necessary energy source. They describe the ocean floor as a giant laboratory, where one-cell organisms cluster around hot vents and form the food for larger organisms: "Tube worms at the sea vents farm archaea, much like rangers raising cattle."

The second chapter begins with the sentence "Life on earth has at times been devastated by great ice ages, flip-flopping climates, volcanic eruptions, asteroidal collisions, massive extinctions, and other natural disasters, but the most catastrophic of these was the appearance of oxygen molecules in the atmosphere beginning a little less than 2 billion years ago." The book goes on to explain how living things overcame the problem: either by escaping into the anoxic depths of the oceans or adapting to and using the oxygen. Iron was (and is) essential for making the second alternative possible.

The ways living systems learned to deal with oxygen, and how iron is used, are described simply and correctly. Again, stories enliven the scientific accounts. For instance, one story tells about the men of the Bantu tribes whose livers "rusted" because they drank too much homemade beer brewed in iron pots. This story makes the point that iron is both necessary and toxic.

Iron is essential in many proteins, hemoglobin being one example. The book describes the basic aspects of the use of iron in enzymes, but the authors also include other biological uses for iron. For instance, iron is incorporated into tiny magnets, which some anaerobic bacteria use to avoid oxygen and which some birds and sea turtles use for directing their travels.

The authors describe the involvement of iron in two of the most fundamental life processes: photosynthesis and nitrogen fixation. Both of these processes are essential for our ecosystem, to which the book devotes considerable attention. Finally, the last chapter, "Feeding the World's Poor," describes the tragic consequences of dietary iron deficiency in large parts of the world.

A clear glossary and an extensive and excellent bibliography complete the slim book and permit the reader to dig deeper. In summary, I can recommend the book without reservation. In particular, physicists who have not delved into the life sciences may find it stimulating.

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Polarization and Correlation Phenomena in Atomic Collisions: A Practical Theory Course

Vsevolod V. Balashov,
Alexei N. Grum-Grzhimailo, and
Nikolai M. Kabachnik
Kluwer Academic/Plenum, New York, 2000. $95.00 (243 pp.). ISBN 0-306-46266-4

Polarization deals with representations of geometries and symmetries of both bound and dynamic systems in a general mathematical way. Correlation deals with interconnection of subsystems and is a key to understanding complex systems. These two topics—polarization and correlation—are broad, with application in various areas of science and technology.

Polarization and Correlation Phenomena in Atomic Collisions, by Vsevolod V. Balashov, Alexei N. Grum-Grzhimailo, and Nikolai M. Kabachnik, grew out of a course in atomic and nuclear physics at Moscow State University, begun over thirty years ago. The scope covers quantum theory of collisions, group theory, solid state physics, atomic spectroscopy, physics of nuclear reactions, and particle propagation through matter.

The authors are all well established: Balashov has been a professor of physics at Moscow State for several decades and has been a leading authority in this area for some time; Grum-Grzhimailo has been an active member in Balashov's group for many years. Kabachnik, also a Balashov collaborator, has an international reputation with an impressive track record working with experimental groups around the world. Their book can be read by a person with a background in elementary quantum mechanics and general atomic physics at the undergraduate level. All necessary information about polarization and correlation is included.

In contrast to earlier books by Balashov and collaborators, this compact text focuses on atomic physics. It is rich with clear applications of density matrices and tensor operators, many of which are based on the extensive research of the authors and their many collaborators. Examples include (e,2e) autoionizing studies, polarization and angular anisotropy of Auger and photoelectrons, superelastic scattering in electron–atom collisions, photo-excitation from laser-excited targets, electron cascading following inner-shell excitation, and ionization and polarization effects in antiproton–atom interactions.

This text is also relatively complete in describing the decay of final states following excitation of a particular unstable, or metastable, final state. However, the aim is not to provide information about specific reactions but rather to use specific examples to illustrate the utility of density-matrix and tensor-operator methods. Included is an unusually useful and compact set of tables summarizing key information on the algebra of angular momentum.

In my view, what distinguishes this book from older books by other authors is new material on multiparticle excitation processes. A "perfect" (e,2e) experiment that includes double excitation to an intermediate state is described in detail. This leads to interference effects from competing pathways, where direct single ionization and decay or a doubly excited intermediate resonance leads to the same final state. The influence of electron correlation can be enhanced, especially in cases in which the interference is destructive in the absence of correlation. In addition, the role of correlation in dynamic processes is addressed. The difficult many-electron problem for dynamic systems, which is also addressed, is likely to become of greater interest with the development of atomic and molecular switches, quantum computing passage of electrons through quantum corrals, and other emerging fields dealing with dynamic nanostructures.

Many excellent books are available in this area; this new one by Balashov, Grum-Grzhimailo, and Kabachnik is relatively compact compared to Karl Blum's *Density Matrix Theory and Applications* (Plenum Press, 1996) or *Polarization, Alignment and Orientation in Atomic Collisions*, by Nils Andersen and Klaus Bartschat (Springer-Verlag, 2000); more mathematical than *Angular Momentum*, by William Thompson (Wiley, 1994), or *Symmetries in Quantum Physics*, by Ugo Fano and Ravi Rau (Academic Press, 1996); and of course has more up-to-date material than the seminal and still useful review by Fano and Joe Macek in *Reviews of Modern Physics*, volume 45, page 553, 1973. The widely used *Angular Momentum in Quantum Mechanics*, by A. R. Edmunds (Princeton U. Press, 1996), and *Elementary Theory of Angular Momentum*, by M. E. Rose (Dover, 1995), are more concise, but lack the detailed examples of this new text from Moscow. Richard N. Zare's text *Angular Momentum* (Wiley, 1988) contains examples of molecular and chemical systems but does less physics. A surprisingly large number of other texts that cover optical, nuclear, and astrophysical applications can be easily found by searching the Internet.

This book is written in clear English and contains a number of neatly done figures illustrating important points. The index, especially useful to a new reader, is adequate. The rather concise bibliography contains only 31 entries, and, as with most comparable books, there are no problems to guide students.

In summary, *Polarization and Correlation Phenomena in Atomic Collisions* is a crisp, fresh look at a topic with relatively broad application, containing numerous and clear examples from the field of atomic collisions and especially helpful mathematical summaries. Written by internationally recognized authorities in the field, it is useful as both a reference book and a textbook for graduate students. Let us welcome this fine addition to our bookshelves.

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Magnetism and Superconductivity

Laurent-Patrick Lévy
(translated from French
by Stephen Lyle)
Springer-Verlag, New York, 2000.
$58.95 (467 pp.).
ISBN 3-540-66688-5

A proper description of Laurent-Patrick Lévy's *Magnetism and Superconductivity* requires a new word generalizing the concept of "monograph" and signifying two topics inside a single volume. This poses a challenge, as "digraph" is neither elegant nor descriptive. Perhaps "dual monographs" or "diatopical" will do. The problem is a title that will lead the casual reader, as it did this reviewer initially, to expect a treatment of a new generation of copper oxides that combine the physical virtues of magnetism with those of superconductivity. In fact, *Magnetism and Superconductivity* has nothing to do with high-temperature superconductivity. Rather, it moves on two separate tracks, with the first 260 pages or so consisting of a treatise on the origins of magnetism in atoms, molecules, and solids, and on the solution of mathematical models thereof, with the rest devoted to conventional, low-temperature superconductivity mediated by the electron–phonon interaction.

The prerequisites for understanding the magnetism portion include a good background in quantum mechanics and some familiarity with linear algebra. However, the concepts of second-quantization, symmetry theory, and group theory are not assumed, as elements of these topics are accurately and briefly developed in appendices.

The contents of the first portion of the book are, in fact, standard in the study of the physical origins of magnetism and are almost all covered in a variety of existing textbooks by other authors. These topics include exchange forces, mean-field theory and phase transitions, Ising and XY models, linear response theory, spin waves, quantum chains, and itinerant magnetism. Each topic is introduced and manipulated with mathematical nicety and a sure hand. Transfer matrices, correlation functions, solitons, and an elementary overview of the Hall effect are additional topics that are touched on (or, rather, distilled) in the manner suitable for French students at a certain level of their graduate education.

The second half is, similarly, a standard treatment of its topic. The theoretical concepts are elaborated as a combination of Bardeen-Cooper-Schrieffer (BCS) theory, Bogoliubov's transformation, and the Ginzburg–Landau phenomenology. Many meaningful applications that are developed or at least touched on include the Josephson effects, Andreev reflection, vortices, gapless superconductivity, type I versus type II materials, and SQUIDs. As in the first half, the contents are standard in the field and can be found in several earlier texts on superconductivity. Again, the presentation is uniformly clear and succinct and readily accessible to graduate students at a certain level.

For the above reasons, I recommend this book to students of magnetism or of superconductivity (alas, there may not be too many students of both these disciplines in the US). They will find this to be an excellent although not an innovative textbook in the field of their choice. Either treatment will expand their horizons and help them deal with the difficult problems sure to arise in an uncertain future. As a bonus, they will receive a second textbook in the other field and may someday be glad of it.

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