

feld paper. But only two of his papers are quoted, and his book, *From c-Numbers to q-Numbers* (U. of California Press, 1992) is not referred to. Chevalley, who has written extensively and insightfully on the philosophical traditions that contributed to Bohr's and Heisenberg's interpretation of quantum mechanics, receives similar treatment. Tian Yu Cao published an important book, *The Conceptual Developments of 20th Century Field Theories* (Cambridge U. Press, 1997), which was extensively and very favorably reviewed by leading physicists, historians, and philosophers. There is no reference to it in Volume 6.

My criticisms notwithstanding, Mehra and Rechenberg's *The Historical Development of Quantum Theory* is indeed a most impressive accomplishment. The volumes will undoubtedly become the point of departure of all future investigations into the history of quantum mechanics.

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Exploring Black Holes: Introduction to General Relativity

▶ Edwin F. Taylor
and John Archibald Wheeler
Addison Wesley Longman,
New York, 2000. \$37.33 (286 pp.).
ISBN 0-201-38423-X

It has been 85 years since Einstein's formulation of general relativity. In that time, the theory has been extensively tested in its weak-field limit in the Solar System. The prediction of gravitational waves has also been dramatically confirmed by the orbital decay of the binary pulsar 1913+16. General relativity is crucial to understanding the astrophysics of black holes, neutron stars, gravitational lenses, and the expansion of the universe. It has even found practical applications: The global positioning system would fail very quickly if it did not take into account general relativistic corrections.

General relativity also occupies a central place in modern physics. It is our best theory of the gravitational interaction, and provides a radical new view of what it means to be in an inertial frame of reference in the presence of gravity, which couples to all matter and energy. General relativity is also central to the effort to unify all the fundamental interactions of physics within a consistent and experimental-

ly testable quantum theory of gravity. Finally, classical general relativity is on the brink of an experimental revolution, with the expected detection of gravitational waves by new generations of such ground-based observatories as LIGO (Laser Interferometer Gravitational Wave Observatory).

Nonetheless, there is no sign of general relativity in the core undergraduate physics curricula of most colleges and universities, apart from the trivial (and highly misleading) derivation of the Schwarzschild radius from Newtonian escape velocity arguments. What a shame, especially when students are generally filled with a tremendous desire to learn about such exotic objects as black holes! The likely reason for this gap in the curriculum is that the mathematics is considered to be too daunting. However, books are coming on the market, that succeed in explaining relativistic gravity correctly and with a minimum of math.

Exploring Black Holes, by Taylor and Wheeler, is a superb example. No tensors or differential forms here; not even any calculus of variations to derive geodesics! Instead, the book uses very basic differential and integral calculus to get at all the essential physics of black holes. Every physicist should be exposed to the ideas presented here at some time in his or her career.

As would be expected from these authors, the book is extremely well written, and the presentation is physical and intuitive. Common student questions and misconceptions are anticipated and addressed head-on in a series of dialogue formats sprinkled throughout the text. Technical jargon is almost entirely avoided. The importance of different classes of observers is emphasized, as are the ideas of extremal aging for geodesic motion and the fact that energy is a unified whole in general relativity. Taylor and Wheeler masterfully explain exactly what those coordinates in the metrics mean and how they are related to measurements by local observers.

This book should be accessible to physics majors in their sophomore year or later; by then they should have had some exposure to basic Newtonian mechanics and special relativity. Its organization provides considerable flexibility, making it suitable for use in courses of many kinds. The central material is presented in just five short chapters entitled "Speeding," "Curving," "Plunging," "Orbiting," and "Seeing." Interspersed among these chapters are seven "Project" chapters, which lead the student through various interesting applications, including

gravitational lensing, rotating black holes, and an introduction to cosmological spacetimes.

This book is not intended to be a broad overview of general relativity. The Einstein equations are not presented or explained, nor is there any discussion of gravitational waves. The cosmology project chapter just scratches the surface of that important field. Such limited treatment is perhaps just as well, given the authors' stated philosophical objections to the recent observational evidence of accelerating expansion. To their credit, however, this is treated fairly in the text. The book also concentrates on the physics of black holes, not their astrophysics, so readers should not expect to find much on accretion disks, iron K-alpha lines, jets, or black hole mass/stellar velocity dispersion correlations.

As a textbook that really teaches the basic physics of black holes and focuses on that physics rather than on difficult mathematics, this book is right on the mark. I can only hope that *Exploring Black Holes* and similar books will equip us to modernize undergraduate physics curricula to include a discussion of general relativity, one of the truly revolutionary advances in 20th-century physics, an advance that is central to modern fundamental physics.

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Nearest Star: The Surprising Science of Our Sun

▶ Leon Golub and Jay M. Pasachoff
Harvard U. Press, Cambridge,
Mass., 2001. \$29.95 (304 pp.).
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Nearest Star: The Surprising Science Of Our Sun tells the story of our most important star, the Sun, and its relationship to our most important planet, Earth. It is a story with many facets, and multiple links to fundamental physics that might surprise as well as engage the reader. The book is beautifully written and conveys the love that the authors have for the subject.

One of its authors, Leon Golub, is a solar astronomer and one of the leaders of the Transition Region and Coronal Explorer (TRACE) team. The other, Jay Pasachoff, is a noted astronomer who has seen more total eclipses than perhaps any other person. Pasachoff has written several astronomy textbooks, including, one of the best middle-school science