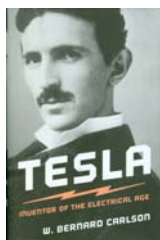


does more than re-create the inventive environment of the late 19th and early 20th centuries: With his understanding of the sociology and history of technology, he paints a world in which inventors sell a persona along with their inventions; reputation can attract investors or keep them away; public opinion can be crucial; and the ability to create a practical, durable device or system is more important than having a brilliant idea.

Working with a daunting scarcity of source material, Carlson grounds Tesla's insights and inventive style as firmly as he can in Tesla's youth and education without explaining them away. Indeed, brilliant ideas were Tesla's stock in trade. The importance of his first great breakthrough—conceiving and then demonstrating that a rotating magnetic field can drive an AC motor—can hardly be overestimated. It led to the practical development of AC power. His subsequent work on components for an AC power system was almost as significant.

One of the book's great strengths is the way Carlson deals with many of the legends and myths surrounding Tesla: He elucidates what did happen and he leaves out what did not. He fleshes out the people who surrounded Tesla, explaining and illuminating their characters and motives. We learn about Tesla's work in the battle between AC and DC, but the titanic personal struggle between Tesla and Thomas Edison, so beloved in popular histories, is nowhere to be found. Indeed, Carlson quietly introduces an 1893 letter from Tesla to his uncle in which he proudly writes of having received a photograph from Edison inscribed, "To Tesla from Edison." And in Tesla's storied attempts to transmit wireless power, we see how his inability to anticipate practical realities and problems led to his underestimating expenditures, overestimating success, and alienating investors.

Carlson's historical sophistication gives the book a contextual depth that helps the reader understand why, despite Tesla's power-transmission attempts, it is historically questionable that he anticipated the radio. Carlson's rich, careful description of Tesla's work—which is sufficiently technical to be satisfying without disrupting the narrative—is given meaning by its juxtaposition with an analysis of invention and innovation that is grounded in the real world of engineers and machines. And when Tesla and his partner Edward Adams fail to entice investors in



the mid 1890s, Carlson's equally deep understanding of business and business history allows him to explain that failure clearly and thoroughly.

It is hard to resist comparing Tesla and Edison, the two most celebrated electrical inventors of their time. They both achieved remarkable early successes, but perhaps the failure of Tesla's wireless power transmission, set against Edison's 1890s failure in iron mining, is a useful illustration. Despite wrestling with and overcoming all sorts of engineering difficulties, Edison failed because he was economically overwhelmed by the opening of the rich Great Lakes ore deposits. He recognized defeat and turned his energies to developing portland cement and storage batteries. Tesla, on the other hand, "was unable to grasp the disjuncture between how he thought his system should work versus how the Earth actually responds" (p. 412), and he suffered a nervous breakdown. Carlson describes one of the great flaws in Tesla's approach to invention: his inability to think convergently, to focus his attention on a goal and sustain it. Again and again he developed an idea, and nearly as often he failed to get it from his head to the laboratory bench and then out into the world. But what he did produce was remarkable, and we now have in Carlson's biography the means to appreciate it properly. Anyone, whether simply an interested reader or a professional historian, engineer, or physicist, will finish *Tesla* with a deepened understanding of his world, character, and accomplishments.

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The Physics of Neutrinos

Vernon Barger, Danny Marfatia, and Kerry Whisnant
Princeton U. Press, 2012. \$99.50
(224 pp.). ISBN 978-0-691-12853-5

A bit over a half century ago, physicists spotted their first neutrino. We now know that the particles are ubiquitous. They are of key importance to our understanding of nature as explored in such subdisciplines as particle physics, nuclear physics, astrophysics, and cosmology. Neutrino physics has come a long

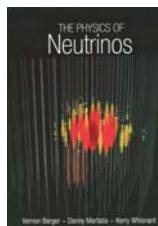
way since that first experimental observation. Indeed, the field has become positively effervescent starting about a decade ago, when neutrino oscillations were experimentally confirmed.

In *The Physics of Neutrinos*, Vernon Barger and his longtime collaborators Danny Marfatia and Kerry Whisnant address the recent developments in the field. Barger is coauthor of *Collider Physics* (updated edition, Westview Press, 1996), the highly regarded handbook of collider-physics phenomenology. Relatively slim, *The Physics of Neutrinos*, a timely overview by active and respected researchers, is packed with useful information and many valuable references. The authors intertwine contributions of theory and experiments to present both the current status of the field and what may soon come.

The authors start by recalling the basic ingredients needed to understand neutrino measurements, describing how neutrinos are produced from weak decays, explaining what neutrino-interaction cross sections are, reviewing detector techniques, and discussing how to produce a neutrino beam. They continue with a description of the theoretical formalism needed to understand the experimentally observed neutrino oscillations in vacuum and in matter. From there, they discuss oscillation experiments involving solar, atmospheric, accelerator, and reactor neutrinos. The presentation culminates by summarizing our present knowledge of the values of the so-called neutrino-oscillation parameters, provided by a global fit of all the experimental data combined.

The Physics of Neutrinos also discusses current and planned long-baseline oscillation and nonoscillation experiments and their role in unraveling some of the remaining open questions. It covers present and future experiments designed to search for neutrinos from astrophysical sources other than the Sun, and it discusses such theoretical advances as the realization that neutrino self-interactions must be taken into account when dealing with supernova neutrinos. A short chapter devoted to model building outlines important theoretical efforts to explain patterns of neutrino masses and mixings and why neutrino masses are so small.

The penultimate chapter describes two results that may be indicative of new phenomena in the neutrino sector: the LSND and MiniBooNE anomalies, as they are known in the field. It also presents alternative theoretical scenarios to the standard paradigm of three



neutrinos with masses and mixings. A minor drawback is the omission of the Gallium and Reactor anomalies, which, in my opinion, are on the same footing as the LSND and MiniBooNE ones.

Although *The Physics of Neutrinos* is not intended as a textbook, it may be of interest as a guide for graduate students who want to enter the field. For a graduate text, I recommend Rabindra Mohapatra and Palash Pal's *Massive Neutrinos in Physics and Astrophysics* (3rd edition, World Scientific, 2004), which is more pedagogical and discusses some theoretical issues—in particular, models of neutrino mass—in greater detail. However, the Mohapatra and Pal book lacks the comprehensive experimental summary provided by Barger, Marfatia, and Whisnant; in that regard, the two books are complementary reads.

Anyone curious about the dramatic progress made in this pivotal area of particle physics would benefit from reading the introduction's brief historical review, which notes many of the early achievements that have led us to where we are today. In my opinion, though, *The Physics of Neutrinos* should prove especially valuable to particle physicists, nuclear physicists, cosmolo-

gists, and astrophysicists who want to learn about the field. Neutrino researchers will certainly want to have it as a reference on their bookshelves.

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A Course in Theoretical Physics

P. J. Shepherd
Wiley, 2013. \$160.00 (465 pp.).
ISBN 978-1-118-48134-9

P. J. Shepherd, author of *A Course in Theoretical Physics*, has been teaching at the UK's Exeter University for more than 30 years. Shepherd sets out to provide full mathematical derivations for the theoretical topics covered in the latter years of a typical undergraduate major. He divides the book into five modules: nonrelativistic quantum mechanics, thermal and statistical physics, many-body theory, classical field theory and relativity, and relativistic quantum mechanics and gauge theories.

Some of the advanced topics—for example, the Bardeen-Cooper-Schrieffer

theory (chapter 16) and the basic standard model of high-energy physics (chapter 20)—may be attractive to advanced students and to experimenters as a desk reference. Even for senior academic physicists, the text can be useful either as a teaching aid or as a back-to-basics reference.

Compared with standard field-specific textbooks, the modules are rather small, about 90 pages each. Still, Shepherd addresses the crucial central concepts and provides enough detail in the derivations that students should be able to follow. The compact, thorough treatment makes the book rather unlike the many available textbooks on the subjects covered in the modules.

I was, however, disappointed by the lack of intuitive physical insights that would have helped to motivate and elaborate many of the concepts addressed. For instance, when obtaining the solution of the Schrödinger equation in a spherically symmetric potential, Shepherd eschews a discussion of the simplifications that can be deduced by appealing to the underlying symmetry. Rather, he jumps right in with a trial solution in which angular and radial variables are separated. Also,



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