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Why Quark Rhymes with Pork: And other Scientific Diversions FREE

Why Quark Rhymes with Pork: And other Scientific Diversions.. N. David Mermin 400 pp. Cambridge U.P., New York, 2016. Price: $29.99 (hardcover). ISBN 978-1-107-02430-4.

John G. Cramer

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BOOK REVIEWS

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Why Quark Rhymes with Pork: And other Scientific Diversions. N. David Mermin. 400 pp. Cambridge U.P., New York, 2016. Price: $29.99 (hardcover). ISBN 978-1-107-02430-4. (John G. Cramer, Reviewer.)

The centerpiece of this book is the collected *Reference Frame* columns written by Cornell University theoretical physicist N. David Mermin and published in *Physics Today* from 1988 to 2009. Many of these columns bear titles that begin as "What's Wrong With…," providing a hint of the critical and somewhat iconoclastic eye with which Mermin regards the physics community, its activities, and its peculiarities. In addition to the columns, the book contains unpublished excerpts from lectures and reminiscences about Mermin's interactions with colleagues. I would have to say that despite Mermin's remarkable wit and style, in overall impact the book is for the practicing physicists rather than the non-specialist reader interested in science. As examples, it contains criticism of the attempts of sociologists to apply cultural anthropology arguments to physics, an extended discussion of the systematic misspelling of the word *lagrangian* in the physics literature, satirical accounts of the activities of one Professor Mozart, who suffers at the hands of NSF proposal reviewers and has other Mermin-like adventures, and it also contains meandering inquiries probing the foundations of quantum mechanics. While the physicist readers may find these discussions interesting, the non-physicist interested in physics is likely to find them peculiar and parochial. Further, I confidently predict that Chapters 23 and 28–33, a sizable part of the book, will be unintelligible to the non-physicist (and to many physicists as well).

Mermin's book takes its title from his December 1993 column discussing the pronunciation of the word *quark*. In the afterword of that chapter, Mermin mentions that Victor Weisskopf told him the column was silly. I would have to agree, since in the multiple pages of discussion about the word *quark* and its pronunciation, Mermin fails to mention how Murray Gell-Mann came up with the term in the first place. It is well known that the inspiration came when Gell-Mann found the word *quark* in James Joyce's *Finnegans Wake*:

> *Three quarks for Muster Mark!*
>
> *Sure he has not got much of a bark*
>
> *And sure any he has it's all beside the mark.*

From Joyce's alliteration, it is abundantly clear to me (and should be even to Mermin) that *quark* must rhyme with *bark*, and *mark*. Certainly in two decades of attending physics meetings in which the quark-gluon plasma was the focus of discussion, I never heard even one physicist pronounce *quark* to rhyme with *pork*. On the other hand, as the writer of a regular column mainly about physics, I understand how hard it is to come up with something clever to say in print every month or so, and I suspect that Mermin was scraping the bottom of the barrel here. That, however, does not explain the use of this peculiar piece as the title for his book.

On the other hand, there are many things to be learned from a careful reading of Mermin's essays. In my recent book, I used "Shut up and Calculate!" as the message implicit in the Copenhagen interpretation, but I had not realized that Mermin was its originator. Mermin explains the famous Schor algorithm for factoring large numbers into primes using a quantum computer as based on the facility with which a quantum computer can produce and recognize patterns in modular arithmetic. He clarifies the Greenberger-Horne-Zeilinger scheme for demonstrating nonlocal correlations in systems of three entangled photons, showing that it leads to a more unambiguous demonstration of quantum nonlocality than do EPR two-photon correlations. Mermin's description of his stress-filled attendance as a guest at the Nobel Prize Award Ceremonies in Stockholm is enlightening and entertaining. Unfortunately, that account gratuitously appears twice in the book, suggesting that his editor should have intervened. I should add that the book contains an excellent joke about the difference between theoretical physicists and mathematical physicists, which I have unapologetically lifted and used in the science fiction novel that I am presently writing.

My main complaint about Mermin's book is the mantle he assumes as a Bayesian Pied Piper, leading the naive and unsuspecting children of Quantum Town down the rodent hole of Bayesian quantum mechanics, which Mermin and others call QBism (for quantum Bayesianism). It is bad enough that the Copenhagen knowledge interpretation requires us to believe that the solution of a simple second-order differential equation relating mass, energy, and momentum somehow miraculously becomes an encoded description of knowledge in the mind of a hypothetical observer measuring the system. Now Mermin wants to double down on this dubious assertion by splitting up that general Copenhagen observer and his knowledge into specific individual observers, each with his or her own expectations and predictions to which Bayesian probability and statistics must be applied. This QBism goes on for several chapters of the book. Its main virtue is that it is quite unconvincing as a way of understanding what is going on in quantum systems.

The real strength of Mermin's book lies in his descriptions of his interactions with several major figures in condensed-matter physics: Daniel Fischer, Walter Kohn, Ken Wilson, and Sir Rudolph Peierls. These chapters are gems, and they are well worth the price of the book for their clear and insightful descriptions of truly excellent physicists at work.

In conclusion, I think this is a somewhat flawed book that nevertheless should be of interest to practicing physicists and to those interested in the tribal customs of the physics

community. The curious non-physicist would certainly find parts of the book interesting, provided he or she was willing to "surf over" the opaque technical parts and the wrong-headed quantum mechanics.

John G. Cramer is Professor Emeritus of Physics at the University of Washington, Seattle. For five decades he has taught physics and done experimental and theoretical research in nuclear and ultra-relativistic heavy ion physics. He is the originator of the transactional interpretation of quantum mechanics, the subject of his new book The Quantum Handshake—Entanglement, Nonlocality, and Transactions, Springer (2016). He has also written two hard-SF novels, Twistor and Einstein's Bridge, and his bi-monthly science column is published in Analog Science Fiction/Fact Magazine.

A Student's Manual for a First Course in General Relativity. Robert B Scott. 320 pp. Cambridge U.P., New York, 2016. Price: $39.99 (paper). ISBN 978-1-107-63857-0. (Neil F. Comins, Reviewer.)

In 1985, Bernard F. Schutz, Professor of Applied Mathematics and Astronomy at University College, Cardiff, Wales (now Cardiff University) published the first edition of his textbook *A First Course in General Relativity*. The book was very well received, undergoing numerous reprints and a second edition, published in 2009. In a general relativity-textbook world dominated by the insightful, albeit voluminous, *Gravitation* by Charles Misner, Kip Thorne, and John Wheeler, Bernard's book represented a lighter, more tractable introduction to Einstein's realm.

In the spirit of full disclosure relevant to this review, I was Charlie Misner's teaching assistant the first year he taught from the bound edition of *Gravitation,* and I wrote solutions to numerous homework problems in the book for his students; they were handed out after the problems were graded. Indeed, I still have the mimeographs (you are showing your age if you remember that technology) of many of them. I was also Bernard Schutz' first graduate student and some of our work in theoretical general relativity was cited by Chandrasekhar in his 1983 Nobel Prize lecture. I have taught general relativity here at the University of Maine using *A First Course in General Relativity* several times to good effect. Furthermore, I am also a textbook author (introductory astronomy texts for non-majors).

Robert B. Scott's *A Student's Manual for A First Course in General Relativity* is written to provide solutions to nearly half of the homework problems in the second edition of Bernard's textbook, as well as to provide further exercises and their solutions. According to Scott, *A Student's Manual* is written with several audiences in mind, including "self-learners," and both undergraduate and graduate students. In other words, *A Student's Manual* was written for use by essentially anyone with the background calculus and the motivation and aptitude for understanding the more advanced mathematics presented in Schutz' book. The solutions are stated clearly and, for the most part, each step is presented and explained. When there are many components to calculate, several are done in detail and the rest are covered with, "after a lot of simple calculus and algebra…." For further clarity, the solutions are all presented in grey backgrounds, while the questions are presented in white. Useful "hints" are provided for several problems. There are also appendices of acronyms, symbols, and "useful results." So far, so good.

It is only when one steps back and looks at the bigger picture of textbooks and their contents that the clouds begin to thicken in regard to this book. As a textbook writer, I am leery of books of solutions to the questions in my texts. My reasoning is that many students are taking the introductory courses in astronomy because they need the credit to graduate, rather than because of a deep-seated interest in the course content. These students are more than happy to have access to solutions that will help them get better grades on their homework, even if those solutions will not help them understand the material as fully as they should. This often shows up when such students do not perform as well on exams as they would if they had made the effort to read the book and use it to answer the questions.

For more advanced courses, such as introductory general relativity, one could reasonably make the case that the students are highly motivated to understand the material. Therefore, they will make a "best effort" to read the book, parse the content, and work the exercises on their own or with their peers, until they solve all the problems they can. For problems they cannot solve, reference to a book or online file with answers to the exercises, used judiciously and with the instructor's permission, would indeed be a good thing. Bernard feels the same way, as he states in a preface to the solutions he released online in 2009 to half the exercises in his text. He says, "Solutions are provided to those problems which might present particular conceptual challenges…."

Robert Scott's book also provides general relativity-related questions and answers that are not in Schutz' book. Such additional exercises, along with their solutions, can be instructive for people who are interested in gaining a deeper understanding of a topic. Indeed, Scott's book is not the first providing new exercises and solutions in general relativity. Schutz cites another book filled with exercises for students to solve: *Problem Book in Relativity and Gravitation* by Alan Lightman, William Press, Richard Price, and Saul Teukolsky (Princeton University Press, 1975). I notice that this book is not cited in the references provided by Scott.

So, who benefits intellectually from a book that provides detailed solutions to exercises set in someone else's advanced-level textbook? Plausibly, students who cannot solve problems and whose other resources have not helped them, as noted above, and who could use published answers as a last resort. Also, non-students interested in a field, who have tried the problems on their own, and if necessary gone to an online chat room to work with others doing the same problems, but who still cannot solve them could find detailed published answers insightful. However, in the case of *A First*

Course in General Relativity, both students and non-students can look up Bernard's solutions online and work backward from them until they understand the problems. A related issue with having access to step-by-step solutions as in Scott's book is if students submit homework based on those answers, their solutions will not necessarily reflect how well they really understand the material.

I could envision one type of ancillary book that could help in this process, for introductory general relativity and many other advanced topics; namely, books that give *effective hints* for many of the textbook exercises, without giving the answers. Such a book could help guide students in ways that their instructors would find helpful without disrupting the best practices for students working to learn advanced materials.

Neil F. Comins teaches astronomy, astrophysics, and physics at the University of Maine. He has had 19 trade and textbooks published. His research focuses on general relativity, galactic dynamics, and correcting misconceptions about astronomy.

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