

rate-limiting in paracellular transport, it is now agreed that it is necessary to consider as well the lateral intercellular spaces as potentially significant barriers. This is brought out strongly by Rector in his report on passive transport in the renal proximal tubule and by Boulpaep in the concluding discussion in which he considers the need for a distributed resistance model to accurately describe epithelial electrical characteristics. In the concluding discussion, Revel clarifies the relevance of electron microscope descriptions of the paracellular route and forcefully reminds us that there may well be material of consequence that is not recorded by electron microscopy. Revel's statement, which virtually ends the book, is in some respects a suitable place to begin reading.

A fair degree of sophistication has gone into the detailed study of paracellular pathways in each of several epithelia, with the result that each appears unique. Schultz and Fromm (colon), Reuss (gallbladder), Wright and Zeuthen (choroid plexus), Fischbarg (cornea), and Lambert *et al.* (the glomerulus, where all the transport is paracellular) contribute detailed summaries of their chosen subjects. These reports encompass a tremendous amount of information and expose the reader to a galaxy of powerful techniques. Coble, Leader, and Spring offer a scrupulously detailed report of an effort to study intercellular space osmolality via refractive index determinations but necessarily conclude that this approach cannot provide the data of interest.

Boyer, Bradley, and Javitt each review attempts to investigate paracellular transport in the liver. It is evident that much may be learned from the study of this organ but that it poses special difficulties and requires rather different techniques from those that are comfortably applied to isolated epithelia.

Both Burg and Tisher review the paracellular permeability properties of each of the nephron segments. In Burg's review of the physiologic findings he uncovers examples of almost every possible combination of ionic conductivity, hydraulic conductivity, potential difference, and permselectivity. Tisher uncovers similar examples when reviewing lanthanum permeability studies of the various nephron segments. Interestingly, Goodenough, a premier microscopist, offers the sternest challenge to the use of lanthanum as a relevant permeability marker and to the use of fixatives in these studies, whereas Wright and Fischbarg, proper physiologists, rise to the

defense of glutaraldehyde as a reliable tool.

Bentzel *et al.* and Cereijido and Meza have carried the subject of paracellular transport a bit further. Each discusses preliminary attempts to study paracellular transport regulation by intracellular means. In each case, there is some evidence for cytoskeletal involvement in the regulation of permeability. Perhaps these investigations most fully acknowledge that a holistic approach to transepithelial transport is necessary.

This book will be worthwhile reading for all who profess an interest in epithelia, and it can be a useful summary to update information on cell-cell junctions for a great many others.

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## The Sun's Magnetic Field

**Solar Magnetohydrodynamics.** ERIC R. PRIEST. Reidel, Boston, 1982 (distributor, Kluwer Boston, Hingham, Mass.). xx, 472 pp., illus. \$99. Geophysics and Astrophysics Monographs, vol. 21.

Evidence of magnetic fields is seen in almost all observations of the sun. Their presence is the cause of an enormous variety of structures in the solar atmosphere—sunspots, spicules, and coronal loops, to mention just a few. The truly remarkable behavior of these structures, the detail with which they can be observed, and of course the accessibility of the sun as a testing ground for new observational techniques have kept interest in solar physics constant and high. From the theoretical side, it is fair to say that much of our understanding of cosmic magnetic fields has its origin in studies of the sun's magnetic field.

In magnetohydrodynamics, the behavior of magnetized plasmas is studied in the fluid approximation. That is, the plasma is considered to be given by its macroscopic properties; microscopic effects like those due to the different properties of electrons and ions are neglected. This approximation is a particularly good one for most (but not all) solar magnetic phenomena. Priest's book deals with magnetohydrodynamics from a specifically solar perspective, and in this sense it is the first of its kind. Factors that are important in the laboratory but not on the sun, such as a non-zero viscosity or the effect of an external

confining device, are mentioned only briefly. On the other hand the book pays special attention to the effects of gravity, such as the rapid outward density decrease in the sun, as well as to the very inhomogeneous nature of the solar magnetic field. The special importance of such factors (not to mention the difficulties they create in building quantitative models) is one of the reasons for the gradual development of a typically "solar" branch of magnetohydrodynamics over the past 20 years.

The book serves several purposes. The first set of chapters (70 pages) gives a concise general introduction to solar physics, mostly from a phenomenological point of view. In a second set the basic methods of magnetohydrodynamics are developed, with special emphasis on the key concepts and on physical insight rather than mathematical development. Examples illustrating the methods are taken directly from the solar literature. A third set of chapters (occupying about half of the volume) is an account of current theories for specific observed phenomena. The account is amazingly complete, covering, among other phenomena, dynamo effects, sunspots, prominences, spicules, coronal heating, and even a few nonmagnetic phenomena like the photospheric 5-minute oscillation. This completeness has been achieved through an economical style and an obvious talent for expressing the essence of a physical idea in a few sentences. In cases where mutually incompatible models exist for a given phenomenon, the models are described separately, the direct confrontation being avoided. The author's preference for a particular style of models is noticeable, of course, in that more space is given to models with limited but clearly defined applicability than to general theories of uncertain relevance. This preference is considered a bonus rather than a limitation by the reviewer.

Because the book contains a great deal of information, inevitably some topics are described in a rather compact way. This compactness of presentation may not be appreciated by some readers. The overall impression, however, is one of clarity of aims and economy of means. A point of minor criticism concerns the quality of the graphical illustrations, which are often somewhat unappealing.

The book should be eminently suitable for a course in solar physics. (The book grew from a course taught at the University of St. Andrews.) Also, it provides a comprehensive review of present magnetohydrodynamical models in solar phys-

ics, which will be quite useful for workers in the field. Finally, the book is strongly recommended to the rapidly growing number of astrophysicists studying magnetically active stars. They will find it an easily accessible review of the ideas and tools that have proven their value in solar physics.

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