixty). He did not expect to live to the age of twenty-five and was tempted to despair. Instead, by his own telling, the knowledge of having this deadly illness gave him courage and hope and a will to live. It took his aimless and futile life (which Hawking himself has described elsewhere in painful and shamefaced detail) and gave it direction and purpose. And he has applied that newfound *Gestalt* to the development of ideas in theoretical physics.

To read any of Hawking's many books, one would never realize just how devastating

Steven G. Krantz is chair and professor in the Department of Mathematics at Washington University in St. Louis. His e-mail address is sk@math.wustl.edu.



Hawking's illness is. He speaks of it only rarely and as if it were just a minor inconvenience. However, his friend Roger Penrose has told me quite frankly that it requires an army of people just to keep Hawking going: He cannot speak, he cannot walk, he cannot pick up a pen, and he cannot even breathe on his own. Hawking's popular writing

is redolent of joy and good humor and great high spirits. One cannot but think that the world would be a better place if we all had the good and optimistic frame of mind of Stephen Hawking. His is truly a profile in courage.

Stephen Hawking's *A Brief History of Time* [HAW] has been a publishing phenomenon. Penned in 1988, it spent more than four years on the bestseller lists and sold more than ten million copies in forty languages. As Hawking's postdoc Nathan Myhrvold (of Microsoft fame) has said, Hawking has sold more books on physics than Madonna has on sex. Part of the appeal of *Time* is the Hawking mystique, but a considerable part of its charm is the breezy and friendly style in which the book is written. Like mathematics, physics is stark and rigorous and forbidding, enshrouded by technical

lingo and recondite ideas. Although “relativity”, “the uncertainly principle”, “the speed of light”, and “black holes” hold great charm and fascination for the layman, most writings on these topics are either facile and incorrect or onerous and obscure. Hawking forges a brilliant path between these two extremes. Obviously everything he says is authoritative and accurate; in those instances where he must blow smoke, he is quite honest about it and still gives the reader a sense of what is going on. Hawking uses analogy and humor and example and metaphor to depict his ideas in an attractive and compelling manner.

So if *A Brief History of Time* is the be-all and end-all of the popular conception of cosmology, then why is there any need for another book? Well, publishers like to sell books; and Stephen Hawking is a best-selling author. But let us be more charitable. By Hawking’s own telling, *Time* is a tough go for the untrained reader. As I was reading the book’s description of the forward and backward light cones, I was struck by how simple and obvious these ideas are to a trained scientist (like myself), and how utterly obscure they must be to a tyro. The rather more expensive “illustrated edition” of *Time* has many attractive graphics, but the original and widely disseminated first edition has only a few simple line drawings. As a result, and in spite of its immense popularity, the book comes off as a bit dry and uninviting. The common wisdom is that millions bought the book, but few have gotten past the first twenty pages.

Enter *The Universe in a Nutshell*. In his preface, Hawking acknowledges the difficulties noted in the preceding paragraph and touts the importance of good pictures. This new book, he claims, will be much more accessible to the lay reader. He points out, wisely I think, that *Time* is written in a linear order—just like a mathematical monograph. Chapter $n + 1$ in *Time* depends strictly on Chapters 1 to n . Of course the mathematical scientist is accustomed to this type of vertical development. The average reader is not. In a much-read article [THU] on mathematics education, William Thurston points out that mathematics is a “tall subject.” The student painstakingly climbs up the pole to the point where he loses his grip, and then he falls down (never to rise again). Thurston argues for the value of making mathematics a “wider subject” with a broad-based infrastructure. Hawking has got this message. In his new book, his organization pattern is a tree: After the introductory material, the book branches out in several different directions. The reader may dip into the succeeding chapters at will and jump around as interest and inclination dictate. Perhaps more important is that *Nutshell* has marvelous figures, many of them in full color. These are pictures (very elementary ones) of scientific ideas, or of equations, or of the scientists

themselves. There are sidebars on Kurt Gödel and Kip Thorne and Richard Feynman and John Wheeler and *Star Trek* and any number of other familiar people and topics. The book is just plain fun. Even when the casual reader gets lost, and he certainly will, he will be encouraged and carried along by the graphics and by the verbal byplay that accompanies the more serious text proper. An added feature is that the book has a concise and useful glossary. Many a reader will have difficulty keeping track of terms and ideas, and this tool will certainly keep many an aficionado going.

There are perhaps those who will criticize *Nutshell* for not being sufficiently serious. Popular singer/songwriter Neil Sedaka says that people fault him for having too much fun with his music. Certainly Hawking has tremendous fun with his physics. A few sample passages suggest the overall tone:

Newton occupied the Lucasian chair at Cambridge that I now hold, though it wasn’t electrically operated in his time.

This [time dilation as explained by relativity theory] might suggest that if one wanted to live longer, one should keep flying to the east so that the plane’s speed is added to the earth’s rotation. However, the tiny fraction of a second one would gain would be more than canceled by eating airline meals.

...I estimate the probability that Kip Thorne could go back and kill his grandfather [using time travel] as less than one in ten with a trillion trillion trillion trillion zeroes after it. That’s a pretty small probability, but if you look closely at the picture of Kip, you may see a slight fuzziness around the edges. That corresponds to the faint possibility that some bastard from the future came back and killed his grandfather, so he’s not really there.

The reader of this review can surely see that I am a great admirer of Stephen Hawking. His strength and his courage and his exuberance are both infectious and inspiring. But I also appreciate the tremendous intellectual effort that it takes to explain a subject as technical and deep as cosmology to the lay public. It takes real gifts, and tremendous determination, to pull this off. It requires a certain amount of *chutzpah* even to try it. The likelihood of failure is considerable, and the likelihood of embarrassment before one’s colleagues is huge. Yet we in the mathematical sciences have suffered in the public eye, have suffered in the derby for

funding, and have suffered among the sciences because we have not been willing to take these risks. I can only hope that we will all see Stephen Hawking as a role model and that we will therefore try—even in a small way, perhaps by consenting to an interview with the campus newspaper—to communicate as Hawking has. There is much to be gained, and the risks are well worth it. Now that Hawking has forged the path, it is much easier for the rest of us to follow.

Hawking confesses that when he wrote *A Brief History of Time* he felt that physicists were on the verge of a great overarching theory that would, in particular, reconcile general relativity with quantum mechanics. Part of the purpose of the present book is to bring the reader up to date with progress on this unified theory in the past thirteen years. Hawking addresses this goal by way of describing various avenues of research that he, himself, has pursued. This of course makes perfect sense, and he does a splendid job of giving the reader a feel for p -branes, string theory, Feynman's multiple histories, black holes, and many other cutting edge ideas. I am not at all sure that, having labored through the book, the reader will have a clear idea of where we are now as compared to where we were in 1988. One is tempted at this point to compare Hawking's new book with Brian Greene's *The Elegant Universe* [GRE]. Greene states point blank in his preface that "... physicists believe that they have finally found a framework for stitching these insights together into a seamless whole—a single theory that, in principle, is capable of describing all physical phenomena." He then proceeds to spend 387 pages telling us (by way of superstring theory and the like) how the physicists have achieved this end. Greene is less interested in entertaining us than in telling a very serious story. As a result, his book is rather more cerebral and ponderous than Hawking's. It has nevertheless been well received and has certainly acquainted a broad cross-section of the populace with some important scientific developments. But the book is perhaps more austere than even *A Brief History of Time*. It contains much more solid information than, and will reach a much more limited audience than, *The Universe in a Nutshell*. This is a trade-off with which both authors should be comfortable.

The Universe in a Nutshell has many features going for it. Like *A Brief History of Time*, it has a delightfully wry and enticing title. It draws the reader in quickly and painlessly and sustains him with wit and popular touchstones and fun. The reader of *Nutshell* will know, because Hawking has told him quite explicitly, that we have not yet reached our goal of a unified theory and that we probably never will. To Hawking's mind, and to mine as well, this is all to the good because the

journey is much more enthralling than the finish. The reader of *Nutshell* will have been left with many opened doors and unanswered questions, and this is clearly how Hawking wants it. Readers of his next book will have all the necessary prerequisites.

References

- [GRE] B. GREENE, *The Elegant Universe*, Norton, New York, 1999.
[HAW] S. HAWKING, *A Brief History of Time*, updated edition, Bantam Books, New York, 1996.
[THU] W. P. THURSTON, Mathematical Education, *Notices* 37 (1990), 844–850.