little is entirely settled. For example, the structure of the channel as revealed by x-ray diffraction differs from images obtained by electron microscopy of negatively stained or frozen gap junctions; hence there is no agreement on the mechanism of channel closing. Equally, the molecular size of the major gap-junctional protein is reported to be 54, 44 to 47, 27, or 16 to 18 kD; which is it, one or all of these? and is lens 26-kD protein actually gap-junctional or not? Questions abound: What factors regulate junctional conductance? Is there a change of structure correlated with uncoupling, and if so can it be resolved with electron microscopy? Is in vitro coupling by liposomes in which gap-junctional channels have been incorporated a useful analogue? How does coupling affect developmental compartmentation? What are the actual messages exchanged in embryonic development? Are gap-junctional connexons reutilized? and what is their mechanism for turnover—internalization, dispersal, or both? Which hormones or second messengers are able to modulate permeability of gap junctions? A range of new physiological and molecular techniques have been brought to bear on these problems, as well as genetic approaches, and this collection provides the reader with detailed information based on these methods. Even if we do not know many of the answers, the questions that can now be asked are, this volume reveals, more specific and searching than before. The book is essential for anyone directly concerned with gap junctions and will be useful for cell biologists, neurobiologists, and developmentalists alike to dip into.

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Cosmic Rays

Cosmic Rays in Interplanetary Magnetic Fields. I. N. TOPTYGIN. Reidel, Dordrecht, 1985 (U.S. distributor, Kluwer, Hingham, MA). xiv, 375 pp., illus. $64.50. Translated from the Russian edition (Moscow, 1983) by D. G. Yakovlev.

Cosmic rays, accelerated in a variety of astrophysical objects including the sun and the galaxy, propagate along extremely convoluted paths. Because the gases through which they pass are generally so rarefied that collisions are negligible, their transport is determined principally by interaction with the irregular ambient magnetic field (the electric field is small and may be determined from the local magnetic and velocity field). This complex process has become much better understood in the past two decades, owing to both theoretical advances and measurements carried out in space. Although early work of Fermi and others suggested that a statistical description of charged-particle motion, assuming a random walk in irregular magnetic fields, could be useful, it took studies of plasma, magnetic field, and cosmic rays from spacecraft in interplanetary space to challenge and sharpen our understanding. Out of this has come a general diffusive transport equation that has manifold applications in many areas of solar-terrestrial research and astrophysics and that accounts for many observed phenomena. The appearance of a monograph covering applications of this theory to the interplanetary medium is welcome.

The author has been an active and respected Soviet researcher in this field for more than 20 years. He presents a very complete discussion of nearly all aspects of the theory of particle transport in interplanetary space, beginning with the solar wind, its magnetic field and structure, and continuing with the detailed theory of particle transport in irregular magnetic fields, application to solar particles, shock acceleration, and modulation of galactic cosmic rays. I can think of no major topic left unmentioned in this generally thorough and complete account. The balance among topics reflects the author's interests. About a third of the book is devoted to acceleration processes in interplanetary space, about 10% to the modulation of galactic cosmic rays, and about 15% to solar particles.

For the most part the discussion is correct, although I noticed one apparent error in the discussion of stationary transport of solar cosmic rays. In the discussion of the small diffusion coefficient limit $(ur/\kappa) >> 1$ at the top of p. 172, the unnumbered equation following equation 12.12 gives a wrong result. In this limit, convection and adiabatic cooling should dominate the transport, and the spectrum should not depend on the diffusion coefficient. This appears to be an isolated lapse, however.

It is regrettable that research in cosmic ray transport theory has had a tendency to advance separately and independently in the Soviet Union and the West, with less interaction between the two sets of workers than would be desirable and much of the research unavailable in translation. This isolation is reflected to some extent in this book, where coverage of Western work is not as complete or up to date as might be desired. As one example, the apparent discrepancy between the mean free path of low-energy solar cosmic rays as determined from flare events and that calculated from the magnetic field is just briefly mentioned, and many relevant papers are not cited. In general, it appears that Western work up to about 1980 is covered reasonably completely. Coverage of shock acceleration is current up to the 1983 publication date of the original Russian edition.

I discovered much that is of use in this book, and it will have an important place on my bookshelf. It should go a long way toward making the extensive Soviet work in this area more accessible to Western scientists and should be consulted frequently by research workers in the field.

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The Sun

Physics of the Sun. PETER A. STURROCK, THOMAS E. HOLZER, DIMITRI M. MIHALAS, and ROGER K. ULRICH, Eds. Reidel, Boston, 1986 (U.S. distributor, Kluwer, Hingham, MA). In three volumes. Vol. 1, The Solar Interior. x, 257 pp., illus. $44.50. Vol. 2, The Solar Atmosphere. xii, 385 pp., illus. $62. Vol. 3, Astrophysics and Solar-Terrestrial Relations. xii, 287 pp., illus. $49. The set, $125. Geophysics and Astrophysics Monographs.

This three-volume work, produced as part of a study commissioned by the National Academy of Sciences at the request of NASA, is monumental in its combination of scope and depth of coverage. Its 22 chapters, prepared by a distinguished group of experts, cover the field of solar physics in a thorough and comprehensive manner, including the formation of the sun and planets, interior nuclear processes, interior structure, dynamics, and magnetic fields, the new and exciting field of helioseismology, the sun's radiation output, various aspects of the solar atmosphere, the physics of solar flares, including nuclear processes, solar radio emission, and the solar neutrino problem. Solar phenomena in other stars and solar effects on the terrestrial environment are also treated.

In nearly all cases it is clear that an enormous amount of effort went into the contributions, most of which read more like monographs or textbooks than reviews. In giving some examples of the contents of these volumes, I must omit mention of important and valuable essays by leaders in their fields.

One of the chapters is a discussion of observational and theoretical aspects of the solar dynamo by Peter Gilman. This 65-page work contains a large number of references. It begins with the fundamental dynamic and magnetohydrodynamic equations relevant to the large-scale dynamo problem and leads the reader through discussions of the convection zone of the sun, including the various known convective scale sizes, and into an interesting essay on the observational and theoretical aspects of global circulation and differential rotation. There are interesting problems in this area that Gilman discusses in detail. This is followed by a thorough review of observations of solar magnetic fields, from small-scale structure of the fields to global patterns. Finally, there is a detailed discussion of dynamo theories, including their strengths and their weaknesses. Gilman presents thorough and balanced discussions of all these topics and leaves the assiduous reader with an understanding of the achievements and remaining problems in this important area.

A chapter by Rosner, Low, and Holzer discusses physical processes in the solar corona. It has become clear over the last decade or two that the corona is a magnificent plasma physics laboratory. In this laboratory the magnetic fields play a leading role in defining both transient events and the more stable "quiet-sun" phenomena. The fields are an important factor not only in the geometry of the structures we see but also in the physical processes at work. A number of these physical processes are treated in this excellent chapter, including energy and momentum transport, equilibrium magnetic fields, and time-dependent phenomena. This contribution is not a source for observational information on the corona, but it is a fine discussion of many of the theoretical aspects of coronal features and phenomena.

The work as a whole includes only a handful of references later than 1983, and a number of the chapters have none later than 1982. Another matter that should be mentioned is that the publisher apparently has left the proofreading almost entirely up to the authors (as it does with its journals), and the result is, as one might expect, very irregular in this regard. In places, typographical errors occur with annoying frequency.

These faults, however, do not detract significantly from the value of the work as a fundamental, authoritative reference and review for the broad field of solar physics. It was an ambitious project and it has been successful.

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