last decade important advances have been made in our understanding of the physics of simple (monatomic) fluids; so a well-planned and carefully written introductory text on this subject would certainly be a welcome addition to the literature and should attract a wide audience. I feel, however, that Croxton's book does not give a sufficiently well-balanced view of the subject to provide a reasonable introduction.

The major part of the present volume consists of a shortened and somewhat modified account of his earlier book *Liquid State Physics: A Statistical Mechanical Introduction,* which appeared in 1974 and is referred to as LSP. After a short introductory chapter, Croxton discusses the calculation of virial coefficients for dilute classical and quantum-mechanical systems before embarking on his longest chapter, which describes the equilibrium structure and properties of dense liquids. It is here that he introduces the formal theory of distribution functions and their use in the calculation of thermodynamic quantities. The various approximate theories of liquids, diagrammatic expansions, functional differentiation techniques, thermodynamic perturbation theories—all are described at varying levels of sophistication. This chapter is more digestible than the corresponding one in LSP, because Croxton has now included many useful sketches of the different functions that appear in the text. The two sections on numerical solutions of idealized models of liquids follow closely those in LSP and give the reader some indication of the important role played by machine calculations in the present studies of liquids.

Croxton's own work has been mainly concerned with the statistical mechanics of liquid surfaces, so it is not too surprising to find a whole chapter devoted to the surface problem. Unfortunately the author concentrates on his own contributions (whose merits are controversial, to say the least), so that the non-specialist reader would probably obtain a completely erroneous impression of the current developments in this field.

The "new" chapters in the present book form a very mixed collection. One finds a short discussion of critical-point studies and a rather idiosyncratic treatment of phase transitions, the latter again biased towards the author's own particular work. While the chapter on the structure and thermodynamics of liquid crystals is not out of place in a book of this kind, Croxton's section on liquid metals appears most inappropriate, because he deals solely with a few aspects of electronic transport in these systems. A more natural topic to include would have been a discussion of effective pairwise interatomic potentials in liquid metals; this subject is of considerable current interest. The final chapters provide a very brief, and not very illuminating, introduction to non-equilibrium properties, such as transport phenomena and the general question of irreversibility. Croxton does not give original references; the reader is frequently referred to LSP, and this naturally becomes tedious or even infuriating.

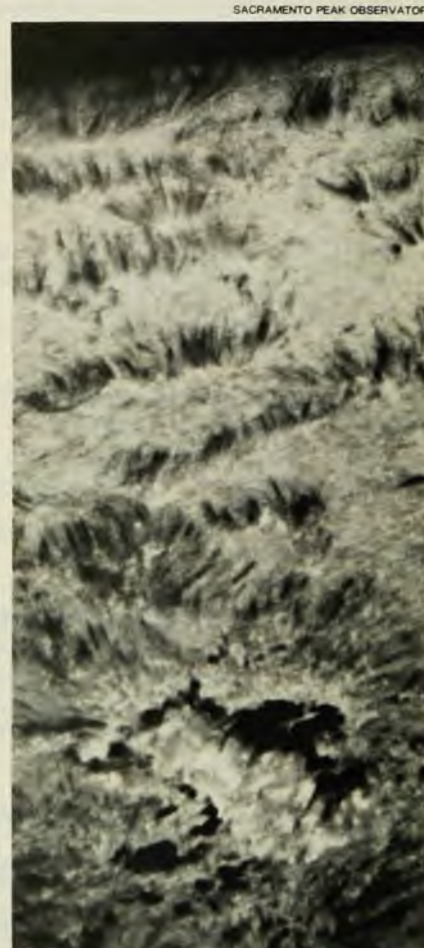
ROBERT EVANS
H. H. Wills Physics Laboratory
University of Bristol
England

The Solar Chromosphere and Corona: Quiet Sun

R. G. Athay
504 pp. D. Reidel, Dordrecht, Holland, 1975. $59.00

This is the second monograph on the solar chromosphere to be published in a short time; the first, by Robert J. Bray and Ralph E. Loughhead, was reviewed earlier (see PHYSICS TODAY, November 1974, page 57). Both monographs cover to a large extent the same areas, but each presents the subject as viewed by the very

SACRAMENTO PEAK OBSERVATORY



Solar chromosphere near the limb, as seen through a ¼-Å-bandwidth filter tuned to the wing of the Balmer-α line of hydrogen. Irregular spicules appear at the limb, and the bright spot near the bottom is a small solar active region.

different authorships. Whereas Bray and Loughhead are strongly observationally oriented, R. Grant Athay has distinguished himself by his work on the theories associated with the interpretation of the spectrum of solar electromagnetic radiation in terms of the physical conditions in the solar atmosphere. His efforts have covered radiations in the optical and far-ultraviolet spectrum, from the average solar disk as well as from individual chromospheric phenomena. Athay, however, has made a major effort to discuss all aspects of the solar chromospheric studies, even those in which he himself has not taken part. He has done so very successfully, and the monograph will therefore be a most useful item on the shelves of those astrophysicists interested in the properties of solar and stellar chromospheres, coronas and other types of extended envelopes.

A weakness of the book (in contrast to the work by Bray and Loughhead) is the absence of a complete bibliography. In fact the sketchy bibliography will make it difficult for the reader to trace the sources of much of the material and ideas that are presented. This does a disservice to the serious reader who wants to explore the subject further and to researchers in the field whose results are discussed.

The solar chromosphere and corona and the solar wind are the results of very complex energy-transport processes in the solar atmosphere, whose general behavior can be sketched but whose detailed workings remain unknown. Athay in fact defines the chromosphere as the layer in the atmosphere where the temperature starts increasing outward, presumably as the result of heating resulting from mechanical or magnetic wave-energy dissipation. The book discusses our knowledge of the theory of wave-energy and dissipation theories, but the source of the actual heating mechanisms has so far escaped definitive observational detection. The chromosphere and corona span a wide temperature range (varying by four orders of magnitude), from 4000 K at the base to approximately 40×10^6 K in the corona near flares; the two regions are therefore the source of a wide range of electromagnetic radiations, from the low-energy radio waves to the very-high-energy gamma rays.

The physics of the solar envelope is of interest to all students of stellar astrophysics, not only because it represents an astrophysical example of an object capable of emitting many radiations, but also because it is an object in which plasma processes can be studied on scales unattainable in the laboratory and because it serves as the prototype for the studies of stellar chromospheres and coronas. For us earthlings the solar envelope has an additional fascination because of its direct effect on our environment.

Athay's monograph was written in a period of very rapid development of our understanding of the solar atmosphere as the result of the flight of Skylab, the OSO-8 satellite and detailed solar-wind studies. In some ways it is therefore already somewhat outdated. Athay makes only minor mention, for example, of what now turns out to be one of the major recent discoveries in solar physics: the identification of the so-called "coronal holes" and their associated open magnetic-field configuration as Julius Bartels's M regions, which are responsible for the geomagnetic disturbances.

JACQUES M. BECKERS
Sacramento Peak Observatory
Sunspot, N.M.

Equilibrium and Non-equilibrium Statistical Mechanics

R. Balescu
742 pp. Wiley, New York, 1975. $29.95

The field of non-equilibrium statistical mechanics has long awaited a definitive graduate-level textbook. At last a leading practitioner, Radu Balescu of Brussels, has presented us with a big, beautifully produced book, which we open with great expectations. We are promised an integrated approach to classical and quantum equilibrium and non-equilibrium statistical mechanics.

One notes with pleasure many hoped-for topics: distribution functions, Wigner functions, thermodynamic limit, the ergodic problem, critical phenomena, Green–Kubo relations and the long tail of correlation functions, dense fluids and normal modes of linearized kinetic equations. The treatment is lucid, the style is lively.

Embedded in this textbook, and occupying seven of the eleven non-equilibrium chapters, one finds a monograph on subdynamics, a Brussels speciality. Because it appeals to an advanced audience, this material should have been published separately. The treatment here becomes highly mathematical, detailed and clear, but the astounding claims made appear to me unproved as presented.

Returning to the textbook proper, one finds three chapters on general concepts and seven on equilibrium, preceding the four on non-equilibrium for the non-specialist. Here, admiration for the clarity of the new topics is balanced by disappointment at omissions, obscurities, and obsolescence. For example, Balescu's treatment of the relation of thermodynamics to statistical mechanics appears perfunctory, with no mention of adiabatic processes; he obtains the hydrodynamic moment equations only from the Boltzmann equation, making no reference to the Kirkwood–Zwanzig technique; the Chapman–Enskog equation he solves by the Sonine expansion, without the use of variational methods; he introduces the transport coefficients without reference to dispersive properties; the treatment of plasmas, which is vintage 1960, ignores the work of the last 15 years, and the photon and phonon gases are dismissed in a short paragraph. I found an occasional tendency to present formulas without interpretation; the most glaring example is the definition and use of the symbol Λ without its identification as de Broglie length. The omission of problems constitutes a serious flaw—these could have illustrated and extended the treatment in the text.

I conclude with thanks to the author for undertaking this monumental presentation; my disappointment is tempered by the hope that a second edition will find these flaws overcome.

ALLAN N. KAUFMAN
University of California
Berkeley

Gauge Theories of Weak Interactions

J. C. Taylor
167 pp. Cambridge U.P., New York, 1976. $26.50

Since 1970 many exciting developments in theoretical particle physics have been in work concerning gauge theories. It is today an extremely active research area. Many features of these theories are yet to be fully studied. However, in the area of weak-interaction physics their application is relatively well-understood, and such theories provide a coherent and theoretically satisfying description of the phenomena observed. Recent new particle discoveries fit beautifully into this picture—they may well be the charmed particles that are a necessary component of gauge theories of the weak interactions.

Given this satisfying situation, it is indeed welcome to find a textbook that provides the necessary information to enable a student to become familiar with these theories. *Gauge Theories of Weak Interactions* is such a book. J. C. Taylor has been a steady contributor to the development of gauge theories over the past several years. His clearly written book begins at a level comprehensible to any student familiar with the basics of quantum field theory. The book is brief, but the material covered is extensive—Taylor does not waste words. It will require considerable work on the part of any student to master all the concepts and techniques presented. However, Taylor provides a clear path for the student to follow and ample references to the literature for further discussion of most points. (One reference I miss is to Sydney Coleman's 1973 Erice lectures on "Secret Symmetry". These lectures in-