

*lumpy matter;
Nothing but bulk, inert, in
whose confusion
Discordant atoms warred; there
was no Sun
To light the Universe; there was
no Moon
With slender silver crescents
filling slowly;
No Earth hung balanced in
surrounding air.*

How far have we come since then? Marcelo Gleiser attempts in *The Dancing Universe* to classify cosmogonical myths and cosmogonical models and show that they offer complementary explanations for the origins of the universe. The book is about the history of ideas in cosmogony and the life and work of such scientists as Copernicus, Galileo, Kepler, Newton and Einstein. The author explores the beliefs and inspirations, often religious, behind the scientific creative process. He illustrates how current theories of the origin of the universe have come nearly full circle with some of the oldest mythical and religious stories.

Many books cover this ground. Although Gleiser's explores the relationships between scientific and prescientific belief systems, it is not as blatantly commercial as the recent spate of God-and-physics or physics-and-immortality books. It does not push Zen or Taoism or mysticism. It is not about the end of physics. It is simply a history of science wherein both "history" and "science" are broadly defined. It is written by a physicist, not a philosopher or historian.

There are a few figures, a long glossary and a complete index. For a reasonable investment of time and money, one can learn how creation physicists think and how their ideas may have evolved. After reading the book and becoming impressed with how far we have come and how much we know, one should go back to the beginning and reread the Hindu *Veda*, (from about 1200 BC):

*Only He who is its overseer in
the highest heaven knows.
He only knows, or perhaps
He does not know!*

Some of the scientific theories that we have embraced and then abandoned seem, in hindsight, much like some of the more amusing myths. Even some modern ideas seem outrageous to those who are not "members of the faith." How will our current naive theories be viewed from the future? Will they be viewed as amusing myths or misdirected energy? Is science just one of today's religions? It

is good to put things into the type of perspective offered in this book.

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Lecture Notes on Atomic and Molecular Physics

▶ Şakir Erkoç and Turgay Uzer
*World Scientific, River Edge,
N.J., 1996. 310 pp. \$48.00 hc
ISBN 981-02-2811-2*

Lecture Notes on Atomic and Molecular Physics is a small (310 half-sized pages) book and is, as the title indicates, a setting in print of notes intended to guide students through a one-semester, junior- or senior-level presentation of atomic and molecular physics. The authors, Şakir Erkoç and Turgay Uzer, intend this to be a self-contained guide to the subject. For this reason, the book assumes little or no background in atomic physics or quantum mechanics; it begins from the vantage point of a reader who has taken a traditional calculus-based university physics course and assumes some familiarity with differential equations, including partial differential equations.

Given these assumptions, the book contains a very brief overview of some of the physical phenomena leading up to quantum mechanics (Rutherford, Bohr models of the atom; Frank-Hertz experiment; photoelectric effect; de-Broglie waves), followed by an equally brief introduction to elementary quantum theory in one and three dimensions. After a short development of perturbation theory, both time-independent and time-dependent, the text begins the discussion of atomic physics, starting with the one-electron atom, helium atoms, the periodic table, vector models and properties of atoms (radii, ionization potentials, inner-shell transitions à la Moseley, quantum defect formula for outer shells). The discussion of molecular structure includes the Born-Oppenheimer separation, vibrations and rotations, simple linear combination of atomic orbitals, molecular orbitals and level-crossing models. A final section is an introduction to Hartree-Fock theory, C. J. C. Roothan's version of Hartree-Fock, and Otkay Sinanoglu's approach.

This book presents a more comprehensive version of atomic physics than is found in a traditional curriculum, which might present some of this material in a so-called modern physics course and some of it under applications of quantum mechanics. I believe

that, in terms of being self-contained, the book does well. It would serve well as a supplementary text in some contexts.

I would have difficulty using this book, however. In teaching a modern physics course, I find the biggest job is getting students to make the connection between physical phenomena and concepts and their newly acquired skills in advanced calculus and differential equations. For many students, neither of these is completely settled, and so they have a hard time making those connections. Their insecurity causes them to avoid risking failure; they do not venture models of their own without much encouragement.

In many cases, this book presents formulas as "the way it is" without indicating how they might have come about. The teaching of physics is an interesting art. There is a fine line between pontificating about "the way it is" and convincing students to struggle to envision a way to formulate a given problem. This book has only minimal words surrounding the presentation of a given formula. A heavily annotated bibliography, carefully referenced in each section of the text to give the student additional guidance, would have been very useful, in my view.

An additional difficulty with this text as I see it is that it would require revamping or replacing a standard modern physics course or reorienting a course on the applications of quantum mechanics. For those students who had not been exposed to modern physics, such a course might serve as a replacement. Some significant part of the material covered here is often included in a full-year quantum mechanics course, however. Coordination is then required.

There is a difference between a pedagogically sound presentation of material, as found in a standard text, and the presentation found in lecture notes. This text provides students with just an outline, which does not answer the questions that arise naturally as they approach this subject matter for the first time. An instructor using this text would have to provide essentially all of the context for the material.

A final comment: I was disappointed to find no discussion of laser interactions, atom and ion cooling and trapping, Bose-Einstein condensates and related developments that have produced so much excitement in the physics community in the last few years. Their inclusion would have made the book much more interesting.

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