

BOOKSHELF

The Edge of Physics: A Journey to Earth's Extremes to Unlock the Secrets of the Universe

by Anil Ananthaswamy, Houghton Mifflin Harcourt. Hardback ISBN 9780547394527, \$25. Paperback ISBN 9780547394527 \$15.95.

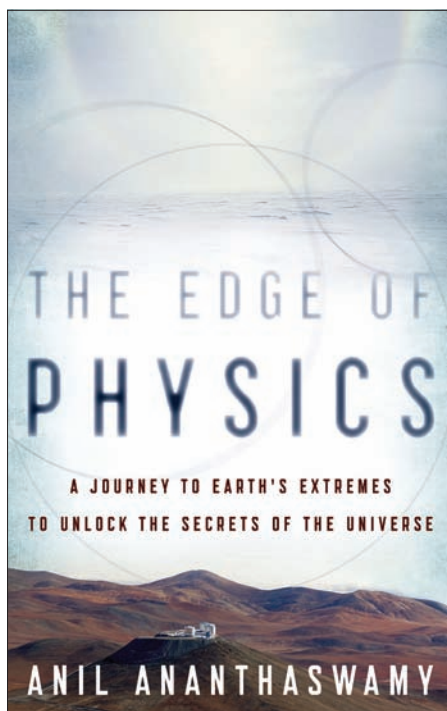
In his recent book *The Edge of Physics*, Anil Ananthaswamy, a science writer for *New Scientist*, covers the most extreme physics and astronomy experiments that are set to uncover the secrets of neutrinos, dark matter and dark energy, galaxy formation, supersymmetry and extra dimensions. The author takes us on an extraordinary journey over five continents to tour the best telescopes and particle detectors, from the summits of the Andes to deep down in the Soudan mine, stopping by the South Pole and paying a visit to CERN. Following him on this trip is already exciting, but reading his account of discussions with physicists, astronomers and engineers along the way is simply fascinating. He tells us about each experiment as he discovered them through discussions with the scientists involved. For example, he writes about the ATLAS experiment through the eyes of Peter Jenni, Fabiola Gianotti and François Butin, with added insight from a meeting with Peter Higgs.

This makes for lively reading about all of these experiments. He not only tells us the most striking details about how each one was built, but he also includes accurate information about the science and technology behind them, avoiding clichés in his efforts to make it understandable to all. You read about his stay at Lake Baikal, discussing neutrino physics with enthusiastic and dedicated physicists such as Igor Belolaptikov and Ralf Wischnewski, sharing stories and vodka with them on the shores of Lake Baikal in the midst of winter – the only time that the photomultiplier tubes of the underwater neutrino experiment can be serviced from the frozen surface of the lake. The reader learns about the scientific research at all of these places through

Summer Bookshelf

Summer for physicists is the season of conferences as well as (or instead of!) well earned holidays, although this year many particle physicists will no doubt be hoping for profitable shifts on the LHC, taking up the nights as well as days.

For those who find some time for reading something other than drafts of their latest papers and preprints with new results, this Bookshelf reviews a selection of less technical books for more relaxed reading, whether on holiday or on those long plane journeys – or between shifts on the LHC!



personal accounts from the scientists involved. At times, it felt as if I was meeting old friends at a conference and hearing their best stories about their experiments, sharing their enthusiasm and discovering unknown details about their research.

The Edge of Physics also allowed me

to learn more about the best astronomy instruments, some located in idyllic places such as Hawaii, while others are under construction in the least life-sustaining places, such as in the Karoo desert in South Africa or the Hanle Valley in India. Ananthaswamy's book is as much a tribute to the science as it is to the dedicated scientists pushing the limits of knowledge. His clear explanations and entertaining style will appeal to scientists and non-scientists alike. A book not to be missed.

Pauline Gagnon, Indiana University and ATLAS.

Lake Views: This World and the Universe

by Steven Weinberg, Belknap Press/Harvard University Press. Hardback ISBN 9780674035157, \$25.95.

This book collects some essays and book reviews written by Steve Weinberg between the years 2000 and 2008. They were written in his study at home, from where the author can see Lake Austin. In 25 chapters he covers an impressive number of subjects ranging from military history to his review of Richard Dawkins' book *The God Delusion*, passing through fundamental physics, missile defence, the boycott of Israeli academics and even offering some advice to young students and postdoctoral fellows.

As with previous books, one is captivated by the depth and breadth of his knowledge, the elegance of his prose and his intellectual honesty. In each chapter there is a preamble where he explains the origin of the article, whether it was asked for by different journals or as an exposition to a learned society; an afterword reveals some of the reactions his views have elicited.

An important part of the book is dedicated to the current theory of multiverses and string landscapes. To a certain extent all of these developments were inspired by his remarkable work in the late 1980s (explained in the book) where he used anthropic reasoning to understand (if not explain) the possible value of the cosmological constant, also known as



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the dark energy of the universe. It is quite remarkable that the value derived from the observations carried out by groups studying galactic redshifts, as well as from the Wilkinson Microwave Anisotropy Probe satellite, are in good agreement with the values favoured by his analysis. The sections of the book describing this work, dealing with Einstein's famous blunder, are a masterpiece of insight and deep mastery of physics.

In other chapters, covering the humanities or religion, he takes his usual "rationalist, reductionist, realist and devoutly secular" viewpoint. Unlike Dawkins, his discourse is not the one of a "born-again atheist" (my quotes), but rather he explains his point of view in a relaxed form not devoid of humour. The effect of the relevant chapters is probably much stronger in US society, where religion plays a much bigger role than in Europe, where a large number of scientists, humanists, politicians and ordinary citizens would easily agree with his discourse. He raises provocation to the level of an art.

Another theme addressed in these essays is the ongoing discussion with philosophers or theologians on the notion of whether science explains only the "how" and not the "why" of things. He makes it very clear that the laws of nature have no purpose, and that the only legitimate purpose of science is to understand the basic laws that rule the

universe. Finality is not the aim of science, but that does not make it a lesser element in the human endeavour to understand the universe that we live in.

Weinberg has not lost his punch. Far from that. This book is thought provoking, informative, challenging and fun to read. A single fault: it is too short.

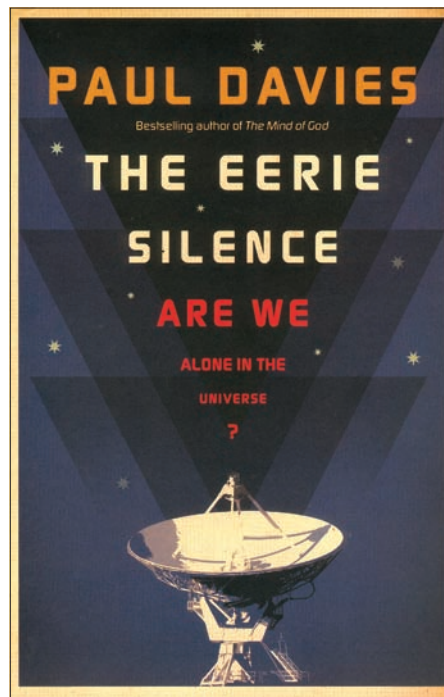
Luis Álvarez-Gaumé, CERN.

The Eerie Silence: Are We Alone in the Universe? by Paul Davies, Allen Lane. Hardback ISBN 9781846141423, £20. (US edition, **The Eerie Silence: Renewing Our Search for Alien Intelligence**, Houghton Mifflin Harcourt. Hardback ISBN 9780547133249 \$27.)

Besides being a theoretical physicist, cosmologist and astrobiologist, Paul Davies is a prolific bestselling author of books about science that are aimed at a general readership and address such "big questions" as the beginning, evolution and "the last three minutes" of the universe, the origin of life and the nature of time, etc. His latest book commemorates the 50th anniversary of the SETI project – the Search for Extra-Terrestrial Intelligence.

I became acquainted with this exceptionally bold enterprise, aimed at searching for (and, hopefully, finding) signals of extraterrestrial intelligence through Carl Sagan's highly successful and somewhat poetic TV series *Cosmos* and his book *Contact*, which was turned into a fascinating film starring Jodie Foster. Davies' new book represents a much more down-to-Earth perspective, so to speak, that tries as much as possible to remain within the boundaries set by a scientific appraisal of the topic. But even staying away from science-fiction fantasy and speculation, the currently accepted general laws of physics provide enough room for all sorts of mind-bending scenarios relating to the existence of alien civilizations or their mysterious and seemingly unexpected silence. Furthermore, "at any given time scientists can only state the laws of physics to the best of their current understanding. In science, the last word is never said; there is always room for revision in the light of new evidence".

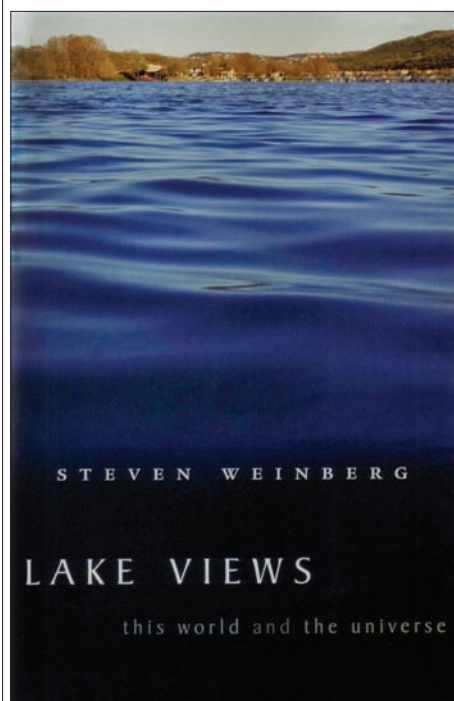
Nevertheless, discussions around SETI require a good dose of "healthy scepticism" and the scientist in Davies answers Enrico Fermi's provocative question, "Where is



everybody?", by freely admitting that "we are probably the only intelligent beings in the observable universe". In parallel, his human nature prefers the romantic moments when he dreams of a more meaningful universe, teeming with intelligent life.

This book is certainly a nice option for "summer reading". I particularly enjoyed reading about the searches for "weird life" on Earth – life based on a different set of amino acids, or using only two of the four standard nucleotides, for example. While known life selects right-handed sugars and left-handed amino acids, the laws of chemistry are mirror-symmetric and do not forbid the existence of life with the opposite chirality. Experiments have already been made, using chirality and many other signatures, to search for a "shadow biosphere" in our planet, whose biodiversity in the microbial domain remains mostly uncharted territory.

The book's main question – Are we alone in the universe? – must rank very highly in the list of the most profound questions that humans can ask and has a very curious feature: whether the answer is "yes" or "no", the consequences are "quite staggering" (as Arthur C Clarke would say). Davies answers, after more than 200 pages packed with information, with the concluding words: "We just don't know". However, I enjoy *Contact*'s conclusion much more, when Jodie Foster's





Quantum Leaps

JEREMY BERNSTEIN

character says to a group of children: "The universe is a pretty big place. It's bigger than anything anyone has ever dreamed of before. So, if it's just us... it seems like an awful waste of space."

Carlos Lourenço, CERN.

Quantum Leaps by Jeremy Bernstein, Harvard University Press. Hardback ISBN 9780674035416, £14.95 (€17.10, \$18.95).

At Bonn I often ask incoming students what persuaded them to study physics. It is a very personal question, which students in Germany already face before they enter university. However, it helps to break the ice and gets the students talking. I also ask because, after all of these years, my own answer is still not clear to me.

In this popular book Jeremy Bernstein describes how, as an American liberal-arts undergraduate, he got sucked into physics when faced with the peculiarities of quantum mechanics. His curiosity took hold of him. Even though he had no previous interest in science whatsoever, he couldn't resist. Here he has extended his personal voyage to explore how the wider world has reacted to quantum mechanics. Bernstein is well known for his profiles in *The New Yorker* magazine. To exemplify his point, he has here chosen an unusual selection of people who have publicly reacted to quantum

mechanics in their lives and work: the Bishop of Birmingham, the Dalai Lama, W H Auden, Tom Stoppard, the physicist and communist Léon Rosenfeld, to name a few. Bernstein would not be Bernstein if he hadn't actually met and discussed with quite a few of these people. Some, like Tom Lehrer, seem to be tossed in for just this effect, but otherwise it is very charming.

Just when you think this is it, the book takes an unexpected twist. After having laid out *en passant* the basics of quantum mechanics in the previous portraits, Bernstein arrives at David Bohm and John Bell. He proceeds to give the best popular account of the quantum measurement problem that I know of. No mysticism, no philosophy: just put it on the table. Wonderful. A slight criticism, which is irrelevant for the argument presented and is not widely known: an electron beam sent through a Stern-Gerlach apparatus in fact only gives one spot and not two, as a result of two extra effects from the electric charge.

Through all of this Bernstein even manages to throw in two more novelists who were influenced by quantum mechanics in their work: Rebecca Goldstein and Michel Houellebecq. It all holds nicely together to give a fabulous account of the fascination of quantum mechanics, especially for the outsider.

This brought me back to my original question: why physics? In school, I had access to back issues of *Scientific American* and read everything that there was on the measurement problem, including the beautiful experiments by Alain Aspect. I was also fortunate to have a good friend, Thomas Burwick, to discuss all of this with. It was discussing with friends such profound questions that really drew me into physics. So, as an alternative title and a follow-up to Bernstein's earlier autobiographical book *The Life it Brings*, I'd like to propose *The People You Meet: Discussing Quantum Mechanics*. Enjoy.

Herbert Dreiner, University of Bonn.

Uranium Wars: The Scientific Rivalry that Created the Nuclear Age by Amir D Aczel, Palgrave Macmillan. Hardback ISBN 9780230613744, £18.99 (\$27). Paperback ISBN 9780230103351, £10.99. Digital Audio ISBN 9781427209320, \$20.99. Online version ISBN 9780230100992, \$12.99.

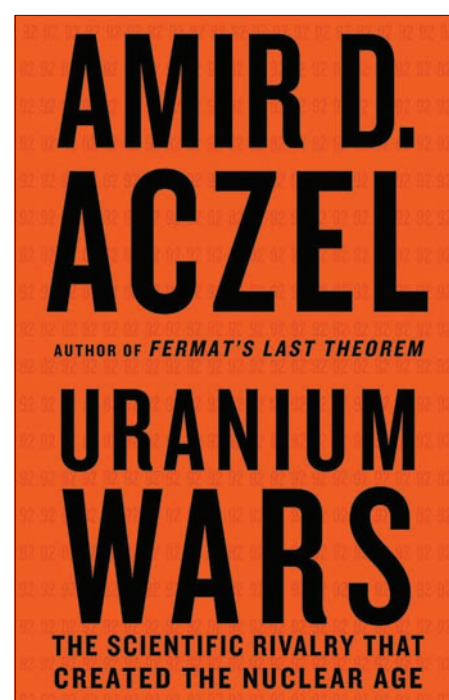
The discovery of nuclear fission and the

race to develop the atomic bomb brought a new age both of history and of science. It is not surprising that it has produced, and continues to produce, its own copious literature. The classic is Richard Rhodes' 900-page *The Making of the Atomic Bomb*, "an epic worthy of Milton", according to 1944 Nobel laureate Isidor Rabi.

The many nuclear threads, whether scientific, political or anecdotal, are closely interwoven by Rhodes, making it indeed a Miltonesque epic. It is a wonderful book, but at the same time a difficult one to consult, with its various themes fragmented and scattered. In addition, new material has been revealed since Rhodes' book first appeared, but which now forms an integral part of Aczel's more succinct story.

One such ingredient was the publication in 1992 of the Farm Hall transcripts, from when German nuclear scientists were secretly brought together in the UK in 1945 and their conversations bugged. This disclosure produced its own ripple of literature.

Another new ingredient was the explosion of speculation surrounding what could have been said at the meeting in 1941 between Niels Bohr and Werner Heisenberg, highlighted by the unexpected success of Michael Frayn's play *Copenhagen* (CERN Courier June 2007 p25). This created a controversy out of all proportion to the



importance of this meeting for history. Other nuclear events and turning points – the Frisch-Peierls memorandum, which showed that a uranium-235 bomb would be easily transportable; whether to use uranium-235 or plutonium; gun-barrel versus implosion techniques; and above all the decision to use the bomb, twice – all affected history far more. The inconsequential Bohr-Heisenberg meeting became grossly inflated.

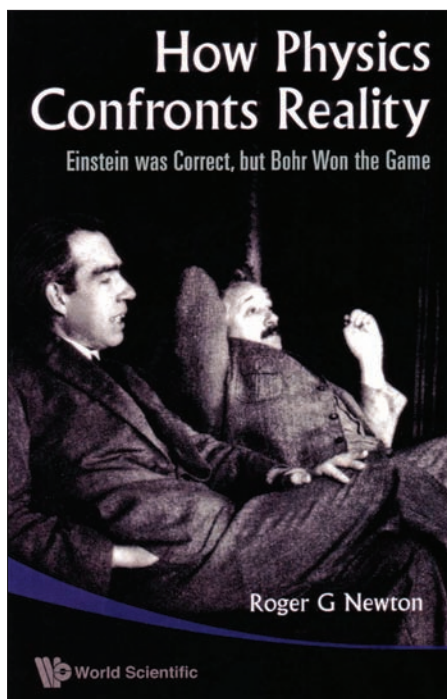
Bohr's private papers in Copenhagen were supposed to remain closed for 50 years after his death in 1962 but the controversy resulting from Frayn's play made the authorities change their mind in 2002. Aczel has drawn on this material, which includes a number of letters to Heisenberg drafted by Bohr, but never sent. Aczel reports "[Bohr's] damning words contradict everything that Heisenberg had said about his meetings with Bohr, the interpretations of the events in Copenhagen as portrayed in books..., as well as the Frayn play".

Other recently released material used by Aczel includes wartime papers that reveal the extent to which Japanese diplomatic communications were monitored by the Allies. The book is a useful survey of the history of nuclear physics and nuclear weapons, with the advantage of being succinct and up to date, from Einstein to Iran. Its revelations from the Bohr papers are important. *Gordon Fraser is editor of The New Physics for the 21st Century, recently reissued by Cambridge University Press in paperback.*

How Physics Confronts Reality: Einstein was Correct but Bohr Won the Game

by Roger G Newton, World Scientific. Hardback ISBN 9789814277020, £41 (\$54). Paperback ISBN 9789814277037, £22 (\$29.95). Online version ISBN 9789814277044, \$70.

In the mid-1960s, when the study of elastic scattering looked promising as a means to understand nuclear forces, I became acquainted with Roger Newton's textbook *Scattering Theory of Waves and Particles*



(McGraw-Hill 1966). I found it to be of great help, even if life and physics turned out to be more complex than elastic scattering.

More recently, he addressed a wider, non-specialized audience, about the making of modern physics. The aim was to help "thinking about physics rather than simply doing it" (*Thinking about Physics*, Princeton University Press 2000). He achieves that in this latest book within nine chapters embedded in an introduction (plus preface) and an epilogue, followed by a list of references and further reading, in a total of 150 pages. Physics and reality in a terse mode!

The reader finds an account of particles and fields with Faraday and Maxwell and JJ Thomson's electron; the origin of quantum theory and wave-particle duality; the uncertainty principle and new mathematical tools. But what is the significance of all of these? Bohr talked of the measurement problem and Schrödinger of entanglement. The whole of chapter 3 takes over these

points to describe Einstein's "defection" from quantum theory – but typical of this book's style we also find an aside on Bose-Einstein statistics and Bose-Einstein condensation, just to show that Einstein was not getting out of touch at the time of the Einstein-Podolsky-Rosen paper.

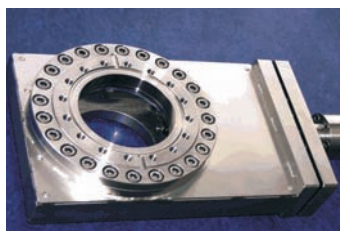
The book then develops along twin threads: how, from the ancient intuition, the reality of atoms was visibly established without doubt (chapter 4); and how in the description of the laws of motion the distance increased between the foundations of the theory and everyday experience thanks to Einstein (chapter 5). A few pages about fields lead to new particles and their quantum origin, and then to the need for accelerators, from Lawrence's cyclotron to CERN's LHC. This is followed by an attempt to explain how the particles go together to form different kinds of matter.

The last chapter casts light on "methods and underpinnings" to bring order to the crowd of particles discovered from the 1950s onwards. The experimental methods are reduced to two examples, without reference to current experiments in particle physics. The theoretical methods cover symmetries, the Standard Model, Higgs particles, strings and superstrings.

The epilogue stresses that while nowadays we visualize the ultimate constituents of matter at an unprecedented level, the laws of dynamics have become awkward and distant from our intuition. This is indeed the leitmotif of the whole book, but the melody becomes inaudible. Where it emerges it does not help the flow of the text.

The tale is pleasant, intertwined by anecdotes, but it proceeds by alighting on topics, which are not always in a logical sequence. What is assessed is accurate and well thought out, but I am not sure that without some previous in-depth knowledge the reader will get to the point. Unfortunately, half of the further reading is out of print, and some I suppose is also out of date.

Maria Fidecaro, CERN.



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