important areas of physics.

It is remarkable how many of these recent developments can trace their origins to much earlier work that had experienced a hiatus, awaiting advances in other areas of physics before further progress could be made. Bose–Einstein condensates, for example, represent a test of N. N. Bogoliubov's theories of weakly interacting bosons, but their creation became possible only after advances occurred in optical physics and magnetic trapping. Similarly, chaos in atomic physics can be seen as the resumption, after a six-decade interlude, of the application of classical mechanics to atomic systems made possible by recent advances in computing, nonlinear dynamics and fundamental experiments on Rydberg atoms. In a sense, Reinhold Blümel and William P. Reinhardt's *Chaos in Atomic Physics* is an attempt to pick up where Max Born's 1925 book, *Mechanics of the Atom* (English translation: Bell, 1927; reprinted by Ungar, 1960), was forced to leave off, for lack of general interest after the "new" quantum mechanics was discovered.

The modern field of chaos in atomic physics started with the 1969 experiments of W. R. S. Garton and F. S. Tomkins on the energy-level structure of alkali earth atoms in strong magnetic fields (the so-called quadratic Zeeman effect, or QZE). A. R. Edmonds connected the unexpected regular modulations in these absorption spectra almost immediately to a particular classical electron orbit perpendicular to the magnetic field direction. This remarkable anticipation of Martin Gutzwiller's trace formalism was followed by numerous demonstrations of how well classical mechanics can describe atomic systems, a notion that is at once unfamiliar and alien to those trained in traditional areas of physics. A book that unifies the experimental and theoretical research on the chaotic aspects of atomic physics would certainly be welcome—a book with the broad view and authoritative sweep of, say, Gutzwiller's *Chaos in Classical and Quantum Mechanics* (Springer, 1990). *Chaos in Atomic Physics* is not quite that. It is, instead, a book about chaos that happens to select its examples from atomic physics.

To their credit, the authors provide a useful introduction to aspects of chaos that arise in some atomic problems. Maps, fractals, chaotic scattering and resonance overlap are illustrated with pedagogical examples. Ultimately, however, the book does not go far enough. For example, the authors retreat from providing a definite answer to the question that for many has been the *raison d'être* for the subject: Does quantum chaos exist? Instead, they organize a key chapter around fairly *ad hoc* definitions and classifications of quantum chaos that are all too likely to increase the confusion already surrounding this subject.

The reasons for the absence of chaos from quantum mechanics (oddities aside) have nothing to do with the linearity of quantum theory, which is mentioned in the preface but not pursued; after all, the Liouville equation, itself linear, manages to preserve all of the chaos contained in Hamilton's equations. Such shortcomings can be traced to a basic structural flaw: The book concentrates almost exclusively on the research interests of the first author, on whose lecture notes it is based.

Overall, the book's parochiality results in undue emphasis on model or spatially one-dimensional (1D) problems. With the exception of the ionization of 1D hydrogen atoms in microwave fields and the excellent application of complex coordinate methods to a model helium atom, the book's chief merit is the theoretical simplicity of the contents, rather than any pressing experimental interest. This bias is maintained at the expense of problems for which *bona fide* experiments exist.

Topping the list of casualties is the QZE itself: It strains credibility to attempt a discussion of chaos in atomic physics without discussing in some detail the problem that defined the field. In a curious reversal of history, the QZE is relegated to a brief section in the last chapter, which deals with *future* directions. Blümel and Reinhardt also exclude recent experiments on Rydberg atoms in circularly or elliptically polarized microwave fields, which exhibit chaos in more than a single space dimension. This all leads to a lopsided picture of the subject.

Our recommendation is to spend some time in the library, deciding whether or not this book is worth your $80, before taking the plunge.

TURGAY UZER
Georgia Institute of Technology
Atlanta, Georgia
DAVID FARRELLY
Utah State University
Logan, Utah

Adventures in Celestial Mechanics

Victor G. Szebehely and Hans Mark
Wiley, New York, 1998 [1989]. 2nd edition. 310 pp. $59.95 hc
ISBN 0-471-13317-5

Adventures in Celestial Mechanics by Victor Szebehely and Hans Mark, published after Szebehely's death in 1997, is the second edition of the 1989 Szebehely book from the University of Texas Press. Both editions are intended to introduce and attract students to celestial mechanics. This new edition has gained an author, doubled the number of pages and added pictures. The additions are chapters on rocket propulsion, elementary spacecraft dynamics and the history of exploration of the Solar System, which seem to be the contributions of the additional author. The preface promises more material on artificial satellites and chaos and, although the promise on chaos is not fulfilled, the book has gained some interesting material. What it loses in exchange, however, is some of its original focus on celestial mechanics.

Nonetheless, it retains the first edition's historical approach and readable introduction to the two- and three-body problems, Kepler's equation, Lambert's theorem and perturbation theory. The contributions of many well-known individuals are used to develop interest in the subject and illustrate the breadth of the mathematical applications in celestial mechanics.

The chapter on exploration of the Solar System is a good brief illustrated history, but it does not discuss some of the interesting celestial mechanical problems that arose with new discoveries, such as ring dynamics, resonances with satellites and librational and co-orbital satellites. There is a good introduction to the use of gravity assist for planetary missions, but details are avoided with the statement that they are too complicated.

The book unfortunately has not been updated in the areas of most interest in celestial mechanics today, which are also the topics that would be of most interest to new students. Thus, the Kuiper belt is never mentioned, and the explanation of the source of comets omits the interesting dynamics research on outer Solar System bodies. Near Earth objects are mentioned, but their dynamics are confused with an explanation of the Kirkwood gaps. There is no mention of relativity, although this may be understandable in an introductory text.

The largest disappointment for me was the inaccurate and inadequate coverage of the hottest current topic of celestial mechanics: chaos. Szebehely was always very interested in stability and the various definitions thereof. Today we have chaos, stable chaos, unstable chaos, multiplicative factors for Lyapunov stability and other terms. The preponderance of new terms leads to the conclusion that there is an urgent need for new definitions and measures for stability. I had hoped for some fundamental definitions and clarity on the subject, in the typical Szebehely fashion. Instead, I found additional confusion. Chaos is not defined and is implied to mean "not predictable" motion or escape in the three-body problem. The concept of chaos introduced is based on the early work by Jack Wisdom on the rotation of Hyperion and long period integrations of the Solar System. (Wisdom is incorrectly identified as being at Caltech rather than MIT.)

The book would be a useful, stand-alone text for a general introductory course in celestial mechanics and space sciences. Because I have been active as a researcher and teacher of celestial mechanics for over 30 years, perhaps I expected too much—based on the previous work and reputations of the authors. Whatever the reason, I was disappointed that the book is not as focused as its predecessor and lacks coverage in the areas of current excitement in celestial mechanics.

P. Kenneth Seidelmann
US Naval Observatory
Washington, DC

New Books

History and Philosophy

Principles of Geology. C. Lyell. Penguin Books, New York, 1997 [1830–33]. 472 pp. $15.95 *pb* ISBN 0-14-043528-X

Science and the Retreat From Reason. J. Gillott, M. Kumar. Monthly Review Press, New York, 1997 [1995, reissued]. 248 pp. $38.00 *hc* ($18.00 *pb*) ISBN 0-25345-986-X *hc* (0-85345-987-8 *pb*)

Scientific Instruments 1500–1900: An Introduction. G. L'E Turner. U. of Calif. P., Berkeley, Calif., 1998. 144 pp. $40.00 *hc* ISBN 0-520-21728-4

To Light Such a Candle: Chapters in the History of Science and Technology. K. J. Laidler. Oxford U. P., New York, 1998. 384 pp. $50.00 *hc* ISBN 0-19-850056-4

Instrumentation and Techniques

Cumulative Sum Charts and Charting for Quality Improvement. *Statistics for Engineering and Physical Science.* D. M. Hawkins, D. H. Olwell. Springer-Verlag, New York, 1998. 247 pp. $54.95 *hc* ISBN 0-387-98365-1

Introduction to Scanning Transmission Electron Microscopy. *Microscopy Handbooks 39.* R. J. Keyse, A. J. Garratt-Reed, P. J. Goodhew, G. W. Lorimer. Bios Scientific Publishers (Springer-Verlag), New York, 1998. 114 pp. $32.95 *pb* ISBN 0-387-91517-6

Inverse Problems, Tomography, and Image Processing. Proc. Cong., Newark, Del., Jun. 1997. A. G. Ramm, ed. Plenum, New York, 1998. 258 pp. $95.00 *hc* ISBN 0-306-45828-4

Particle Image Velocimetry: A Practical Guide. *Experimental Fluid Mechanics.* M. Raffel, C. E. Willert, J. Kompenhans. Springer-Verlag, New York, 1998. 253 pp. $79.95 *hc* ISBN 3-540-63683-8

TeX Unbound: LaTeX & TeX Strategies for Fonts, Graphics, and More. A. Hoenig. Oxford U. P., New York, 1998. 580 pp. $60.00 *hc* ($35.00 *pb*) ISBN 0-19-509685-1 *hc* (0-19-509686-X *pb*)

Materials Science

Electrocatalysis. *Frontiers in Electrochemistry.* J. Lipkowski, P. N. Ross, eds. Wiley-VCH, New York, 1998. 376 pp. $145.00 *hc* ISBN 0-471-24673-5

Fractals and Fractional Calculus in Continuum Mechanics. *International Centre for Mechanical Sciences Courses and Lectures 378.* A. Carpinteri, F. Mainardi, eds. SpringerWien (Springer-Verlag), New York, 1997. 348 pp. $80.00 *pb* ISBN 3-211-82913-X

Large Plastic Deformation of Crystalline Aggregates. *International Centre for Mechanical Sciences Courses and Lectures*