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Celestial Calculations: A Gentle Introduction to Computational Astronomy FREE

Celestial Calculations: A Gentle Introduction to Computational Astronomy.. J. L. Lawrence 390 pp. MIT Press, Cambridge, MA, 2019. Price: $39.95 (paper). ISBN 9780262536639.

Timothy F. Slater

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Celestial Calculations: A Gentle Introduction to Computational Astronomy. J. L. Lawrence. 390 pp. MIT Press, Cambridge, MA, 2019. Price: $39.95 (paper). ISBN 9780262536639. (Timothy F. Slater, Reviewer.)

At its very core, astronomy is a quantitative science. Since its prehistoric beginnings, the questions of where?, when?, how big?, how far?, and how many? are the fundamental questions that drive astronomers to do astronomy. Scientists communicating with journalists, government representatives, and the general public need to be fully prepared to answer these numerical questions in layman's terms anytime a new discovery, observation, or exploratory mission is announced. But how do seemingly omniscient sky watchers know the wheres and whens of astronomy? It is with the goal of providing a how-to-calculate-it manual that J. L. Lawrence created with his newly released book, *Celestial Calculations: A Gentle Introduction to Computational Astronomy*.

The book is nothing short of comprehensive, divided into 10 core chapters. With more than 350 pages printed in the tiniest 10-point font, the book appears ominous and impenetrable at first glance. At the same time, the subtitle—*A Gentle Introduction to Computational Astronomy*—promises accessibility. The book jacket and forward suggest that nothing more than high school algebra and some trigonometry are all that is needed to make reasonably accurate calculations predicting sky positions and motions. In terms of review, it is unclear if the author successfully made good on his promise; even though there is no formal integral calculus required to complete the included exercises, the numerous mathematical equations definitely appear ominous to those that lack courage to roll up their sleeves.

Knowing that the equations give a challenging appearance, the author purposely attempts to be disarming about the abundance of equations that dominate the book. Friendly guidepost comments like "don't panic!" and "At this point, the reader may well be a bit confused" (p. 109) go a long way toward lessening the blow of what appears to be impenetrably dense material. The book's writing style is definitely conversational, even when longwinded.

At the same time, there are ideas curiously missing from such a long treatment of the subject. For one, although the book lists dozens of ways to refer to the time of day (p. 21), it does not describe sky watchers' seemingly important definitions of civil twilight, nautical twilight, or astronomical twilight. In much the same way, the book spends considerable time talking about calculating apparent angular diameter (p. 145), but never mentions the apparent diameter of the sun when talking about calculating sunrise, noon meridian transit, or sunset, or the minutes it takes to cross a line, and how that depends on one's latitude. One would assume the question "how long does it take the sun to set?" is a reasonable one to tackle in a published work of this magnitude.

Another challenge the book encounters—as do all authors writing about the vast subject of astronomy—is using terms before they are introduced and defined. An example of this is the use of the term Vernal Equinox, which is used early in the text but not actually defined until a later chapter (p. 83). Some terms deserve a serious treatment, like the important concept of an epoch, but are not even mentioned in the book's section on creating and using star charts where it would be most applicable (p. 119). Moreover, the book unnecessarily mentions terms a single time, Draconian year (p. 27) and evection corrections (p. 163), for example, which are never used again. These attributes damage the intended readability of a book designed specifically for non-professionals.

The book does take time at the beginning of each chapter to talk about the chapter object itself. For example, the beginning of the Moon chapter devotes considerable space to talking about the nature of the Moon's surface, the Moon's role in creating Earth's tides, and the Apollo missions to explore our closest celestial neighbor. A future, less "thick" edition of this book might save considerable space if the author passed the responsibility of describing this unrelated material to different sources.

Although there are many valuable things about this book, the strongest part of this resource is likely the accompanying computer software programs provided online by the author. Although clearly more comprehensive, the book probably does not replace the classic and much shorter book by Duffett-Smith and Zwart on the same topic, *Practical Astronomy with your Calculator or Spreadsheet*. The book does make good on its promise not to delve into integral calculus and shows readers ways to calculate sky positions and motions using principles of algebra and trigonometry, and, as such, represents a valuable contribution to the serious amateur astronomer's library.

Timothy F. Slater holds the University of Wyoming Excellence in Higher Education Endowed Professorship in Science Education and is a Senior Scientist at the CAPER Center for Astronomy & Physics Education Research. His research focuses on better understanding the nature of effective science teaching and learning at the introductory college level.

BOOKS RECEIVED

Asymptotic Diffraction Theory and Nuclear Scattering. Roy J. Glauber and Per Osland. 208 pp. Cambridge U. P., New York, 2019. Price: $140 (hardcover) ISBN 978-1-107-10411-2.

At the Edge of Time: Exploring the Mysteries of our Universe's First Seconds. Dan Hooper. 242 pp. Princeton U. P., Princeton, NJ, 2019. Price: $24.95 (hardcover) ISBN 9780691183565.

Classical Kinetic Theory of Weakly Turbulent Nonlinear Plasma Processes. Peter H. Yoon. 249 pp. Cambridge U. P., New York, 2019. Price: $155 (hardcover) ISBN 978-1-107-17200-5.

Conceptual Developments of 20th Century Field Theories (2nd ed.). Tian Yu Cao. 459 pp. Cambridge U. P., New York, 2019. Price: $79.99 (hardcover) ISBN 978-1-108-47607-2.

Einstein on the Run: How Britain Saved the World's Greatest Scientist. Andrew Robinson. 367 pp. Yale U. P., New Haven, CT, 2019. Price: $25 (hardcover) ISBN 978-0-300-23476-3.

Falling Felines and Fundamental Physics. Gregory Gbur. 351 pp. Yale U. P., New Haven, CT, 2019. Price: $26 (hardcover) ISBN 978-0-300-23129-8.

Horace's *Ars Poetica*: Family, Friendship, and the Art of Living. Jennifer Ferris-Hill. 442 pp. Princeton U. P., Princeton, NJ, 2019. Price: $45 (hardcover) ISBN 9780691195025.

Introduction to Lens Design. José Sasián. 249 pp. Cambridge U. P., New York, 2019. Price: $64.99 (hardcover) ISBN 978-1-108-49432-8.

Nano Comes to Life: How Nanotechnology is Transforming Medicine and the Future of Biology. Sonia Contera. 228 pp. Princeton U. P., Princeton, NJ, 2019. Price: $24.95 (hardcover) ISBN 9780691168807.

The Physics of Krav Maga. John Eric Goff. 248 pp. Johns Hopkins U. P., Baltimore, MD, 2019. Price: $28.95 (paper) ISBN 978-1-4214-3161-1.