with cross references to the subject index. Given the audience Mills is attempting to address, these additions would add greatly to its usefulness.

I recommend this book to any first-year graduate student who may wish to learn about the opportunities of this exciting field. But to really learn what is going on, or what is involved in the subject, the student will need to be guided by a book that goes into greater details.

RICHARD R. FREEMAN
University of California, Davis

Galaxy Formation

Malcolm S. Longair
*Springer-Verlag, New York, 1998. 536 pp. $64.95 hc
ISBN 3-540-63785-0*

The discipline of cosmology–extragalactic astronomy is one of the most rapidly evolving fields in astronomical research. During the last three decades it evolved from the search for three numbers—the Hubble constant (H_0), the density parameter (Ω_0), and the deceleration parameter (q_0)—to a full-fledged quantitative science with considerable predictive power and substantial impact on such other topics in physics as particle physics.

Of these three decades, the most recent one has probably been the most fruitful, mainly because of the breathtaking images captured by the Hubble Space Telescope, but also because of the advent of other superb research facilities during that time. Those facilities include the Keck 10 m telescopes and space probes such as ROSAT (Roentgen (x-ray) Satellite) and COBE (Cosmic Background Explorer) to name only a few. Actually, one could argue that a similar if not even larger boost still lies ahead, triggered by the large number of 8 m telescopes that are going to be dedicated in the next few years and such new satellites as SIRTF (Space Infrared Telescope Facility) and MAP (Microwave Anisotropy Probe), and, in the somewhat more distant future, the Planck and the NGST (Next Generation Space Telescope).

To write a textbook at the graduate level on such a rapidly evolving subject is a formidable challenge. This challenge has been met by about a half-dozen textbooks, all of them excellent and none older than about five or six years. Some appeared as recently as 1998.

Malcolm Longair's *Galaxy Formation* is a very nice addition to that pool of textbooks. Despite its title, the book actually covers pretty much all of extragalactic astronomy and cosmology. Among the smallest textbooks by mass (it's still suitable for your carry-on luggage), it nonetheless offers one of the most comprehensive descriptions of the topic, in particular where observational data are concerned. For example, it gives a 20-page crash course on general relativity, but one also finds the Hubble Galaxy classification scheme, mass estimates of galaxy clusters using lensing and x-ray data, linear and nonlinear theory of structure formation, and the physics of the cosmic microwave background.

Although many topics are covered, Longair never fails to place the results within the big picture. Of course, one cannot expect every topic to be derived with the depth and rigor of a theoretical physics textbook, but Longair knows how to use physical intuition to comfort the reader who is stepping into unfamiliar terrain.

Besides completeness, it is also the most up-to-date textbook. Even very recent developments are included, such as supernova projects to measure cosmological parameters, the Hubble Deep Field, the clustering of the so-called Lyman-break galaxies (a galaxy population at redshift 3), and the paradigm shift in explaining the Lyman-alpha forest based on the outcome of large hydrodynamical simulations.

The only weakness I could identify is, ironically, in the topic of galaxy formation itself, which is discussed somewhat too briefly. Some recent developments that involve numerical simulations using N-body and gas dynamical techniques, as well as the so-called semianalytical or phenomenological galaxy formation models, are hardly mentioned, even though these topics have made up a fair share of the literature of the last couple of years.

I very much enjoyed reading this book, and I am sure I will make use of it the next time I teach a cosmology graduate course, as both a textbook for the students and a guide in preparing my lectures.

MATTHIAS STEINMETZ
*University of Arizona
Tucson, Arizona*

Physics of the Space Environment

Tamas I. Gombosi
*Cambridge U. P., New York, 1998. 339 pp. $74.95 hc
ISBN 0-521-59264-X*

Space physics, narrowly defined as the study of Earth's plasma environment, has had an identity crisis throughout its relatively brief existence as a discipline:

▷ The limited and often serendipitous nature of the data requires the research style of an astrophysicist.

▷ However, the *in situ* observations and instrumentation that are central to the field are quite different from the remote observations and instrumentation of astronomers.

▷ Compared to neutral gases, the wealth of additional phenomena and the complexity associated with magnetized plasmas and their interaction leave the space physicist little in common with the atmospheric scientist.

▷ Although the phenomena studied in space physics are ultimately important to astrophysics, the intimate measurements of plasma properties provide a greater commonality with the methods of the plasma physicist.

Tamas I. Gombosi's *Physics of the Space Environment* cuts through this diversity to deal with the interpretation of space physics observations. The book is intended for well-motivated graduate students and research scientists and engineers. It is based upon graduate-level courses taught by the author in the College of Engineering at the University of Michigan. Although the book does not delve into numerical modeling, the author's interest in this area is evident throughout.

The book emphasizes physical processes rather than phenomenology. In particular, it stresses the application of transport theory to the space environment. The reader is assumed to be proficient in undergraduate physics and mathematics through tensor algebra, complex variables, statistics, and the solution of basic ordinary and partial differential equations. Knowledge of elementary chemistry and astronomy is also helpful. Terms that are not part of the standard physics curriculum, such as "spectral type G2V" and "type IV radio emission," are sometimes used without explanation.

The text is divided into three parts. There is no overview or historical introduction. (A reader will have to look elsewhere for historical perspective.) Part I presents the theory of gases and plasmas. This includes single-particle orbit theory, the Boltzmann equation and collision terms, the fluid and magnetohydrodynamic equations, basic MHD and plasma waves, shock waves and discontinuities, and energetic particle transport. Part II is devoted to aeronomy, the physics and chemistry of Earth's upper atmosphere. The neutral atmosphere, the ionosphere, the aurora, and airglow are covered. Part III addresses the Sun, the solar wind, cosmic rays and energetic particles, and Earth's magnetosphere. Four appendices contain physical constants and summaries of vector and tensor identities and some special functions.

Each of the 14 chapters concludes

with several homework problems, which typically involve short derivations and the plugging of numbers into results obtained in the text. The student will also need to work through the derivations in the text to become proficient at the material. The level of detail in the derivations is uneven, and much is frequently left for the student (or instructor) to fill in. There are a number of places in the book where the student would have been better served with a few extra words of explanation rather than a phrase such as "It is obvious that. . . ."

The book's greatest strength is in its demonstration of the derivation of specific results from the various approximate transport equations (such as MHD, Fokker–Planck, and Navier–Stokes) and, ultimately, the Boltzmann equation. Many sections begin with a clear description of the equations, assumptions, and approximations that lead to a particular result. This is especially useful to a reader who will eventually be pursuing more extensive analytic or numeric computations.

The author is not always careful to explain or provide supporting material. The normalization of the axes on two plots of the Maxwellian distribution function is not explained, even though it is important to a discussion in the text. Another figure shows the decrease of stratospheric ozone in Dobson units, but Dobson units are not defined in the text. A section on particle acceleration leaves the incorrect impression that only two mechanisms, second-order Fermi acceleration and shock acceleration, are important in the Solar System, and that an exponential particle energy distribution implies second-order Fermi acceleration while a power-law energy distribution implies shock acceleration. The author's decision to cite directly only certain journal articles and books in the text, and to place other books in a general bibliography, often leaves the reader uncertain of a topic's heritage and where to find additional information.

It would be unfortunate if Gombosi's text were a student's only exposure to solar-terrestrial physics. A good advanced undergraduate prelude to *Physics of the Space Environment* would be Thomas F. Tascione's *Introduction to the Space Environment* (Krieger, 1994, 2nd edition). Tascione's text requires less mathematical sophistication and has chapters on atmospheric and solar physics. And although it was not intended to be a textbook, Kenneth R. Lang's *Sun, Earth, and Sky* (Springer, 1995) presents an excellent nonmathematical introduction to the Sun–Earth connection for any reader. For the advanced reader, however, *Physics of the Space Environment* is a welcome addition to the space physics literature.

Gordon D. Holman
NASA/Goddard Space Flight Center
Greenbelt, Maryland

Molecular Symmetry and Spectroscopy

Philip R. Bunker and Per Jensen
NRC Research, Ottawa, Canada, 1998. 2nd edition. 747 pp.
$64.96 hc ISBN 0-660-17519-3

Molecular spectroscopy is sometimes perceived as a mature domain of science offering few genuine surprises. Yet some fascinating discoveries have been made recently in the field. (That of carbon-60, the so-called Buckminsterfullerene molecule, is a prime example.)

Philip Bunker and Per Jensen have written *Molecular Symmetry and Spectroscopy* for everyday use by molecular spectroscopists faced with the typical problems of this field: how to classify the quantum energy levels arising from the complex motions of the electrons and nuclei in a molecule and how to predict the frequencies and intensities of optical transitions taking place between those levels, by which molecular systems are usually detected and identified.

Generations of molecular scientists have been trained through intense use of the late Gerhard Herzberg's famous *Molecular Spectra and Molecular Structure* (Van Nostrand), the three volumes of which appeared in 1939, 1945, and 1966, respectively. (They were reedited at the beginning of this decade by Herzberg himself (Krieger, Malabar, 1989 and 1991)). These classics present an overview of the field of molecular spectroscopy as it existed at the time they were written.

Bunker, a renowned theoretical spectroscopist, has been associated for many years with the institute founded by Herzberg in Ottawa, Canada. Jensen, based at Wuppertal in Germany, is known for his contributions to the theory of large amplitude vibrations in floppy systems (non-rigid molecules). As reflected by its title, the scope of the first edition of their book (Academic Press, 1979) was more limited than Herzberg's, concentrating on group theory and its application to spectroscopic problems. However, the vastly expanded second edition (the first edition had 424 pages) has grown into a quite-complete compendium of modern-day spectroscopy, which, if it does not fully replace Herzberg's textbooks, represents a welcome and necessary update and complement.

The interested reader will find detailed chapters on, for example, normal