book touches on a number of peripheral subjects such as nuclear reactions in the solar interior and in the earth's atmosphere due to galactic cosmic rays, the internal structure of the earth and global tectonics, electrical charges on interplanetary dust particles, the atmospheric circulation at all levels in the atmosphere, and the interaction of the solar wind with the moon, other planets, and comets.

The book is a compilation and a new organization of published material, from standard references as well as from research articles. Very little new material is presented except for some convenient syntheses in the form of diagrams showing the relations among various phenomena and processes occurring in magnetospheric storms. A valuable feature of the book is the approximately 3500 references grouped according to subject and divided into standard works, contemporary works (monographs), and contributing articles. The book includes a large number of useful illustrations, mostly taken from journal articles.

The format of the book is similar to that of its predecessor, except that its subject range is greater. In the first 450 pages, separate chapters introduce the major physically separable components that enter into solar-terrestrial relations, the sun, the earth, the atmosphere, and the magnetosphere, with an additional chapter on energetic particles, plasma, and electromagnetic waves in the magnetosphere. These chapters emphasize descriptions of the features and properties of each region and the associated physical principles. The remainder of the book details the reactions and interactions of these regions under the stimulation of solar storms and the associated interplanetary and magnetospheric disturbances. We find here a very thorough account of storm-time phenomenology.

I think the section explaining the many indices of geomagnetic activity will be especially useful in clarifying a generally confused subject. Present understanding of storm-time phenomena is incomplete and characterized by competing hypotheses. The book minimizes the pedagogically deleterious aspects of the situation by considering mainly established phenomenology and those theories that are well defined and amenable to mathematical analysis. There is not much emphasis on the many current speculations, which is in keeping with the authors' intention that the book be a permanent reference.

The separation of quiet-time and storm-time phenomena in the book is rigorously maintained. For example, solar activity is discussed only under storm phenomena and not in the earlier chapter on the sun. In all chapters observations, models, and theories are sharply separated, usually by being put in separate sections. The data and their interpretation are not mixed or confused.

The book has been carefully edited. I did not find many misprints. Although each chapter treats a very complete set of topics, most researchers will probably find that the sections devoted to their specialty could profitably be expanded. Of course, that would require expanding an already very large book, and the lack of completeness is mitigated by the thorough bibliography. The policy of avoiding controversies has resulted in the omission of some interesting topics such as the mechanism of field line merging, which is believed to be an essential part of the magnetospheric storm process, and the growth phase and triggering mechanism of magnetospheric substorms.

Sydney Chapman died before the book went to press. He must have known, however, that this final major work would rank with his others as a valuable, authoritative, and permanent reference on the subject of solar-terrestrial relations.

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Atmospheric Processes

Weather Forecasting as a Problem in Physics. ANDREI S. MONIN. Translated from the Russian edition (Moscow, 1969) by Paul Superak. M.I.T. Press, Cambridge, Mass., 1972. x, 200 pp., illus. $12.50.

A. S. Monin of the Institute of Oceanology of the Academy of Sciences of the U.S.S.R. is best known in the West for his contribution to the study of turbulence, but in this work he turns his attention to the larger-scale processes involved in the atmospheric circulation, its variability and degree of predictability. He develops the essentials of the dynamics and thermodynamics involved in a way that, in principle, a physics graduate student could follow, though he might find some of it heavy going. Meteorologists and dynamical oceanographers will find Monin's approach stimulating and sometimes provocative, but this is the measure of a good book.

In the problem of weather prediction, a natural time scale of interest is that for the generation of the kinetic energy associated with the synoptic processes (or the energy dissipation time), which is of the order of one week. Over time intervals short compared to this, it is possible to define adiabatic invariants governing the motion and to consider synoptic regions, say the Western Pacific Ocean and North America, or the North Atlantic Ocean and Europe, for prediction purposes. The first part of this book develops the analytical description of the atmospheric state and motion over these short time scales, pointing out that hydrodynamic theory already can cope with the short-range problem for the pressure, temperature, and wind fields and is making steps toward prediction of cloudiness and precipitation.

The long-range problem, on the other hand, is necessarily global—only the planet as a whole serves as a natural synoptic region. Analytical methods are less useful since the "adiabatic invariants" are no longer invariant over periods in excess of about one week. Monin describes the strides made recently, some associated with the Global Atmospheric Research Program, the numerical models being developed, the problem of uncertainty in initial data, and the consequent limits on predictability. Unanswered questions abound. Why is the intertropical convergence zone not at the equator but usually at latitudes from 3° to 20°? What is the interaction time between the Northern and Southern hemispheres? What is the reason for the 26-month oscillation in the equatorial stratospheric zonal flow? The advent of satellite observations has opened our eyes to a whole range of phenomena previously unsuspected—the spiral structure of cloud systems in large-scale cyclones, the long, narrow cloud streets, and the cell structure of cumulus clouds. In some other respects, satellites have been measurement platforms in search of a problem, but substantially greater information can be expected to supplement surface observations as the needs are recognized and instrumentation developed.

Too few books can be recommended with enthusiasm. This one can.

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