mining the constancy of solar radiation over decades is a difficult task with little short-term reward (such as makes for grant renewals).

But solar astronomers have scrambled to get their act together. First there was the Big Bear conference on the solar constant in June 1975. This was followed by the Solar Output Workshop in April 1976, which enlarged the scope of inquiry to include all emanations from the sun: radiation, particles, and fields. *The Solar Output and Its Variations* is a product of that workshop. It brings us an up-to-date, authoritative account of the historical and paleontological evidence for solar variability, the status of the spectral measurements, and the theory that might predict variation.

John Eddy's convincing paper questions the immutability of the 11-year solar cycle. From records such as the sightings of naked-eye sunspots and aurora he deduces the suppression of solar activity coincident with cooling periods, or "little ice ages." In spite of the skimpy evidence Eddy has done such a thorough job that his historical detective work has gained wide acceptance. New to me, as an astronomer, is the history of the earth's climate over the past billion years, which is discussed in the paper by James Hays. The role of continental drift so dominates this picture that the insolation factor is almost lost. Intriguing is the concept that the earth might adapt to an increase of several percent in solar luminosity, say as a result of cloud-induced albedo change, but that a reduction in the sun's output might prove fatal.

Douglas Gough searches the solar interior theories for possible causes of luminosity variation. Standard models require a 50-percent rise in energy output since the earth was formed, a consequence of hydrogen burning. Such a change is not supported by geologic evidence, nor can Gough find other causes that cannot be questioned.

The subject of radiometry divides naturally on the basis of wavelength and is discussed by the respective experts. Charles Abbot's work remains a hallmark of what can be done in the wavelengths visible from the ground. Abbot believed that he had found climatic changes related to variations in the sun's total radiant output, but Claus Fröhlich's summary, in this book, of 44 years of Smithsonian measurements is that "changes of more than 1 percent were not seen and changes of less than 1 percent were not capable of being seen." Now the hope of the observationalists to attain accuracies of 0.1 percent lies in the shuttle era, with its opportunity for pre- and post-flight calibration.

The book abounds with interesting and diverse themes in its 35 papers. Its aim is to present our current knowledge of the sun's energy output and its variation over the complete range of the solar spectrum. The editor has done an excellent job of assembling the book, and Colorado Associated University Press is to be thanked for pricing it under $10. Many persons besides solar astronomers will want to own a copy.

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Theoretical Chemistry

Statistical Mechanics. BRUCE J. BERNE, Ed. In two parts. Part A, Equilibrium Techniques. xvi, 242 pp., illus. $39.50. Part B, Time-Dependent Processes. xvi, 262 pp., illus. $39.50. Plenum, New York, 1977. Modern Theoretical Chemistry, vols. 5 and 6.

These volumes are part of a continuing series devoted to recent developments in the microscopic study of chemistry. Several other volumes in the series deal with electronic structure. Here the focus is on small molecules, mostly classical and mostly spherical.

Statistical mechanics and kinetic theory are unusual in that the fundamental differential equations to be solved are known exactly. Newton, Boltzmann, Gibbs, and Schrödinger formulated equations to describe the structure and motion of matter in quantitative detail. Analytic solution of these equations was hampered by the large number of variables; now, fast computers are suited to solving many-variable equations numerically. These computers are the principal research tools motivating the work described in these two volumes, which are designed to assist the reader in understanding and using modern nonlinear many-body techniques.

The research goal is to develop simple but accurate approximations to the solutions of the exact equations of statistical mechanics and molecular dynamics. Exact solutions are closely approximated by the Monte Carlo and molecular dynamics simulations of systems of several hundred atoms. These simulations are of primary importance in constructing and testing new approximate theories. Two excellent chapters are devoted to the strengths and weaknesses of modern Monte Carlo methods. One strength is the increasing number of schemes that use importance sampling to favor microstates of particular physical significance. A continuing weakness lies in the difficulty of handling long-range forces in small computer systems. An instructive chapter treats molecular dynamics of hard spheres. Studies of this simple system have led to the understanding of melting and to the "long-time-tail industry," and they continue to provide unexpected glimpses of simplicity in a mature and complicated field. The chapters treating computer simulation provide sufficient technical information for a reader wishing to carry out calculations of his or her own.

A chapter detailing the structure of gas-phase kinetic theory comprehensively describes both the difficulties encountered in straightforward perturbation approaches and the success achieved in understanding intermediate-time dynamics. A list of outstanding problems is included in the chapter.

The remaining chapters on statistical mechanics deal mainly with perturbation approaches to the many-body problem. The original low-density graph-theoretical approach of Mayer and Mayer has led to an increasing variety of expansions. The definitions and formal structure of these perturbation expansions are covered. To gauge the success of these methods, or to use them, the reader would need to consult the reasonably complete list of references. The new memory function and mode-mode coupling approaches are described in totally different styles, so that it is difficult for a reader to compare the limitations or the power of the approaches. The chapter on mode-mode coupling is written so as to emphasize the physical ideas underlying the formalism. The weak features are pointed out, as are the areas in which progress is expected. The description of the memory function approach follows the logical structure of the I Ching and is accordingly harder to follow.

The somewhat uneven nature of the volumes can be seen in the lack of space given to solids and to the new methods for solving dynamic problems with polyatomic molecules and in the inclusion of a chapter on nonsteady chemically reacting systems, which is not connected with the other chapters. Because several subjects are combined in these volumes, their historical perspective is particularly helpful. Helpful also is the inclusion of article titles in the references. These features would be welcome in future additions to the series.

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