and advances into perspective with the old in a way that young people entering the field can become oriented and enthused, and all can get a better vision of the future.

Such seems to be the task Earl McDaniel has set for himself in writing *Atomic Collisions* book. McDaniel, a professor who has taught the subject for many years and who has earned distinction for experimental research in atomic collisions, has authored, co-authored and edited several books and monographs in the field.

Because it has been 26 years since McDaniel's earlier book of this nature, *Collision Phenomena in Ionized Gases* (Wiley, New York, 1964), and 20 years since the second edition of the classic series by H. S. W. Massey and E. H. S. Burhop, *Electronic and Ionic Impact Phenomena, Vols. 1–2* (Oxford, London, 1969), the time has very much come for such a work. The more recent graduate text by Robert E. Johnson, *Introduction to Atomic and Molecular Collisions* (Plenum, New York, 1982), though useful in its context, is not as comprehensive in its treatment of phenomena or of the literature as this book and the others mentioned.

Those who join me as one who has profited from McDaniel's 1964 book will definitely find this update valuable. Because of the growth of the field, McDaniel has had to divide his treatment into two volumes, this being the first. The second volume on heavy-particle collisions, will follow at a future date. Volume one includes chapters on fundamental concepts; background information from the kinetic theory of ionized gases; collision theory; elastic scattering of electrons on neutral atoms and molecules; excitation and de-excitation of neutrals by electron impact; ionization of neutrals by electron impact; collisions of electrons with charged particles; and photon processes. The first three chapters and Appendix I seem to be verbatim repeats from McDonald's 1964 book, except for important additions to Chapter 3 on the quantum theory of inelastic collisions and approximation methods in colllision theory. Updated references have also been added to these early chapters. A new feature of the book is the addition at the end of each chapter of approximately 30 problems—with references to locations of solutions for most—thus enhancing its value as a graduate text. The tone and level of the book also make it suitable for this purpose as well as for a general reference.

Recognizing the increased vastness of the field, McDaniel has rightly put concept ahead of detail and has included substantially more theoretical description of the topics in each chapter. With the resulting loss of discussion of data, however, there is in my opinion an attendant loss of life and excitement from the treatment. Nevertheless, references to original data, reviews and monographs are exhaustive, and the serious reader will be able to thoroughly pursue a topic with this book as a guide.

The author gives excellent coverage of the ubiquitous field of resonances in electron scattering, and his frustration at having to put a cutoff date on material to include comes through; references to exciting new work in ionization are given, but discussion in the text is not. His treatment of other advances in the field, such as positron collisions, collisions between spin-polarized particles, "perfect or complete" scattering experiments and new techniques, is similarly generally good. However in places the coverage is little more than a sentence or two to recognize the area and references given. Again his frustration shows as he attempts to provide a detailed view of such a broad and diffuse field. Individual readers may question why their pet topic isn't treated in more detail, while others less valuable to them are treated more thoroughly. For example, it's difficult for me to understand why so much effort is given to the binary encounter treatment of electron-impact ionization, while only lip service is paid to distorted-wave methods, used for most of the successful calculations of the process. The list of such "whys" could fill a page and would be different for each reader; it's just a part of deciding to write a book of finite length.

This work's main detraction is its failure to communicate adequately the life, excitement and directions in the field, and I've alluded to why I think that has happened. My bottom line, however, is that this book is a well done and needed addition to the field. It will find broad use as both a graduate text and a reference guide for researchers.

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Geophysical Geodesy

Kurt Lambeck

Oxford U. P., New York, 1989. 710 pp. $135.00 hc
ISBN 019-854438-3

Geodesy, the measurement of the shape, gravity field and orientation of

the Earth, is best thought of as the metrology of geophysics. Like the metrologist, the geodesist strives to add another decimal place (or a higher degree of spatial coverage) to our knowledge of certain quantities; and as in metrology, much of the drive for this increased precision has come from technical applications such as cartography and the aiming of intercontinental ballistic missiles. But geodetic data have also been important in advancing our understanding of the Earth, and it is this aspect that Kurt Lambeck addresses in this extremely comprehensive book.

Lambeck aims to show geophysicists the specialized methods of geodesy, to show geodesists the knowledge of the Earth gained from other geophysical methods and to show both groups problems where their interests can fruitfully converge. He has done very well: This book should become a major reference in the field and the volume of choice for those seeking an introduction to its topics. For many areas that it covers, there is simply no other book available.

This is a good time for such a book to appear, for the last two decades have seen immense advances in geodetic methods. These advances have largely taken the form of measurements between extraterrestrial sources and ground points, augmenting the "classical" methods of measuring between ground stations. The extraterrestrial sources include quasars and satellites, both natural and artificial. From a geodetic perspective, satellite measurements have the bonus of containing information about the gravity field as well as being useful for determining the relative positions of points.

Lambeck opens with brief summaries of basic geodetic theory (potential theory and coordinate systems) and geophysical data on Earth's structure. The chapter on the effects of the ocean and atmosphere is particularly welcome, since these effects are almost always important and not something that many geodesists or geophysicists usually learn about. The four chapters on geodetic methods form a large part of the book, and though somewhat uneven in depth, all provide good introductions. The chapter on the "classical" methods is clearly—and successfully—aimed at the geophysicist who wants to work with such data but does not wish to become entangled in the more obscure parts of geodetic practice. The discussion of geodetic radioastronomy techniques (very-long-baseline interferometry) likewise avoids full detail, but is very valuable, since it is almost the only discussion outside the specialized literature of how these procedures actually work.

The chapter on artificial satellite methods is by far the most detailed, and it contains a complete discussion of Earth–satellite orbital theory, as might be expected from the author's background as a practitioner of this subject. One flaw (largely beyond the author's control) is the very cursory discussion of the recently developed Global Positioning System satellites, which are presently revolutionizing geodetic surveys over distances from 1 to 1000 km. The orbit theory is used again in the chapter on observations of the Moon—more of interest, apparently, for providing data on this body than for geodetic purposes.

The final three chapters focus on various problems for which geodetic techniques are useful; by Lambeck's own admission, there is some bias towards problems he has worked on (fortunately, a very wide range).

Lambeck first describes how the Earth's gravity field can be interpreted in terms of both deep and shallow structure. There is then a fairly full discussion of crustal movements, including plate tectonics, glacial rebound and deformation along plate boundaries. In view of its importance in the seismic cycle, the last of these is treated somewhat too briefly. The book closes with a discussion of Earth tides and Earth rotation—and an amazingly wide-ranging bibliography.

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Elements of Quantum Optics

Pierre Meystre and Murray Sargent III
Springer-Verlag, New York, 1990. 484 pp. $44.50 hc
ISBN 0-387-52160-7

This is a well-written and useful book containing a broad coverage of the basic elements of quantum optics. It was a pleasure to read. The stated aim of the authors is to "present a variety of theoretical tools, so that after completion of the course students should be able to understand specialized research literature and to produce original research of their own." I believe that the student who seriously studies this text will achieve the goal set by its authors.

The second stated purpose of the book is to serve as a reference for a number of topics in quantum optics for which information cannot be found except in the original literature or in specialized monographs. On this count also the book is a success. There are indeed many topics in this combination text and reference that cannot be found elsewhere between hard covers, particularly those topics for which the authors are the acknowledged experts.

What does the book actually contain? Here I must admit that I have never understood exactly what the term "quantum optics" should include. A purist might say the term describes that branch of physics in which the quantum nature of the optical field plays an essential role. By this interpretation, only about one third of the book deals with quantum optics proper. (The quantized field is introduced on page 312, and its properties are developed thereafter.)

But, in fact, quantum optics is much broader than this narrow definition would suggest. There is no clear dividing line between quantum optics, laser physics, quantum electronics, atomic physics, quantum electrodynamics, spectroscopy, nonlinear optics and so on. Accordingly the author of a text on quantum optics must draw the line for himself, and different authors would undoubtedly draw the line in different places. In my view the selection of topics made by Pierre Meystre and Murray Sargent gives a balanced picture of the field.

The topics covered by *Elements of Quantum Optics* include: nonlinear optics, laser theory, optical bistability, nonlinear spectroscopy, cavity quantum electrodynamics, resonance fluorescence, squeezed states and coherent transients. Topics some readers might like to have seen covered but that are not present include: the theory of resonance radiation pressure (the manipulation of atomic trajectories by light), super-radiance, quantum jumps and descriptions of experiments.

Both authors have long been major players in quantum optics and are eminently qualified to write a text on this subject. The book brings together seemingly unrelated topics, such as four-wave mixing, optical instabilities and resonance fluorescence, and displays the close connections among them through a cogent unified presentation. During the short time the book has been in my hands, I have found it to be a useful reference in my own research and have recommended it to a number of colleagues. All in all the book makes an important contribution to the literature of the field and deserves a place in the library of every serious student of quantum optics.

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Particle Physics and Cosmology

P. D. B. Collins, A. D. Martin and E. J. Squires
Wiley, New York, 1989. 496 pp. $59.95 hc ISBN 0-471-60088-1

Particle Physics and Cosmology by P. D. B. Collins, A. D. Martin and E. J. Squires is successful in reaching very ambitious goals. From the title, I expected a book that would focus on the new interdisciplinary field of research often known as "particle physics and cosmology" that applies many of the ideas arising from particle physics to the study of the early universe. The synthesis of the two fields has been extremely fruitful in generating ideas for understanding the origins of our universe and in providing a laboratory for particle