

Bookshelf

Summer Bookshelf

Summer is the season of conferences for physicists, with holidays squeezed in where possible. This year many particle physicists have been working hard on preparing the latest results from the LHC, in particular searches for the Higgs boson, based on the bumper crop of data already achieved.

For those with time for reading something other than drafts of their latest papers and preprints with new results, this Bookshelf features a few books for more some different reading – or for recommending to family and friends, while the hard work continues.

Powering the Future: How We Will (Eventually) Solve the Energy Crisis and Fuel the Civilization of Tomorrow

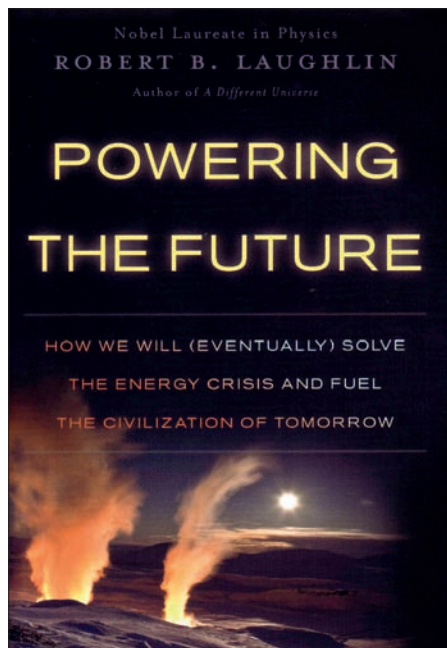
By Robert Laughlin

Basic Books

Hardback: £17.99 \$24.99

Nearly 90% of the world's economy is driven by the massive use of fossil fuels. The US spends one-sixth of its gross domestic product on oil alone, without counting the important costs of coal and natural gas, even though its use of oil and the other fossil fuels has progressively decreased since the mid-1970s. While the debate on fossil fuels continues to rage on both sides of the Atlantic, Robert Laughlin, professor of physics at Stanford University and Nobel Laureate for the fractional Hall effect, has written *Powering the Future* – a hypothetical voyage through the future, where the human race will have demands and expectations similar to those of today but where technologies will probably be quite different.

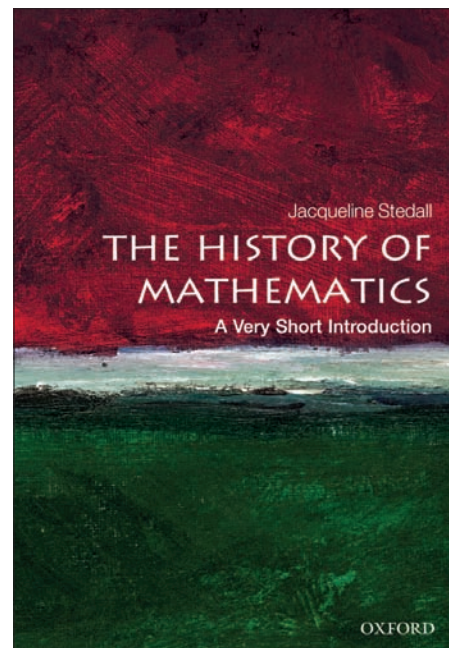
The book is essentially one of two halves. The first half contains the main chapters, where all of the essential statements and the logical lines of the various arguments are developed with an informal style. These are then complemented by the second half, which consists of a delightful set of notes. The notes encourage readers to form their own opinions on specific subjects using a number of tools, which range from assorted



references to simplified quantitative estimates.

Treatises on energy problems that are written by political scientists are often scientifically inaccurate; specialized monographs are sometimes excessively technical. This book uses an intermediate register where the quantitative aspects of a problem are discussed but the overall presentation is not pedantic. Of the numerous examples, here are two short ones. What is the total precipitation that falls in one year on the world? The answer is “one metre of rain, the height of a golden retriever” (page 7 and note on page 127). What is the power-carrying capacity for the highest voltage currently used in North America? The answer is “2 billion watts” (page 46 and note on page 156) and is derived with simple mathematical tools.

Laughlin's chain of arguments forms a composite approach to the energy challenge, where fossil fuels will still be needed 200 years from now to fly aeroplanes. Nuclear power plants will inevitably (but cautiously) be exploited and solar energy will offer decisive solutions in limited



environments (see chapter nine, “Viva Las Vegas!”). While the author acknowledges that market forces (and not green technology) will be the future driver of energy innovation, the book does not explicitly support any partisan cause but tries to inspect thoroughly the issues at stake.

A few tweets may not suffice to develop informed views on the energy future of the human race. On the other hand, *Powering the Future* will certainly stimulate many readers (including, I hope, physicists) to form their own judgements and to challenge some of the canned statements that proliferate on the internet these days.

● Massimo Giovannini, CERN and INFN Milan-Bicocca.

The History of Mathematics: A Very Short Introduction

By Jacqueline Stedall

Oxford University Press

Paperback: £7.99 \$11.95

What a wonderful surprise. I was going to review another book before this one but it wasn't to my liking (actually it was pretty bad) and I gave up after the first few

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chapters. So I settled instead on this book, mainly because it is short, or “very short” as the subtitle suggests.

Seeing that it was part of a series, I was expecting a typical history starting with Pythagoras and Euclid, then Newton and possibly Leibniz, Euler, Gauss and Riemann, followed by a collection of moderns, depending on how much space was left. I looked in the (excellent) index at the back (opening Q–Z) and was surprised to find no entry for Riemann. Was this British bias? No, Hardy was missing as well – but instead there were other people who I’d never heard of: William Oughtred, for example, (author of the first maths book published in Oxford) and Etienne d’Espagnet (who supplied Fermat with essential earlier works). Samuel Pepys also makes an appearance but more as an example of how little maths educated people knew in the 17th century.

I learnt in this charming book that what I had been expecting is called the “stepping stone” approach to the history of mathematics, focusing on elite mathematicians. This book is refreshingly different. It is actually more about the subject “history of mathematics”, i.e. about how we compile and recount a history of mathematics rather than about a sequence of events. However, it does this by focusing on intriguing stories that show the various features that must be considered. In doing so, it fills in the water between the stepping stones, for example, in the story of Fermat’s last theorem. It also tells the story of the majority of people who actually do maths – schoolchildren – by discussing the class work in a Babylonian classroom (around 1850 BC), as well as in a Cumbrian classroom around 1800.

After reading this “preview version”, I am now going to get the “director’s cut” – *The Oxford Handbook of the History of Mathematics*, which is co-authored by the same author with Eleanor Robson.

Happy reading and exploring!

● Herbert Dreiner, University of Bonn.

How the hippies saved physics: science, counterculture, and the quantum revival

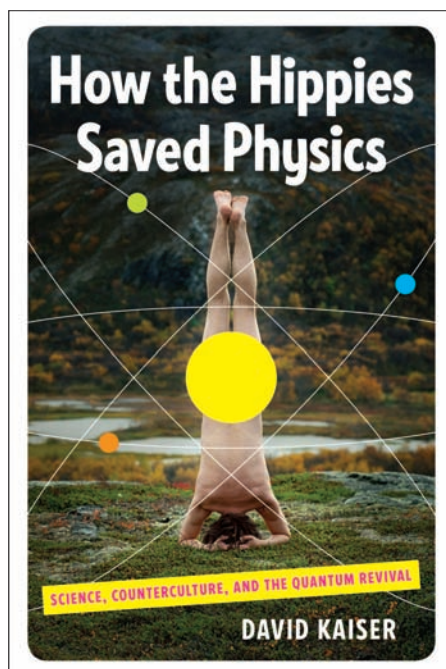
By David Kaiser

W W Norton & Company

Hardback: £17.99 \$26.95

Paperback: \$17.95

In this curious book, David Kaiser presents a detailed “biography” of a group of young physicists, the “Fundamental Fysics Group”, based in Berkeley, California, and their unconventional impact on the development of “the new quantum age”. Most of the action takes place in the 1970s and includes a surprising mixture of characters and plots,



as suitably summarized in these illuminating words: “Many of the ideas that now occupy the core of quantum information science once found their home amid an anything-goes counterculture frenzy, a mishmash of spoon-bending psychics, Eastern mysticism, LSD trips, CIA spooks chasing mind-reading dreams and comparable ‘Age of Aquarius’ enthusiasms.” These people regularly gathered to discuss all sorts of exotic topics, including telepathy and “remote viewing”, as well as faster-than-light communication and the fundamental concepts of quantum theory.

Among many other things, I liked learning about early discussions regarding Bell’s theorem, the Einstein-Podolsky-Rosen paradox and the nature of reality, sometimes taking place in workshops with sessions in hot baths, interspersed by drum playing and yoga exercises. I also enjoyed reading about the first experimental tests of Bell’s work by John Clauser and about the genesis of the bestseller *The Tao of Physics*, by Fritjof Capra. It was particularly interesting to learn about a paper on superluminal communication (published despite negative reports from referees), which triggered the development of rebuttal arguments that ended up being quite revolutionary and leading to quantum encryption etc. It was thinking outside the “establishment” way that led to a wrong but fruitful idea about implications of Bell’s theorem, which forced others to improve the understanding of quantum entanglement and gave rise to a new and highly successful branch of physics: quantum information. Kaiser’s basic message is that, sometimes, crazy

ideas push the understanding of science beyond the frontiers set by people working in conventional environments, within universities, and by government grants.

I know that we should not judge a book by its cover but with such a title I expected this book to be an interesting summertime read and was surprised to find that it is written in a rather heavy style that is more suitable for historians of science than for physicists relaxing on the beach. The topic of the book is actually quite curious, the language is fluid and the narrative is well presented but the level of detail is such that many readers will often feel like jumping ahead. It is elucidating to note that almost 25% of the book’s 400 pages are devoted to listings of notes and of bibliography. Essentially every sentence, every paragraph, is justified by an “end note”, which is an overkill for a book targeting a general audience. Writing this dense book must have been a long-term job for Kaiser, who is both a physicist and a historian. The result does not really qualify as an easy read. I enjoy reading biographies if they have a nice rhythm, some suspense and a few anecdotes here and there – which is not exactly the case for this book. I wonder how many readers end up moving it aside after realizing that they have been misled by the spirited title?

● Carlos Lourenço, CERN.

Niels Bohr and the Quantum Atom: The Bohr Model of Atomic Structure 1913–1925

By Helge Kragh

Oxford University Press

Hardback: £35

Next year, 2013, is the centenary of the Bohr model of the atom. One hundred years ago, the scene had been set after Max Planck had formulated the need for quanta and Ernest Rutherford had discovered the atomic nucleus. But nobody knew what atoms looked like or how they functioned. In a series of milestone papers, Niels Bohr set atomic understanding on a new path.

Bohr was influential and led a productive life. The broad lines have been well sketched in *Niels Bohr’s Times*, the biography by Abraham Pais. In this new book, Helge Kragh fills in the details of Bohr’s early career and how it affected science, not to mention Bohr himself. As befits a science historian, Kragh commendably links Bohr’s enduring contributions to the painstaking efforts of the many researchers who found the various tiny pieces of the atomic jigsaw and helped fit them together.

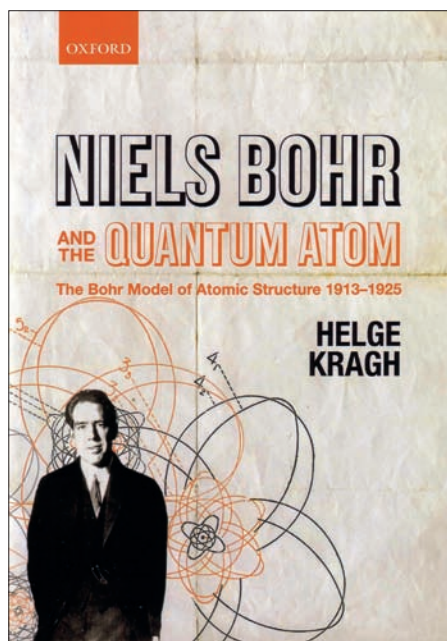
After initial studies in Denmark, the ambitious young Bohr went to Cambridge in 1911 but his motivation was quickly quenched when he realized that his idol,

JJ Thomson, seemed to have lost the plot. This situation was rapidly rectified when Bohr decided instead to move to Manchester and work with the dynamic Rutherford.

In 1913 Bohr proposed his famous idea of “quantum jumps”, which changed the scenery of physics and brought a new phrase into common language. His initial picture was confined to hydrogen atoms with circular electron orbits. Arnold Sommerfeld extended it to bigger atoms and elliptical orbits, allowing the empirical model to keep pace with new developments, such as the Stark effect and the fine structure of atomic spectra.

With his reputation made, Bohr returned to Denmark – although the UK later tried to coax him back. Rutherford had cornered the market in nuclear physics but atomic studies were becoming a German speciality. One reason that Bohr preferred to remain in Copenhagen was that he was busy with a new challenge: he was setting up what would become a world centre for atomic physics and a staging post for young researchers from across the world.

Kragh relates how Sommerfeld viewed Bohr’s new scientific venture: “The Institute



... should not only serve the up-and-coming generation of Denmark, it will also be an international place of work for foreign talent whose countries are no longer in a position

to [support] scientific work.” It sounds like a job description for CERN, written half a century ahead of its time.

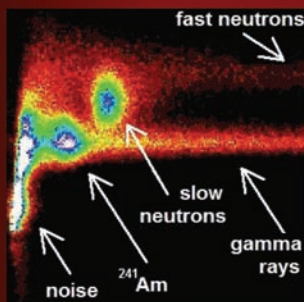
Perhaps the most interesting part of this book is its final chapter, “Crisis: the end of the Bohr Model”. Experiments were now covering scattering as well as spectroscopy and it was becoming increasingly difficult to reconcile the model with these new results on one hand and with classical phenomena on the other.

In all this, Bohr had temporarily lost his way. The once-attractive idea of electrons revolving round the nucleus in planetary-like orbits were having to be cast aside and replaced with new ideas – less conventional but more productive. The death throes of the Bohr-Sommerfeld model are redolent of the “wheels within wheels” contortions of Ptolemaic astronomy right before another scientific revolution – that one Copernican.

According to Kragh, the Bohr model had ‘lost credibility’ even before the formulation of quantum mechanics in 1925. However, those who formulated this new mechanics had been schooled by Bohr’s thinking and many of them had worked in his institute.



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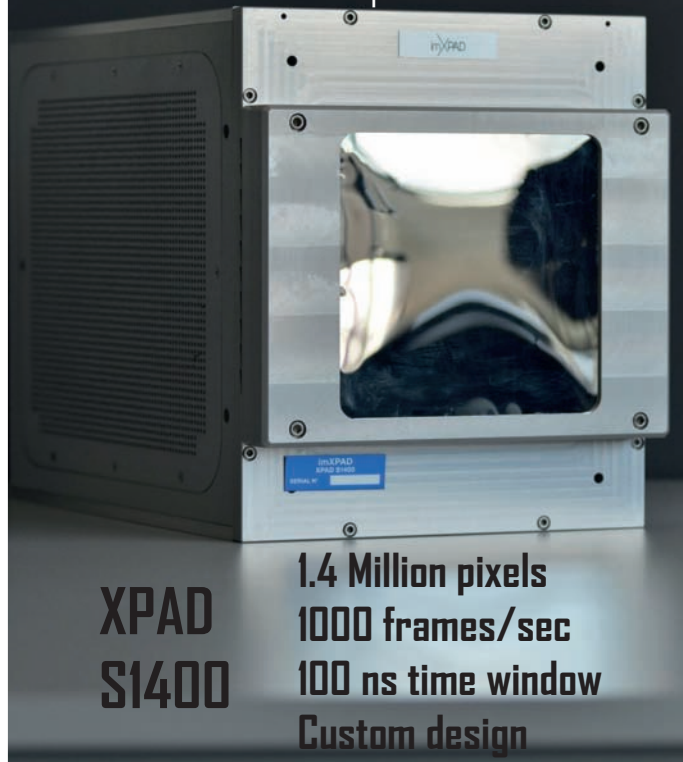
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Despite the demise of his model, Bohr always kept an open mind. For him, the advent of the quantum era was not a revolution. He preferred to call it a “joyful advancement”.

● *Gordon Fraser is author of Quantum Exodus: Fugitive Jews, the Atomic Bomb, and the Holocaust.*

Higgs Force. The Symmetry-Breaking Force that Makes the World an Interesting Place

By Nicholas Mee

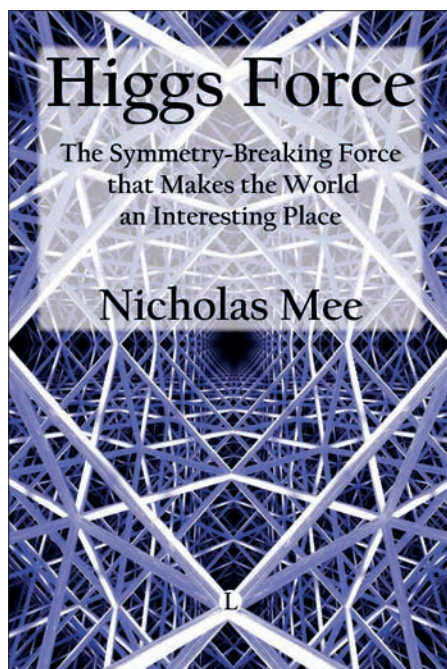
Lutterworth

Hardback: £25

Paperback: £15

Almost 30 years ago, ground was broken at CERN for the Large Electron–Positron collider. It was attended by François Mitterand, the last socialist president of France until now – when another François, this time Hollande, has been inaugurated. At the time, the new accelerator and the concomitant physics were described in an unusually readable pamphlet by a Russian, Yefime Zarjevski, who – I found out later – worked at the United Nations High Commission for Refugees. I had occasion to ask him: what do you know about physics? The answer: nothing! He went round CERN, talked to people and then put on paper what he understood, returned to them to check, and that was how it was done. (He was also the author of several books.) It was an intersection of literature and science. Today, we have a replay at CERN with the efforts of Ariane Koek to bring together physics and the arts (*CERN Courier* May 2012 p28).

In reading the *Higgs Force* by Nicholas Mee, I am reminded a little of these events. In about 300 pages, Mee takes us through a history of science from the early beginnings to the present. He is a physicist, but appears – through many analogies that he makes between more complex physical events and modes of vibration of strings and higher-dimensional instruments – to bridge a little the gap between science and art. (Max Planck also went from musician to physicist.) He succeeds in presenting most clearly the physics, from insights into the atom, the nucleus and then into the nucleons – with quark structure, matter and force-mediating particles, as well as symmetries – and finally arrives at the place reserved for the eagerly sought-after (but not



yet found) Higgs particle, one of the *raison d'être* of the LHC.

As an experimentalist, I would have liked to see rather more credit to this side, e.g. the wave nature of the electron, as found by Clinton Davisson and Lester Germer, or the detection of quarks in the scattering experiments of Jerome Friedman, Henry Kendall and Richard Taylor, while the collider has its origins in the proposal by Gerald O'Neill. Other missing persons include: Edward Purcell, Robert Dicke, Arno Penzias and Robert Wilson for the discovery of cosmic background radiation; and earlier, Joseph von Fraunhofer and solar spectroscopy. Is due credit given to László Tisza for his two-fluid theory of liquid helium? And closer to CERN, Isidor I Rabi (who never liked to be called “Isidore” – author, please note the correct spelling!), who was instrumental after the Second World War in the establishment of this multinational laboratory to unify scientists from the previously warring European countries.

However, these should not detract from Mee's book. It reminds me a little of Max Born's *Atomic Physics*, with more narrative in the main part of the book and details in

the appendices. The author concludes with the most impressive detectors, the impact of technological development on society, such as the World Wide Web, born at CERN, and finally the physics beyond the Higgs particle. The book is clear and would make good reading for anyone interested in getting an idea of what it is that today's physicists are excited about.

● A new edition of *The Higgs Force* published by Quantum Wave Books is due out on 1 August 2012.

● *H Henry Stroke, New York University and CERN.*

Catalysed Fusion

By Francis Farley

www.smashwords.com/books/view/152272

E-book: £3.84 \$5.99–6.03

The author – well known in particle physics for his work on the early muon g-2 experiments at CERN – sent this book to me and to the *CERN Courier* in April noting that it was intended “to sell particle physics to the uninitiated” and was “hot in some places”. Before I started reading, some reviews, for example in the *The Telegraph*, a prestigious British newspaper, confirmed its steamy character.

So does it work? Regarding the physics, I worked in muon-catalysed fusion for three years and I find the subject well explained and accessible to non-experts. However, I think that the air of mystery is superfluous in this context. Regarding the “steamiest”, although the story includes a large number of love scenes and all of the couples sooner or later mix up, I didn't find it all that erotic, maybe because of the predictable ending, which leaves nothing for the reader to anticipate.

Was this really a necessary exercise? Perhaps not, but it is useful. While I don't agree with the reviewer in *The Telegraph* that the book challenges the serious image of CERN, I do think that it confirms that physicists are normal people and are not disconnected from society or shut in their laboratories. Does the book describe real situations? I would like to reply with the following: if your husband or your wife is a physicist, just consider him/her as any other person with a normal job. The rest is just normal life.

● *Antonella Del Rosso, CERN.*

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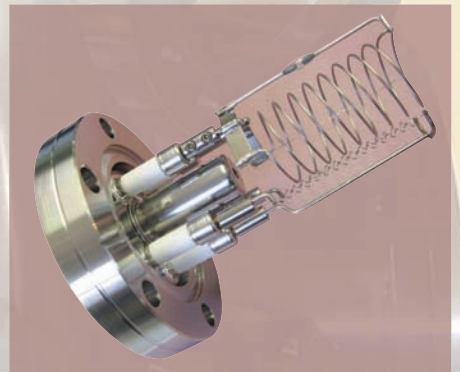
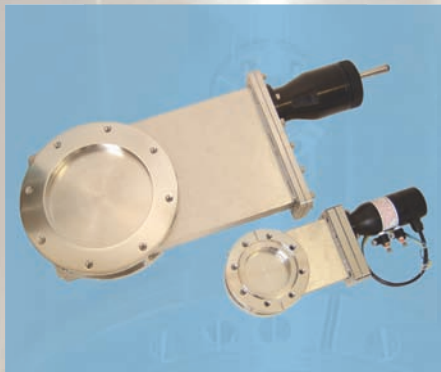
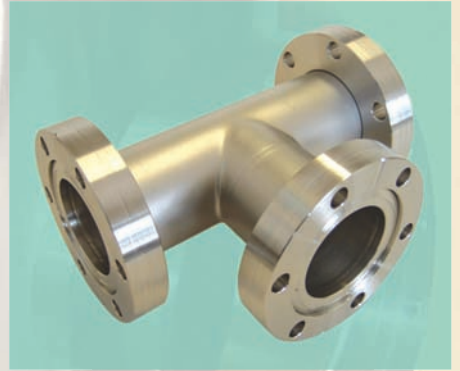
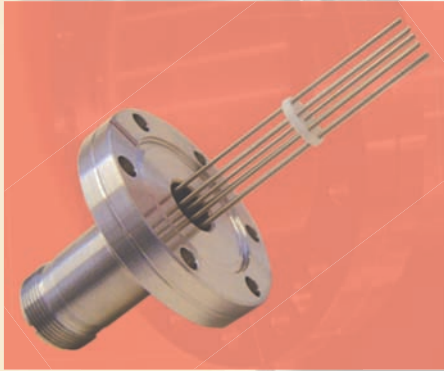
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