

# BOOKSHELF

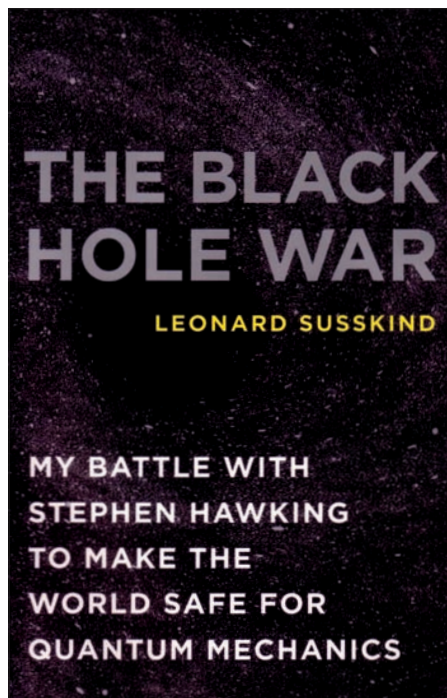
**The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics** by Leonard Susskind, Little Brown and Company. Hardback ISBN 9780316016407, \$27.99.

Despite appearances, you will not encounter Stephen Hawking in an armoured wheel chair, Lenny Susskind wearing a short spade and a net, or Gerard 't Hooft with a spear and a shield; all three in the gladiator's arena. This book contains a lot of drama, but most of it happens in the heads of these physicists and in their discussions. All three, the main characters of the book, are good friends and respect each other profoundly.

In the 1970s Hawking studied quantum mechanics near black holes and made the remarkable discovery that they are not black after all. They radiate energy with an apparently thermal spectrum, the temperature of which is inversely proportional to the mass of the hole. For the black holes that occur in nature at the centre of galaxies, or as the final products of the deaths of supermassive stars, this radiation is completely negligible. So, what was the point? Elaborating on his computations, Hawking concluded that in this process, if some information is gobbled up by the hole once it passes its event horizon, it will be forever lost. There is no way to retrieve it.

This was the starting shot in the war, and what a shot it was. As Susskind explains in great detail, it rocked the boat of physics so badly that it almost caused it to sink.

The claim was made in the late 1970s but 't Hooft and Susskind learnt about it in a special meeting in 1981, in the attic of Werner Erhard (of "est" fame). Many physicists at the time dismissed the problem, but our two heroes recognized the mortal blow that it represented to the heart of quantum mechanics. A basic feature in the quantum description of nature is the conservation of information. In more technical terms, we believe that no matter how complex a process, it will never violate the unitarity of quantum evolution in time. The formation of a black hole out of ordinary stuff – and its subsequent evaporation – should not represent an exception despite its complexity. Hawking put his finger on a fundamental issue that hindered the possible unification of general relativity and quantum mechanics, which was a major preoccupation of Albert Einstein and many after him.



Hawking had clearly won, by surprise, the first battle. This we learn at the beginning of the book. The rest describes Susskind's strategy of attrition until he could claim victory a quarter of a century later.

In sharing the author's path to victory you will learn a lot of deep physics: the basis of quantum mechanics; the fundamental characteristics of black holes; the need to use string theory and some of its tools developed in the 1990s – arcane notions such as the principles of black-hole complementarity, the discovery of D-branes by Joe Polchinski and, above all, the holographic principle that appeared first in the study of the problem by Susskind and 't Hooft, but that was masterfully formulated in string theory by Juan Maldacena. There are many other heroes in this story: Strominger, Vafa, Sen, Witten, Callan, Horowitz, Giddings, Harvey, Thorlacius and Russo etc. – who all provided the ammunition necessary to demolish Hawking's edifice, to the point that he surrendered by around 2003.

In parts three and four of the book, the going gets necessarily rough. The ideas are deeply unfamiliar and one may from time to time feel some form of mental saturation. Being a consummate storyteller, the author punctuates the more difficult passages with a good deal of irreverent and iconoclastic humour. Read the chapter "Ahab

in Cambridge". His description of life and academia in Cambridge, England, is hilarious. Indeed, throughout the book you will get a good number of laughs.

In all, the book presents a fascinating and intellectual adventure in accessible terms where you can learn some of the more challenging ideas in modern theoretical physics. The author follows to the letter Einstein's mandate of making things as simple as possible, but not simpler. It is original, honest, profound and fun. You could hardly ask for more.

*Luis Alvarez-Gaume, CERN.*

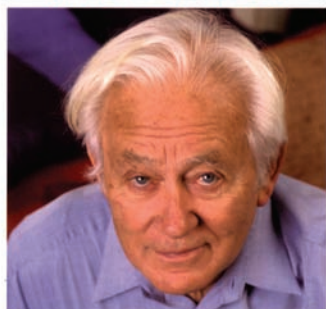
**Mémoires d'un Déraciné, Physicien, Citoyen du Monde** by Georges Charpak, Odile Jacob. Paperback ISBN 9782738121844, €23.

Eighty-five years and at least three lives' worth of living unfold in the three sections of these memoirs by Georges Charpak with the contributions from François Vannucci, Roland Omnès and Richard L Garwin.

Uprooted as a child from his native town on the Polish-Ukrainian border during the anti-Semite persecutions of the Russian civil war, he narrates the tribulations of a central-European immigrant in the first part of the book, entitled "Déraciné" (Uprooted). This is the account of his incredible early destiny, from his arrival in France at the age of seven, through his brilliant secondary studies in Paris to his engagement in the struggle against Fascism and subsequent imprisonment, and finally his survival of deportation to Dachau.

Charpak's career as a physicist "started at age 24 and was more complex than that of most young French scientists". This sets off the second part "Physicien", which is entirely devoted to physics and – through the account of his career – a golden age of physics. After liberation, he first joined the Ecole des Mines ("not the right choice," he says on p24) before finally moving to the laboratory of Frédéric Joliot Curie at the Collège de France, where he specialized in particle detection. A detailed account follows of all the steps in the invention of the multiwire chamber, from Curie's lab through Charpak's career at CERN to applications in medicine. This is all complete with images, anecdotes and original documents. "One of the ambitions of the book," Charpak writes on the back cover, "is to show the extraordinary construction of particle physics in the space of one century". For this reason he asked Vannucci to write

## GEORGES CHARPAK

MÉMOIRES  
D'UN DÉRACINÉ, PHYSICIEN,  
CITOYEN DU MONDE

an in-depth but accessible explanation of the meaning of the Standard Model, which is included in this section.

Another objective of the book is to “throw light on the imminent threat to all the treasures accumulated by civilizations over thousands of years, if we do not change radically the way that mankind manages its material and spiritual richness, its creativity and the education we give to children”. The last part, “Citoyen du monde” (Citizen of the world), written with Richard Garwin, details another chapter of Charpak’s life, devoted to the teaching of science to the young and towards the cause of total nuclear disarmament – “le danger toujours plus pressant ... non seulement pour la paix mais pour la survie même de l’humanité” (the most pressing danger, not only for peace but for the survival of mankind).

Personal anecdotes provide another enjoyable feature of the book. As Charpak says, he “did not hesitate to describe ... his short-term dreams”, such as his research on fossil sound in ancient objects and his attempts to sell a comedy scenario inspired by *Dr Strangelove* to Hollywood.  
Paola Catapano, CERN.

**Discrete Symmetries and CP Violation: From Experiment to Theory** by Marco Sozzi, Oxford University Press. Hardback ISBN 9780199296668, £55 (\$110).

During the past decade there have been important experimental results on CP violation both in the K-meson sector, with the precise measurement of  $\epsilon'/\epsilon$ , and in the B-sector, with the discovery of CP violation in  $B^0$  decay. The state of the art was summarized in 2003 (*Uncovering CP Violation, Experimental Clarification in the Neutral K Meson and B Meson Systems* by K Kleinknecht, Springer 2003) and also in a number of summer schools’ proceedings (e.g. *CP Violation in Particle, Nuclear and Astrophysics* by M Beyer (ed), Springer 2002, and *CP Violation from Quarks to Leptons* by I Mannelli, A I Sanda (eds), IOS 2006). However, the most recent textbooks dedicated to CP violation were published nearly 10 years ago (*CP Violation* by I Bigi and A I Sanda, Cambridge University Press 2000; by G C Branco, L Lavoura and J P Silva, Oxford University Press 1999). Thus, the time was ripe for a new compendium that would also discuss how the field might evolve and which problems remain unsolved. From the experimentalist’s point of view, the new book by Marco Sozzi does the job very effectively.

The book evolved from lecture notes for undergraduate and graduate students. With 550 pages subdivided into 11 chapters plus a coda, six appendices, nearly 600 references (about a quarter of them dated after the year 2000) and 28 experiments described in detail, it turns out to be not only a source book for courses in physics but also an excellent companion in the search for symmetry. It is 80 years since Hermann Weyl published *Gruppentheorie und Quantenmechanik*, which with Eugene Wigner’s book *Gruppentheorie und ihre Anwendung auf die Quantenmechanik*, published in 1931, was to provide the foundations for the study of discrete symmetries in the atomic and subatomic worlds. In this respect Sozzi’s book stands on the shoulders of giants.

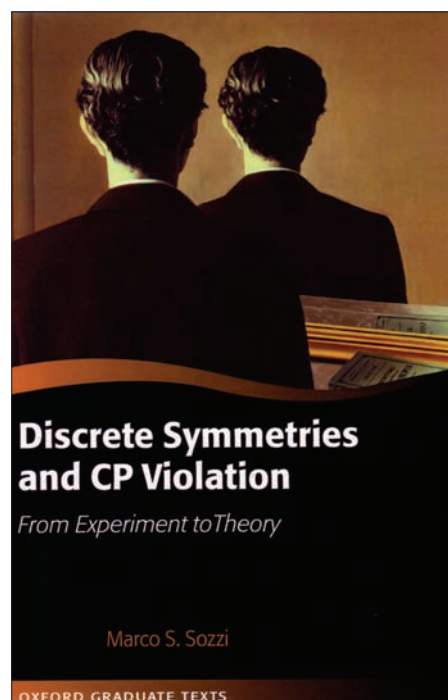
The book’s structure is one of a modern encyclopedia. The chapters are all self contained, with suggested further reading and a number of exercises (a good method for some subtle topics but there are no hints to the solutions). Each opens with quotations by people ranging from Roger Bacon to members of the rock band Queen, and Sozzi inserts many more in the text to bring it alive.

Chapter 1 sets the general discussion on discrete symmetries, within a quantum formalism suited to the description of

microscopic and elementary phenomena. The next three chapters deal with parity, charge conjugation and time reversal in some detail. Chapter 5 discusses CPT symmetry and the connection between spin and statistics. The breaking of CP symmetry – the topic of the title – is first introduced in general terms in chapter 6, where the reader learns how the kaon’s features opened the way to the discovery of CP violation in 1964.

Contrary to the case of parity violation, CP violation was not immediately accepted by the whole physics community. A conclusive piece of evidence came just one year later with the detection of the interference between the two-pion state obtained from  $K_S$  decays and that obtained from the newly discovered  $K_L$  decays. In the words of the protagonists, the observation of CP violation was a purely experimental discovery – a discovery for which there was no precursive indication either theoretical or experimental. As Sozzi comments, “experiments come with a certain season, at a certain time, at a certain place” and, anyway, discoveries are still paced by technical advances.

Chapter 7 moves on to give details of the system in which CP violation was detected, namely neutral, flavoured mesons, while chapter 8 discusses the kaon system both from a phenomenological view and as a template for heavier flavoured mesons. These



heavier mesons are dealt with in chapter 10, which gives their relevance in determining the flavour structure of the Standard Model, briefly introduced in Chapter 9.

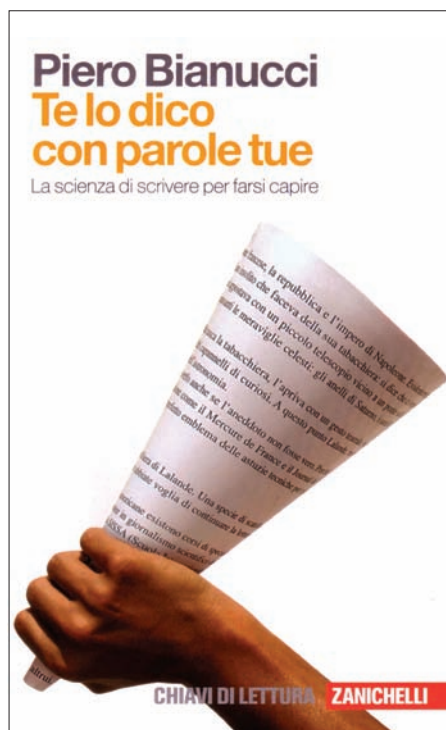
Finally, chapter 11 considers more speculative topics: the symmetries of the gravitational field; the strong CP problem; the cosmic connection with the possibility of an asymmetric universe and the three requirements that Andrei Sakharov thought necessary for baryon asymmetry to evolve from an initial symmetric state; and finally some of the baryogenic models within grand-unified theories. Nor are mirror matter and even chirality in living matter forgotten. The appendices provide a reminder of some of the theoretical tools and of how to handle systematic errors.

**Te lo Dico con Parole Tue** (Telling it in your own words) by Piero Bianucci, Zanichelli. Paperback ISBN 9788808195302, €9.80.

Piero Bianucci is a well known Italian science journalist. In 1981 he founded one of the most popular science weekly publications, *Tuttoscienze*, nowadays a regular rendezvous for many readers and school classes. He is also the author of many books, mainly about astrophysics and cosmology. One noticeable thing about him is that, although not a scientist, his writing is always accurate and well documented. *Te lo Dico con Parole Tue* (unfortunately available only in Italian) is the first book in which he shares the secrets of a good science communicator.

The book is quite timely as scientists are increasingly requested to communicate to society not just the results of their work but, more specifically, its *raison d'être*. They are “requested” in that funding increasingly depends on how well a given experiment is able to sell its objectives. The problem is that, in parallel, the scope of science broadens, and therefore specializes, so much so that even experts of the same level but in different fields may find it difficult to understand each other. Scientists often appear to become caught in webs of jargon where objects and procedures acquire strange names, thus increasing the distance between the original (and fascinating) curiosity-driven question and the practical work.

In this scenario, there is a major role for the scientific journalist. As Bianucci points out in his book, “the journalist is not just the translator of an obscure jargon”; he/she is



the missing link in the chain, the potential solution of the problem of communication between scientists and society. Bianucci gives guidelines on how to write a readable text, regardless of the initial intrinsic difficulty of the specific topic. He explains in practical terms how to select the information that is newsworthy, how to distinguish between trustworthy and non-trustworthy sources, and he advises on how to speak with the primary scientific source.

I liked the book. It gives clear examples, tells you real stories and reads so well that you can finish it in just a few hours. The book is multifunctional: if you are a journalist, you will find it to be a useful manual; if you are a scientist, you will learn how to turn your work into a story with media appeal; if you are a simply a reader, you will learn about effective science communication.

Antonella Del Rosso, CERN.

#### Books received

**Beyond the Hoax: Science, Philosophy and Culture** by Alan Sokal, OUP. Hardback ISBN 9780199239207, £20 (\$34.95).

In 1996 Alan Sokal, a professor of physics at New York University, wrote a paper for the cultural-studies journal *Social Text*, entitled *Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum*

*Gravity*. It was reviewed, accepted and published. Sokal immediately confessed that the whole article was a hoax – a cunningly worded paper designed to expose and parody the style of extreme postmodernist criticism of science. The story became front-page news around the world and triggered fierce controversy. In *Beyond the Hoax* Sokal turns his attention to a new set of targets – pseudo-science, religion and misinformation in public life. The book also includes a hugely illuminating annotated text of the hoax itself, and a reflection on the furore it provoked. This intelligent and lucid analysis will appeal to academic as well as general readers.

**Concepts of Modern Physics: The Haifa Lectures** by Mendel Sachs, Imperial College Press. Hardback ISBN 9781860948213, £29 (\$58). Paperback ISBN 9781860948220, £16 (\$29).

This book highlights foundational issues in theoretical physics in an informal and open style of lecture. It expresses the flow of ideas in physics – from Galileo and Newton to the contemporary ideas of the quantum and relativity theories, astrophysics and cosmology – as explanations for the laws of matter. The book leaves it to the reader to decide which of these 20th century ideas in science will carry over to the 21st century for our further comprehension of the laws of nature in all domains, from elementary particles to cosmology. Academics, undergraduates and general-interest readers will find this book a useful resource.

**Quantum Mechanics: Its Early Development and the Road to Entanglement** by Edward G Steward (contribution by Sara M McMurtry), Imperial College Press. Hardback ISBN 9781860949777, £39 (\$75). Paperback ISBN 9781860949784, £29 (\$55).

This book explains the origin and establishment of quantum mechanics and explains mathematics in a digestible form along with a descriptive survey of developments up to the present day. The mathematical treatment closely follows the original treatment, but in modern terms, using uniform symbolism as much as possible and with simplifications (e.g. the use of one dimension instead of three) to avoid unnecessarily complicated mathematics. It will interest those studying physics as well as those studying the history of science.