K-meson decay are reduced to homework problems. Other good, recent pedagogical topics are left out, such as the neutron interferometer, Bell's theorem, and the Josephson effect. But an author has to pick and choose topics, so one can't really criticize him for the omissions.

My overall conclusion? It's good to have Merzbacher back. The second edition was getting seriously out of date. The third is a good, substantial, well-written text and will compete well with the other recent good texts out there. I have had good luck with the earlier editions of *Quantum Mechanics*, so I recommend that anyone looking for a first-year graduate text consider using it.

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Classical Dynamics: A Contemporary Approach

Jorge V. José and Eugene J. Saletan
Cambridge U. P., New York, 1998. 670 pp. $125.00 hc ($54.95 pb) ISBN 0-521-63176-9 hc (0-521-63636-1 pb)

Classical mechanics has for years been the Cinderella of the graduate curriculum in many physics departments. Some departments have actually stopped teaching it. Recently, mainly as a result of the renewed interest in deterministic chaos (and the discovery that the warhorse of mechanics—the Solar System—falls into this category), there has been renewed interest in the subject, and the number of modern textbooks on classical mechanics is increasing. Many of these, however, require a familiarity with differential geometry, which has led to some reluctance to adopt them in many graduate schools. *Classical Dynamics*, by Jorge V. José and Eugene J. Saletan, should certainly redress this: It strikes the right balance between physical reasoning and mathematical sophistication, at the same time as it takes the reader to the forefront of active research in the field.

From the focus of the book, one can guess that the authors' backgrounds are in particle or plasma physics rather than celestial mechanics. José is the Matthews Distinguished University Professor and director of the Center for Interdisciplinary Research on Complex Systems at Northeastern University. Saletan, a professor emeritus of physics at Northeastern, is coauthor with Alan Cromer of *Theoretical Mechanics* (Wiley, 1971) and with Giuseppe Marmo, Alberto Simoni, and Bruno Vitale of *Dynamical Systems* (Wiley, 1985).

Classical Dynamics, a rather hefty book, can be used as a textbook and as a reference on newer topics in mechanics. It does not confine itself to particle mechanics, and it contains an interesting chapter on continuum mechanics and nonlinear field theory. It introduces the reader along the way to some of the differential geometric aspects of Lagrangian and Hamiltonian mechanics, without getting too involved in the mathematical nitty-gritty. It contains a wealth of worked examples and interesting problems, the solutions to which are available (to instructors) on DOS or Macintosh diskettes in PDF format.

Some of the book's refreshing features bear mentioning. Instead of the usual presentation, starting from Newton's laws or Hamilton's principle, Newton's laws are "derived" (in the spirit of Ernst Mach) by analyzing momentum conservation in two-particle interactions in an inertial frame. Mass thus appears naturally via mass ratios, and force is treated as it should be, as acceleration. The notions of stability and chaos appear as early as page 10.

The book moves on briskly to the Lagrangian treatment of constrained problems, and the notions of manifold and tangent bundle appear in chapter 2, with lots of good illustrations to facilitate understanding. Motion of charged particles in electromagnetic fields is used to illustrate gauge invariance.

The chapter on variational principles is succinct but discusses such difficult topics as nonholonomic constraints and dissipation with much greater clarity than do most textbooks I know. The chapter ends with a discussion of Noether's theorem and active and passive symmetry transformations.

There is a nice chapter on classical and inverse scattering, including chaotic scattering (with an easy introduction to fractal dimensions). A useful application is the scattering of a charge by a magnetic dipole (the Störmer problem). The chapters on Hamiltonian dynamics, canonical transformations, and completely integrable systems are clear and easy to read. The Kolmogorov–Arnold–Moser (KAM) theory is clearly explained, based on a presentation of Jean Belissard and preceded by good examples of deterministic chaos. The necessary number-theoretic concepts are explained in an appendix.

Recent interesting developments, such as the Hannay angle, are also introduced. A brief chapter on the rigid body is followed by a nice chapter on continuum theories, nonlinear field theories, and solitons. Starting with the Sine–Gordon equation as the continuum limit of a chain of coupled pendulums, the authors introduce the reader to Maxwell's equations, some special relativity, solitons, and the Euler and Navier–Stokes equations.

The book is nicely typeset and printed on an ivory-colored, heavy-textured paper that is pleasant to the sight and touch, and the illustrations are very good. There are few if any obvious mistakes and surprisingly few misprints (most of them in proper names). I highly recommend this book to instructors and students alike.

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The Defining Years in Nuclear Physics: 1932–1960s

Milorad Mladjenović
IOP, Philadelphia, 1998. 441 pp. $150.00 hc ISBN 0-7503-0472-3

A complete history of nuclear physics is sorely needed. I say "sorely" because of all the remarkable accomplishments made since the discovery of the neutron in 1932. During this period, the existence of the mean field as represented by the shell model and the optical model was established, showing that the mean field is a good approximation in spite of the strong interactions between the constituent particles.

Nuclei were found to have deformed shapes and thus exhibited rotational and vibrational spectra and, of course, the ultimate deformation of fission. Compound nuclear resonances were discovered before World War II; the surprising giant resonances followed later. The short interaction time reactions (direct reactions) were differentiated from the long interaction time reactions (compound nuclear reactions), later, intermediate time reactions (multistep reactions) were included in the description of reactions.

It was found that highly resolved nuclear cross sections are chaotic (although that term was not used), and successful stratagems that extracted the signal from the noise were devised. Their first application led to the optical model in 1954. I shall stop this listing at this point; I could cite many more examples, not the least of which are the weak interactions.

Milorad Mladjenović's *The Defining Years in Nuclear Physics: 1932–1960s* does not, of course, cover the history of all of these various research directions in detail. The author's choices are rather idiosyncratic, governed mostly by his research interests. There are extensive discussions of nuclear instruments (pages 83 to 209) and the theory of β decay and internal conversion (pages 214 to 279). Compare this with the treatment of nuclear reactions (pages 363 to 424).

The book opens with a discussion of nuclear physics prior to World War II. Included are the discoveries of the neutron, the positron, fission, and artificial radioactivity. Early consideration of the nuclear force led to estimates of its strength and range. No mention is made of the quadrupole moment of the deuteron and the consequent theory by Rarita and Schwinger.

Part two is devoted to nuclear instruments, including accelerators, gas and scintillation counters, semiconductor counters, and beta-ray spectrometers. This part concludes with a discussion of phenomena in which spectroscopy is a principal focus. The chapters on β decay contain a discussion of the Fermi theory and the detection of the neutrino, as well as of parity nonconservation as discovered by T. D. Lee, C. N. Yang and Chien-Shiung Wu. The Konopinski–Uhlenbeck theory is discussed, and the cause of the incorrectness of the data upon which it was based is described.

The next-to-last section of the book, part three, deals with the shell model and, under the heading of "Collective Models," the deformed model of Aage Bohr and Ben Mottelson. Considerable effort is expended on the discussion of these models. No mention is made of the giant electric dipole resonance, which was discovered shortly after World War II. Nor is mention made of the Feenberg–Wigner shell-model calculations, although the Wigner supermultiplet theory is given in great detail. There is scant coverage of the important contribution made to the theory of the shell model by the analysis of stripping and pickup reactions.

Part four presents a very abbreviated history of nuclear-reaction studies, including nucleon–nucleon scattering at low energies. None of the extensive studies involving scattering or polarization, made at higher energies, are mentioned. The references are, for the most part, prior to 1940. There is little discussion of Eugene Wigner's reaction theory or his seminal work on the statistical theory of energy levels, and there is no discussion of the scattering of electrons by nuclei.

This is a good but limited book. It is well-written and enlivened by extensive quotes from the original papers; it is an interesting story, but there is much more left to tell.

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The Electrical Nature of Storms

Donald R. MacGorman
and W. David Rust
Oxford U. P., New York, 1998.
422 pp. $85.00 hc
ISBN 0-19-507337-1

The ten chapters in Donald R. MacGorman and W. David Rust's *The Electrical Nature of Storms* span well the spectrum of methods and results in the study of storm electricity: fundamentals of electricity and magnetism, processes of charge separation, storm electrical structure, electrical currents of all kinds, lightning, instruments, numerical cloud models, and electrical effects on cloud processes. The observation of the electrical characteristics of storms, covered in chapters 7 and 8, are the meat and potatoes of this book, with many of the results based on observations in the authors' backyard—the Great Plains. I'd buy the book for these two chapters alone. Further, it contains more than a thousand references, many of which are critically discussed, not just casually cited; no wonder this work was so many years in the making.

The book's plan is generally ordered and logical, but chapter 2, on electrified nonthunderstorm clouds, could have been more appropriately included elsewhere. Further, it seems that the authors' division of labor in writing the book led to occasional failed connections. As one example, the nice discussion on elevated charge structure and the prevalence in chapter 8 of intracloud lightning in severe storms also has considerable applicability to ordinary thunderstorms and so could have been introduced in chapter 7.

The authors do an excellent job of laying out the observations, and their clear attention to assembling recent material is likely to make this a book without peer for many years. The classical text, *Atmospheric Electricity* by J. Alan Chalmers (Pergamon, 1967), is very out of date and, like other texts on atmospheric electricity, lacks the meteorological perspective of this new text. MacGorman and Rust also go to great lengths to integrate and compare different results and observations in specific topics, which include, as examples, rainfall–lightning relationships, comparisons between intracloud lightning and cloud-to-ground flash observations, radar reflectivity profiles of thunderstorms, and the distribution of lightning with respect to storm structure.

One shortcoming of the presentation is the uneven attention given to the various interpretations of observations, which may well reflect the authors' interests in the various topics. For example, the authors give comprehensive treatment of the interpretation of charge structure in mesoscale convective systems, the behavior of layered lightning, and the competition between intracloud and ground lightning in severe storms. In contrast, little interpretation is provided for the meteorological origins of type A and type B soundings in mesoscale convective systems, the reasons for the pronounced land–ocean lightning contrast, the explanation for the systematic intracloud status of the initial flash in a storm, and the discrepancies in the amplitude variations of different measures of the global electrical circuit. Every chapter in this book contains an introduction, but no summary or conclusion. Perhaps if these had been added, the interpretative aspects would have been more complete.

The electrical structure of ordinary isolated thunderstorms is a central issue, and the book follows closely on the heels of a paper by Rust and Thomas Marshall that advocates the abandonment of the tripole model for ordinary thunderstorms. Although the paper has stimulated much discussion in the community of atmospheric electricians, this suggestion, in my view, throws the baby out with the bathwater and raises the noise level in a field in which the noise level is already uncomfortably high. MacGorman and Rust's book is a bit schizophrenic on this important issue of charge structure, but nevertheless takes a more moderate stand.

The text consistently reflects the prevailing view and the weight of the evidence that gravity-driven ice-phase precipitation particles (that is, graupel) are major contributors to cloud electrification in a wide variety of meteorological situations. The authors' emphasis on macroscopic electrical structure and numerical cloud models rather than ice physics obscures one important message: The microscopic problem of thunderstorm charge separation is still largely unsolved.

The 1990s has seen a greatly expanded interest in troposphere–ionosphere coupling and the occurrence of luminous discharges called sprites, elves and blue jets. The authors discuss these phenomena and, quite appropriately, give very extensive attention to the charge structure and lightning characteristics of mesoscale convective systems that appear to be the source regions for sprites.

This book has obviously been carefully edited, but is not without conceptual errors. The definition of virtual temperature is incorrect, for example. And the condition for liquid water to