

Bookshelf

Festive Bookshelf

Once again, it will soon be time for many of us to take a well-earned break with friends and family, probably after a few hectic hours searching for presents in this festive season. To help with the shopping – whether for others or for yourself – this end-of-year Bookshelf presents some suggestions for more relaxed reading.

Faraday, Maxwell, and the Electromagnetic Field: How Two Men Revolutionized Physics

By Nancy Forbes and Basil Mahon

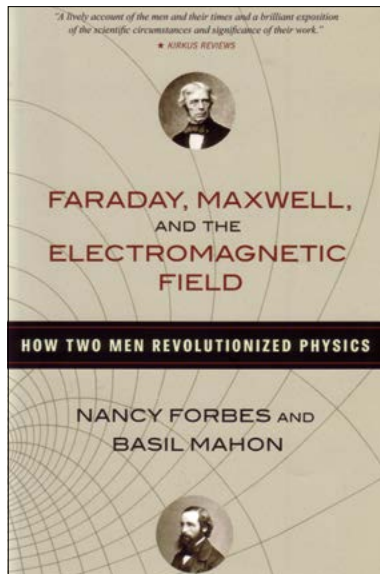
Prometheus Books

Hardback: \$25.92

The birth of modern physics coincides with the lifespans of Michael Faraday (1791–1867) and James Clerk Maxwell (1831–1879). During these years, electric, magnetic and optical phenomena were unified in a single description by introducing the concept of the field – a word coined by Faraday himself while vividly summarizing an amazing series of observations in his *Experimental Researches in Electricity*. Faraday – a mathematical illiterate – was the first to intuit that, thanks to the field concept, the foundations of the physical world are imperceptible to our senses. All that we know about these foundations – Maxwell would add – are their mathematical relationships to things that we can feel and touch.

Today, the field concept – both classically and quantum mechanically – is unavoidable, and this recent book by Nancy Forbes and Basil Mahon sheds fresh light on the origins of electromagnetism by scrutinizing the mutual interactions of Victorian scientists living through a period characterized by great social and scientific mobility. Faraday started as a chemist, became an experimental physicist, then later a businessman and even an inspector of lighthouses – an important job at that time. Maxwell began his career as a mathematician, became what we would call today a theoretical physicist, and then founded the Cavendish Laboratory while holding the chair of experimental physics at the University of Cambridge.

The first seven chapters focus on Faraday's contributions, while the remainder are more directly related to Maxwell and his scientific descendants or, as the authors like to say, the Maxwellians. The reader encounters not only the ideas and original texts of Faraday and Maxwell, but also a series of amazing scientists, such as the chemist

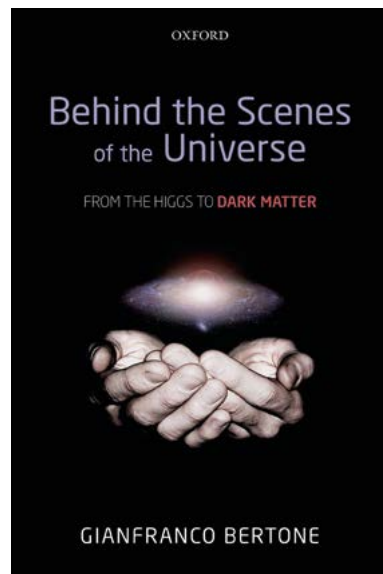


Humphry Davy (Faraday's mentor), as well as an assorted bunch of mathematicians and physicists including David Forbes (Maxwell's teacher), John Tyndall, Peter Tait, George Airy, William Thomson (Lord Kelvin) and Oliver Heaviside. All of these names are engraved in the memories of students for contributions sometimes not directly related to electromagnetism, and it is therefore interesting to read the opinions of these leading scientists on the newly born field theory.

The historical account might at first seem a little biased, but it is nonetheless undeniable that the field concept took shape essentially between England and Scotland. The first hints for the unification of magnetic and electric phenomena can be traced back to William Gilbert, who in 1600 described electric and magnetic phenomena in a single treatise called *De Magnete*. More than 200 years later, the Maxwell equations (together with the Hertz experiment) finally laid to rest the theory of "action at a distance" of André-Marie Ampère and Charles-Augustin de Coulomb.

The last speculative paper written by Faraday (and sent to Maxwell for advice) dealt with the gravitational field itself. Maxwell replied that the gravitational lines of force could "weave a web across the sky" and "guide the stars in their courses". General relativity was on the doorstep.

● Massimo Giovannini, CERN and INFN Milan-Bicocca.



Behind the Scenes of the Universe: From the Higgs to Dark Matter

By Gianfranco Bertone

Oxford University Press

Hardback: £19.99

Also available as an e-book, and at the CERN bookshop

With the discovery of a Higgs boson by the ATLAS and CMS experiments, the concept of mass has changed from an intrinsic property of each particle to the result of an interaction between the particles and the omnipresent Higgs field: the stronger that interaction is, the more it slows down the particle, which effectively behaves as if it is massive. This experimental validation of a theoretical idea born 50 years ago is a major achievement in elementary particle physics, and confirms the Standard Model as the cornerstone in our understanding of the universe. However, as is often the case in science, there is more to mass than meets the eye: most of the mass of the universe is currently believed to exist in a form that has, so far, remained hidden from our best detectors.

Gianfranco Bertone seems to have been travelling through the dark side of the universe for quite a while, and I am glad that he has taken the time to write this beautiful account of his journey. The book is easy to read, the scientific observations, puzzles and discussions being interspersed with interesting short annotations from history, art, poetry, etc. Readers should

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enjoy the non-technical tour through general relativity, gravitational lensing, cosmology, particle physics, etc. In particular, one learns that space–time bends light rays travelling through the universe, and that we can deduce the properties of a lens by studying the images it distorts. At the end of this learning curve we reach the conclusion that “we have a problem”: no matter where we look, and how we look, we always infer the existence of much more mass than we can see. Bertone expresses it poetically: “The cosmic scaffolding that grew the galaxies we live in and keeps them together is made of a form of matter that is unknown to us, and far more abundant in the universe than any form of matter we have touched, seen, or experienced in any way.”

The second half of the book wanders through the efforts devised to indentify the nature of dark matter, through the direct or indirect detection of dark-matter particles, with the LHC experiments, deep underground detectors, or detectors orbiting the Earth. As more data are collected and interpreted, more regions of parameters defining the properties of the dark-matter particles are excluded. In a few years, the data accumulated at the LHC and in astroparticle experiments will be such that, for many dark-matter candidates, “we must either discover them or rule them out”. The book is an excellent guide to anyone interested in witnessing that important step in the progress of fundamental physics.

● Carlos Lourenço, CERN.

Publishing and the Advancement of Science: From Selfish Genes to Galileo's Finger

By Michael Rodgers

World Scientific

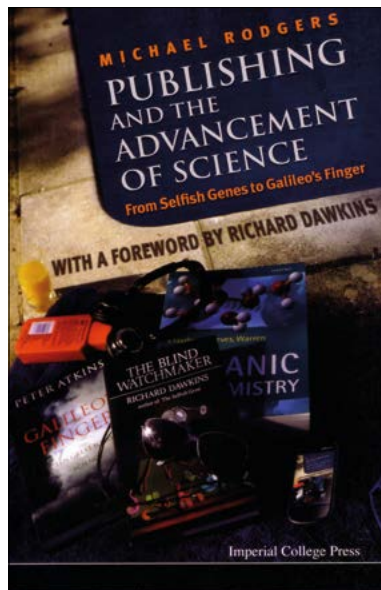
Hardback: £50

Paperback: £25

E-book: £19

In *Publishing and the Advancement of Science*, retired science editor Michael Rodgers take us on an autobiographical tour of the world of science publishing, taking in textbooks, trade paperbacks and popular science books along the way. The narrative is detailed and chronological: a blow-by-blow account of Rodgers' career at various publishing houses, with the challenges, differences of opinion and downright arguments that it takes to get a science book to press.

Rodgers was part of the revolution in popular-science publishing that started in the 1970s, and he conveys with palpable excitement the experience of discovering great authors or reading brilliant typescripts for the first time. Readers with an interest in

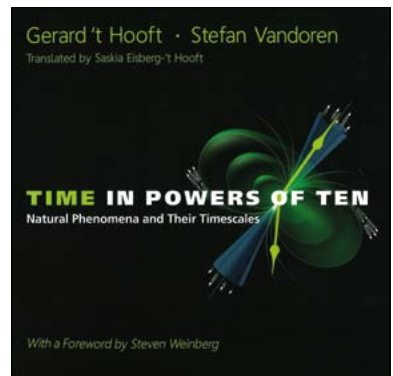


science will recognize such titles as Richard Dawkins' *The Selfish Gene* or Peter Atkins' *Physical Chemistry*, both of which Rodgers worked on. Frustratingly, he falls short of providing real insight into what makes a popular-science book great. There is a niggling sense of “I know one when I see one”, but a lack of analysis of the writing.

Rodgers' first job in publishing – as “field editor” for Oxford University Press (OUP), starting in 1969 – had him visiting universities around the UK, commissioning academics to write books. Anecdotes about the inner workings of OUP at the time take the reader back to a charming, pre-web way of working: telephone calls and letters rather than e-mails and attachments, and responding to authors in days rather than minutes. The culture of publishing at the time is conveyed with wry humour. OUP sent memos about the proper use of the semicolon, and had a puzzlingly arcane filing system, which added to the sense of mustiness.

A section on the development of Dawkins' seminal *The Selfish Gene* threw up interesting tidbits – altercations about the nature of the gene, and a discussion about what makes a good title – but I was less interested in the analysis of the US market for chemistry textbooks, or such tips as “The best time to publish a mainstream coursebook is in January, to allow maximum time for promotion.”

At times, the level of autobiographical detail dilutes Rodgers' sense of intellectual excitement about the scientific ideas in his books. The measure of a book's success



in terms of copies sold and years in print makes publishing a commercial rather than intellectual exercise, which to some extent left me disappointed. And although Rodgers worked part time, freelance or was made redundant at various points in his career, apart from a brief section in the epilogue, he seems rather blind to the changes sweeping the publishing industry, with the advent of free online content.

Those interested in the world of publishing, with a special interest in science, will find much to like about this book. But although Rodgers provides quirky tidbits about how some famous books came to be, it falls short of telling us what makes them great.

● Cian O'Luanigh, CERN.

Time in Powers of Ten: Natural Phenomena and Their Timescales

By Gerard 't Hooft and Stefan Vandoren (translated by Saskia Elsberg-'t Hooft)

World Scientific

Hardback: £31

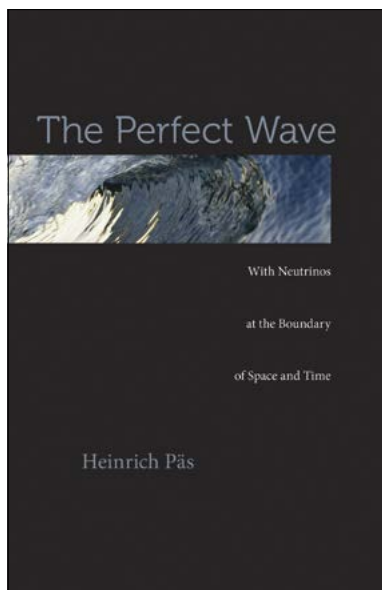
Paperback: £16

E-book: £12

Also available at the CERN bookshop

With powers of 10, one cannot fail to think of the iconic 1970s film made by Charles and Ray Eames – a journey through the universe departing from a picnic blanket somewhere in Chicago. However, this book is not about distance scales, rather time. And the universe it reveals is one of constant turmoil and evolution. No vast empty wastelands here, where nothing changes across many powers of 10. Journeying across the time scales, we discover a universe teeming with activity at every stage – processing, ticking, cycling, continuously moving, changing, surprising.

Every page brims with the authors' evident enthusiasm for the workings of the universe, be it the esoteric or the more mundane. I would never have expected to read a book where cosmic microwave



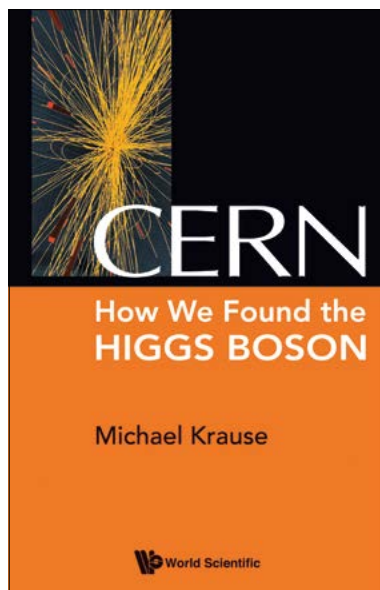
background radiation sits side by side with the problems of traffic congestion in the US (time = 10 trillion seconds).

Leaping in powers of 10, the book races through stories of life, the Earth and the solar system, and on to physical processes quadrillions of times the age of the universe itself. The largest and smallest of time scales transport the reader to the strange and fascinating. Just as with distance scales, the very small and the very large are intimately entwined.

There is a gap between the more anecdotal and the more scientific. Record sprint times (time = 10 seconds) and the rhythm of our biological clock (time = 100,000 seconds) are light interludes in contrast with the decay modes of the η_c meson (time = 10 yoctoseconds) and the Lamb shift (time = 1 nanosecond). While this eclecticism is part of the book's charm, some scientific baggage is required to enjoy the contents fully.

Where the book fails, is in the design. Visually, it is a little dull. With disparate styles of graphic illustrations, many taken from Wikipedia, the image quality is not up to that of the text. A clever design could take readers on a visual voyage, adding to the impact of the writing. The story warrants this effort.

It is striking that mysteries exist at every time scale, not only at the extremes – be it the high magnetic field of pulsars (time = 1 second), the explanation of high-temperature superconductors (time = 10 million seconds) or the origin of water on Earth (time = 100 quadrillion



seconds). The book reveals the extraordinary complexity of our universe – it is a fascinating journey.

• Emma Sanders, CERN, author of *The Large Hadron Collider Pop-Up Book: Voyage to the Heart of Matter* (Papadakis 2013).

The Perfect Wave: With Neutrinos at the Boundary of Space and Time

By Heinrich Päs

Harvard University Press

Hardback: £19.95 €24.50 \$26.95

The Perfect Wave begins with an entertaining introduction that links the Ancient Greeks and atomism to the effects of psychedelic drugs and (naturally?) particle physics. The book then describes a few key moments in the history of quantum mechanics, the Standard Model of particle physics, the importance of symmetries in the Standard Model, and even delves a little into supersymmetry as a natural extension. Eventually, it moves on to present a brief history of experimental signatures of neutrinos and their masses and mixing, followed by a discussion of the links between neutrino mass and the implications for the evolution of the universe as we know it. The book's concluding chapters describe links between neutrino physics and string theory, which is the author's current area of research.

The fact that neutrinos were postulated to exist about 30 years before they were seen directly, inspires Päs to postulate some other crazy ideas in this book. He hopes that the reader might agree with his assumption that what currently seems “too remote from reality to be of interest” – as

Fermi's theory of neutrino interactions was once described – might, one day, be the daily bread of experimentalists, and eventually provide the clues to how the universe can exist at all. One of those crazy ideas, which inspires both the title of the book and about 25% of its pages, is the possibility that neutrinos could be the most likely particle to be capable of travelling backwards in time or faster than the speed of light by going through extra dimensions. Another idea that might be almost as crazy, but is practically assumed to be true and “about to be confirmed at the LHC”, is that of supersymmetry, which postulates the existence of an entire zoo of other particles.

The book could be a little too technical for the general public to appreciate, although the readers of *CERN Courier* might feel at home in its pages. There are several novel analogies with everyday phenomena – such as moisture condensing on a beer bottle – that any reader would appreciate, and many references to famous works of art that would also draw in a general audience. Päs also describes the political context and personalities of some of the most important characters in the history of quantum mechanics and particle physics, which helps bring the physics he is describing to life. Unfortunately, however, towards the end of the book he lists several names without any additional character development, which tends to distract from the physics being described (unless of course you are related to the person being named).

In all, this book is much more detailed in its description of particle-physics theories (proven or otherwise) than of the experiments that have brought us to the current state of understanding. But for a fun journey through the intersection of particle-physics history, speculation and literature, this would be the right book to purchase.

• Deborah Harris, *Fermilab*.

CERN: How We Found the Higgs Boson

By Michael Krause

World Scientific

Hardback: £38

Paperback: £19

E-book: £14

Also available at the CERN bookshop

Also published as

Wo Menschen und Teilchen aufeinanderstoßen: Begegnungen am CERN
Wiley-VCH

Hardback: £22.50 €24.90

E-book: £18.99 €21.99

Also available at the CERN bookshop

There have been quite a few books recently

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about CERN and its latest “biggest” discovery – the Higgs boson. According to the preface, this one sets out to tell the story from a different perspective, by putting at its centre the modern scientists who are exploring this *terra incognita*. Interviews with a dozen scientists working at CERN, ranging from the director-general, Rolf Heuer, to physicists working on the experiments, form the main part of the book. These interviews are interspersed with explanatory texts, and there are also a number of factual chapters about the history of physics and especially particle physics, from Galileo to Einstein.

Does the book achieve what it sets out to do, namely to give basic research a human face? Yes and no.

When I first opened the book, I was curious to get to know some of the physicists, to understand what motivates them and to learn how they feel about working in such a huge “laboratory” with thousands of people. But the first chapter (and a long one at that) is about the history of CERN. While this is interesting in itself – CERN was founded after two devastating world wars, as a place where people from many different cultures could work together peacefully – I was not interested in facts and figures.

So I skipped ahead to the interviews – but again they were interspersed with explanatory texts, which I found quite distracting. Although some of these contain interesting and useful information, I found them too long, taking my mind away from the interview, so it was hard to rejoin the conversation one or two pages later.

Nevertheless, you do get to know some hardcore scientists at a personal level. Their answers give the reader a glimpse of the great endeavour that is CERN, and they also hint that the adventure is far from over – even after the Higgs discovery. And with all the background information, you do not have to have a physics degree to gain a basic understanding of the science.

● Hannelore Hämmerle, Max Planck Institute for Astrophysics.

Faithful to Science: The Role of Science in Religion

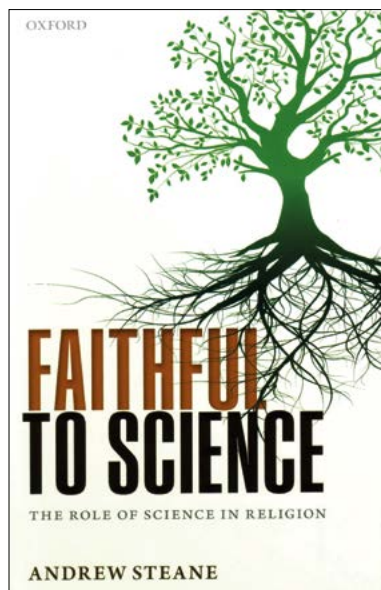
By Andrew Steane

Oxford University Press

Hardback: £19.99

Also available as an e-book

The interface between science and religious faith represents one of the most important areas in human conversation, where the aim is to bring together these two central and influential forces of human life and experience, and to examine how and if they link together.



This book sets out to validate the premise that modern science is an integral part of the ordinary and mainstream theistic belief. The author makes an excellent case of demonstrating that science and religious faith have much in common, and that they relate in a fruitful, inspiring and productive manner. In fact, the author concludes indisputably that the most general world view of human life encompasses both science and theistic belief naturally, and that there is no conflict between the two.

CERN is also reflecting on these themes in terms of the origins of the universe with the Big Bang. In partnership with Wilton Park, two conferences have been held with experts to examine the various world views of science, philosophy and theology, and to consider what they share in terms of common understanding. The first conference in 2012 focused on reaching a common language among the world views, while the second conference in 2014 considered the common understanding of the truth. Andrew Steane's book is therefore timely.

Faithful to Science is instructive, well laid out and easy to read. It is written clearly and covers many aspects of the conversation, making arguments clear without being technical. As both a scientist and a believer that reality is deeply personal, the author communicates the excitement and wonders of science and scientific discovery with clarity, particularly within the framework of a larger world view and human understanding that includes religious faith.

In conclusion, the book should

appeal to anyone who has an interest in understanding the broader world view of human endeavour that includes religious faith and science. I hope that it inspires people to take a more open and wide-ranging view of human life. *Faithful to Science* should be on the bookshelf of anyone who is interested to explore this more comprehensive human experience.

● Emmanuel Tsesmelis, CERN.

Books received

What Makes a Champion! Over Fifty Extraordinary Individuals Share Their Insights

By Allan Snyder (ed.)

World Scientific

Paperback: £18

E-book: £14



What drives great and successful individuals — be they athletes, artists, or scientists — and businesses to achieve the extraordinary? The focus is Australian, but the more than 50 champions come from all walks of life. Contributing authors include some well-known names, such as Nelson Mandela, Edmund Hillary and Corazon Aquino.

Magazines

Cent ans de particules... Où va la physique ?

Dossier *Pour la Science* n° 85 – Octobre-décembre 2014

Edition numérique : 5,49 €

Edition imprimée : 6,95 €

Also available at the CERN bookshop



À l'occasion des 60 ans du CERN, le magazine *Pour la Science* consacre un numéro spécial à la physique des particules. Le dossier commence avec une introduction du physicien Etienne Klein, qui rappelle les conquêtes de cette discipline, et de l'ancien Président du Conseil du CERN, Michel Spiro, qui revient sur l'histoire du grand laboratoire européen. Des articles de scientifiques de renom sont ensuite répartis en trois chapitres. Le premier est consacré au bestiaire des particules et à la découverte du boson de Higgs, avec notamment une interview du prix Nobel François Englert. Le deuxième chapitre porte sur le futur de la discipline, tandis que le troisième s'intéresse à l'impact de la physique des particules sur la société, avec un panorama complet des technologies d'accélérateurs et un article sur l'avenir du web écrit par Nigel Shadbolt et l'inventeur du web, Tim Berners-Lee.