

textbook on the same subject. McQuarrie acknowledges his debt to Hill both as the teacher under whom he learned statistical mechanics and as the author whose approach he uses in his own book. The influence is obvious; in fact, at times it comes dangerously close to word-for-word copying. Compare, for example, this passage from McQuarrie:

The simplest distribution function is $\rho^{(1)}(\mathbf{r}_1)$. The quantity $\rho^{(1)}(\mathbf{r}_1) d\mathbf{r}_1$ is the probability that any one molecule will be found in $d\mathbf{r}_1$. For a crystal this is a periodic function of $\mathbf{r}_1$ with sharp maxima at the lattice sites, but in a fluid all points within V are equivalent and so $\rho^{(1)}(\mathbf{r}_1)$ is independent of $\mathbf{r}_1$.

with this one of Hill:

The simplest distribution function $\rho^{(n)}$ is $\rho^{(1)}(\mathbf{r}_1, \xi)$. The quantity $\rho^{(1)}(\mathbf{r}_1, \xi) d\mathbf{r}_1$ is the probability that one of the molecules of the system will be found in the element of volume $d\mathbf{r}_1$ at $\mathbf{r}_1 \dots$. In a crystal $\rho^{(1)}(\mathbf{r}_1, \xi)$ is a periodic function of $\mathbf{r}_1$ with sharp maxima at lattice points, but in a fluid all points $\mathbf{r}_1$ inside of V are equivalent. That is $\rho^{(1)}(\mathbf{r}_1, \xi)$ is independent of $\mathbf{r}_1 \dots$

McQuarrie's book, however, covers a wider range of topics than Hill's, and of course he brings up to date much that is now outmoded in the older book. Twelve chapters of this work were reproduced from McQuarrie's earlier book, *Statistical Thermodynamics* (1972).

After a brief review of classical and quantum mechanics, the author treats the standard ensembles, properties of ideal gases, chemical equilibrium, degenerate quantum gases and nonideal gases. The chapter on solids covers the Einstein and Debye treatments and a brief introduction to lattice dynamics. Several theories of the liquid state and the Debye-Hückel theory make up three chapters. The rest of the book includes the kinetic theory of gases, transport theory, time-correlation functions and several appendices. Expected but missing topics are lattice statistics of solids, liquids, solutions and adsorbed phases. Each chapter is followed by numerous exercises of a very wide range of difficulty; some are almost trivial, while others are so hard that the professor who assigns them had better make sure first that he can work them himself. In general I find the basic material in McQuarrie's book easier to understand than that in Hill's, perhaps largely because he uses the familiar symbols p and V instead of Hill's X and x ; the loss in generality is not really important at this stage.

A few negative comments are in order: In his treatment of chemical equilibrium, McQuarrie only substitutes the statistical-mechanical expression for chemical potential into the thermodynamic condition for equilibrium, thereby losing the advantage of showing that the equilibrium conditions can be derived directly from statistical considerations. The

treatment of nonideal gases starts with the assumption that the pressure can be expressed as a power series in the activity and then sets about to interpret the coefficients in terms of cluster integrals. This reversal of the traditional approach is, of course, well known—Hill's book includes both—but I feel that for pedagogical reasons textbooks should include the traditional treatment. The author seems a bit careless with differentials: "The total derivative of f is $df = \dots$ " (italics added); "Since A is an exact differential $\dots$ "; " $\omega(\epsilon)$ is the number of energy states between ϵ and $\epsilon + d\epsilon \dots$ " These are trivial slips, but two of them were reproduced uncorrected from the author's previous book.

Despite these criticisms, I do not want to convey a negative impression of McQuarrie's book. Well written, generally good in its coverage (at least of topics of interest to chemists, perhaps less so for physicists) and easily readable by any properly prepared student, it should find wide acceptance as a textbook for graduate students and as a convenient summary of current statistical mechanics for the research worker. The paucity of typographical errors attests to the care the author has given to the tedious task of proofreading, and the publisher should be commended for holding the price to less than five cents a page for a book with a limited market and the difficult typesetting problems of highly mathematical material. Anyone who has, like me, taught statistical mechanics for years with a dissatisfied feeling at the choice of available textbooks will surely welcome this one.

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Optics of Thin Films

Z. Knittl
548 pp. Wiley, New York, 1976. \$37.50

Thin-film optics has developed into its current status as a specific discipline in the domain of physical science essentially within the past thirty-odd years. Though the basic principles underlying light interference in thin layers have been known for over a century, real interest in exploiting the subject was only aroused by developments in vacuum technology, starting in the 1930's; these developments allowed production in a practical way of multilayer films with tightly controlled optical properties and acceptable durability for use in spectral-filtering applications. The bulk of the material presented in this new book has, accordingly, been developed over the years since World War II. It is interesting indeed to

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1976, xviii, 170 pp., illus.
hd. 4650, \$19.50; pbk. 4651, \$9.50

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view the richness and scope of the theory that has been developed in such a relatively brief time period and in such a field as thin-film optics, which has certainly never been a glamour spot in the realm of research in physics.

Optics of Thin Films, as the title implies, is in essence a theoretical study of the problem of plane lightwave propagation in stratified media (based upon Maxwell's electromagnetic theory), with applications to methods of thin-films computation and to the design of optical filters. The author, Zdenek Knittl, has, for the most part, limited his treatment to "conventional" thin-film optics by introducing the usual idealized assumptions concerning the properties of the individual layers (that is, all media are optically isotropic; layer boundaries are plane parallel, smooth and of infinite extent, and so on) and by omitting treatment of such topics as wave guiding and non-linear optical effects. Some treatment of non-ideal-film properties is provided in a concluding chapter entitled "Perturbations." In other respects, the above-mentioned limitations in treatment are really in keeping with the avowed purposes of this work.

The author has noted in his introduction that his book is intended primarily to be used as a theoretical text for university courses or as a reference book for workers in the thin-films field. I believe his intention has been very adequately achieved. The book has a basic pedagogical flavor. It contains rather intensive treatment of certain areas of the mathematical theory, and at the same time it is a veritable storehouse of useful and practical information on computational and design methods in thin-film optics. A good selection of exercises at the end of each chapter, together with an excellent bibliography, adds much to the value of the book as a text-reference work.

Some specific features of the book are:

- ▶ a thorough treatment of basic theory and the optics of single films, as well as the more sophisticated studies on multilayer systems;
- ▶ a predominant use of the powerful matrix methods in the theoretical developments;
- ▶ an extensive treatment of multilayers with absorbing layers, and
- ▶ separate chapters devoted to methods of exact synthesis of multilayers and a study of inhomogeneous layers.

Knittl has done a fine job of assembling and presenting the material in this new contribution to the literature on thin-film optics, which includes some of his own work previously unpublished. He presents to the reader an up-to-date and true "world view" of pertinent developments in the field (within the scope of the aforementioned limitations) and at the same time retains a good historical perspective, giving rightful tribute to the

pioneer workers of the past years. This is a book that should be welcomed by students and professionals alike.

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Thermal Conductivity of Solids

J. E. Parrott, A. D. Stuckes

157 pp. Academic, New York, 1975.
\$10.50

Heat conduction is governed by the Fourier equation, but this field of study has been vacated by physicists to become the domain of applied mathematicians and of engineers. The thermal conductivity, however, which enters these equations as a material parameter, is determined by the properties of the substance on a microscopic scale and is thus very much the concern of solid-state and atomic physicists. There has been no review of the thermal conductivity of solids for several years; one earlier account is given in relevant chapters of *Thermal Conductivity*, edited by R. P. Tye (Academic, London, 1969).

A theoretician, J. E. Parrot, and an experimentalist, Audrey D. Stuckes, have combined to write this compact and very readable book. They explain the equation of heat conduction but use it only to discuss methods of measuring the thermal conductivity. Stationary and time-varying techniques are treated compactly; the principles are well explained, but not much attention is given the pitfalls that have caused so much confusion in the literature of the 1950's and 60's. The theory of thermal conductivity is treated straightforwardly. Conduction electrons and lattice waves are introduced, and their interactions are discussed in a semi-quantitative way; that is, the authors state the processes and interference conditions, but they do not treat the strength of the interactions—they only state the results. This is, of course, in line with the given level of the book, which is for senior students. It is customary at this stage to discuss energy levels and classify interactions, but to shy away from problems of intensity. When treating transport properties, intensity is the salient property of the interactions. The theoretical treatment in this book therefore becomes a catalogue of theoretical papers, and not always a sufficiently critical one. However, it is difficult to see what else could have been done in that space, and the account is very readable.

The authors compare the theory with the experimental data, covering all important cases. Semiconductors are particularly well treated, as could have been expected from the authors' background. The last chapter, on technological materials (that is, on inhomogeneous materi-