polarization effects (Sternheimer shielding), the discussion is then extended to results of molecular-orbital calculations. This establishes the background for the widely used semiempirical approximations due originally to Townes and Dailey, in which field gradients in molecules are related to the p electron density in the $\sigma$, $\pi$, and lone-pair orbitals of the atoms. Although the validity of these simplifying assumptions is considered with care, the author has not presented a formal development of this theory. It will likely occasion some confusion among the uninitiated—compounded here by some printing errors and some expressions quoted without derivation.

A particularly worthwhile account is given, however, of the importance of the radial part of the atomic wave functions in the accurate calculation of field gradients in both atoms and molecules. Lucken raises the very interesting question as to whether the $\sigma$ and $\pi$ electrons contribute equally in determining molecular coupling constants because they appear to differ in their radial dependence. The evidence on this point is sparse, but it is clear that the question is crucial in aiming at an improvement in the significance of the Townes and Dailey treatment.

The solid-state physicist will find that the book, although generally quite complete, makes scant mention of dynamic processes, relaxation effects, line widths and the general problems of field gradients in ionic solids and metals. A chapter on experimental methods in NQR is notably absent. Such an account might also have helped give the reader a feeling for the physics of the experiments, which is otherwise treated rather formally.

Experimental results are summarized in the second half of the volume, with extensive references up to the end of 1967. A spurt of new work on NQR in transition metals, principally cobalt, rhenium and manganese, has not been included. The author rightly does not attempt a complete compilation of known quadrupole-coupling constants, but quite enough are quoted to serve as a useful reference work.

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## Frühgeschichte Der Quantentheorie, 1899–1913

**By Armin Hermann**
**181 pp. Physik Verlag, Mosbach in Baden, 1969. Paper, 24 DM; cloth, 27 DM**

Armin Hermann's book makes it apparent that the history of the early years of quantum theory differs markedly from the sketchy, over simplified chronicle that many of us accept and recount to our students. This was brought home to me particularly by the chapter on the contributions of the Viennese theoretical physicist Arthur Haas (1884–1941).

Although I knew Haas and had worked with him on a project of mutual interest after he came to Notre Dame University in the 1930's, I had not realized his priority in applying the quantum idea to the atom. Hermann shows that in this regard, Haas anticipated the work of Niels Bohr by more than three years. For it was Haas who first connected Planck's constant with the dynamics of the atom and who first succeeded in expressing the Rydberg constant in terms of fundamental atomic quantities.

Curiously enough, the model used by Haas was not the nuclear atom but that of J. J. Thomson; Ernest Rutherford's scattering experiment had not yet been conceived. Nevertheless, the result was valid for a planetary atom because the Haas calculation referred to electrons coursing over the *surface* of the Thomson model. As a consequence, the size of the sphere of positive charge did not affect the result.

Because of a computational error, the numerical value of the Rydberg constant turned out to be wrong, but both $R$ and the atomic radius $a_1$ were of the right order of magnitude. More importantly, the method used by Haas was essentially the one Bohr later adopted.

Haas first presented his ideas in a talk before the Vienna Chemical and Physical Society in February 1910. Unfortunately this was at about the time of the winter carnival and the experimenter Ernst Lecher characterized Haas's work as a carnival spoof. Later, according to an unpublished Haas autobiography, Fritz Hasenöhrl remarked to a colleague that "Haas was not to be taken seriously because he naively tried to combine quantum theory and spectroscopy—two subjects that could not possibly have anything in common." Subsequently, Hasenöhrl reversed himself, and others were at least charitable enough to characterize Haas's thesis as "harmless."

By October 1910, H. A. Lorentz had dignified the idea as "a daring hypothesis;" and it was taken up and seriously discussed by Arnold Sommerfeld at the first Solvay Congress in 1911. Finally, in a recorded interview for the *Sources for the History of Quantum Physics* Bohr remarked that "It was quite clear [in 1912] . . . that we now had the Rutherford atom . . . and that it was regulated by the quantum. Haas had written all these things the year before, but I did not know of them . . . ." Another ironical twist in the skein of history.

*Frühgeschichte der Quantentheorie, 1899–1913* is an exceedingly well documented account of the first 15 years of the quantum idea. It takes the reader from Planck's presentation of his theory of blackbody radiation in a talk before the Berlin Physical Society on 14 December 1900 to Bohr's quantum description of the hydrogen atom in March 1913.

The author, formerly engaged in high-energy physics research in Hamburg, is now professor of the history of the natural sciences and technology at the Stuttgart University. He is the editor of a recently compiled collection of the Einstein–Sommerfeld correspondence.

The book is arranged according to the work of the eight greatest contributors to the theory: Planck, H. A. Lorentz, Einstein, Stark, Haas, Sommerfeld, Nernst and Bohr each get a chapter. This ordering by men rather than by ideas makes for some repetition, but it is not troublesome. The author's intention is to make possible the reading of any one chapter independent of the rest. A comprehensive list of literature references is appended to each chapter.

Hermann maintains that one can attain a true understanding of a theory only by personally following the thought process that originally led to its establishment—the path taken by the great innovators themselves. His book proves to be an effective guide in this quest.

IRA M. FREEMAN
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## Understanding Thermodynamics

**By H. C. VanNess**
**103 pp. McGraw-Hill, New York, 1969. Cloth $4.95, paper $2.95**

This little collection of lectures is a laudable attempt to help students who, for the first time, are encountering thermodynamics beyond the substituting-in-formula stage. The work is frankly pedagogic, and therefore shares the vulnerability to differences in taste that is characteristic in poetic or culinary works. It is *not* a text, but is rather a supplement to any standard one.

The response to the material varies even in a single reader. The opening chapter, on the First Law, is in my view an unfortunate beginning. In the attempt to show the basic character of the First Law, H. C. VanNess, professor of chemical engineering at Rensselaer Polytechnic Institute, has unwittingly violated his own precept of trying first to help the students. The treatment, to be sure, is rewarding for those who already understand its logical nature. But a beginning student must feel that the conservation of energy principle, as met in a thermodynamics course, is

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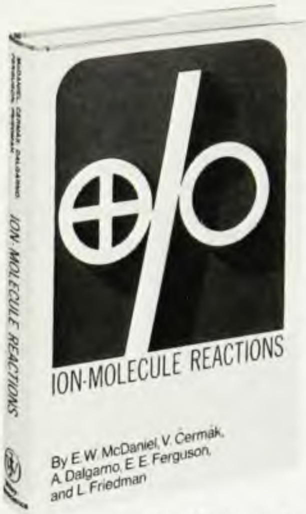


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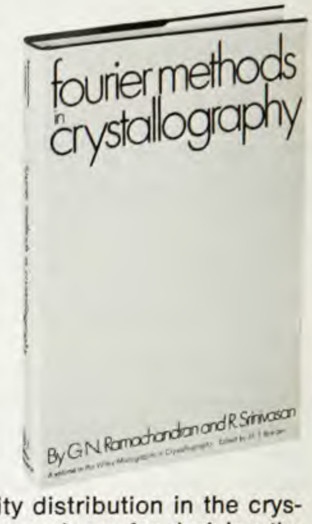
1970 313 pages $17.50

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*By* ARNOLD ROY SHULMAN, *Goddard Space Flight Center*

A volume in the *Wiley Series in Pure and Applied Optics,* edited by S. S. Ballard

Profusely illustrated, this book provides the background for understanding coherent optical data processing techniques, giving practical examples and results of these techniques applied to specific types of data. The volume presents a thorough introduction to this new field without challenging the reader with advanced mathematical formulations early in the text.

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1969 489 pages $14.95

## SOLID STATE THEORY

Methods and Applications

*Edited by* P. T. LANDSBERG, *University College, Cardiff*

"Professor Landsberg has edited in this volume a useful and interesting text for an intermediate to advanced course for those concerned with the quantum mechanical theory of electrons and phonons in solids.... The text does indeed meet the editor's desire for clarity of exposition. For this, and for the interesting variety of applications, the book is warmly recommended."—*IEEE Spectrum*

1970 529 pages $24.95

hard enough to manipulate without having to search for its meaning in an elaborate analogy. In brief, the chapter on the First Law answers a question the student does not want asked.

On the other hand, the treatment of reversibility in a subsequent chapter is a gem; and here the book answers questions that the student has asked, and that most texts avoid (as do their instructors). The treatment of the Second Law in later chapters is uneven, in that the virtue of pointing out the fatuousness of several traditional statements about this law is counterbalanced by the contrived treatment of entropy. An unexpected and refreshing aspect is the illustration of the fundamental properties of heat engines in describing a nuclear-power plant; it should help in motivating the student who may wonder whether thermodynamics has anything to do with the real world.

In any event, most teachers of introductory thermodynamics will find here useful approaches and viewpoints for students first meeting high levels of technical abstraction.

The author has striven hard to produce a useful and appealing work. His devotion and his skill are apparent, and instructors will find themselves recommending it to their aspiring students.

DONALD J. MONTGOMERY
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## Mathematical Methods In Kinetic Theory

**By Carlo Cercignani**
227 pp. Plenum, New York, 1969. $15.00

The kinetic theory referred to in the title of this book is restricted to the solution of the Boltzmann equation for inert, monatomic gases under all degrees of rarefaction. This problem has been of interest to aerodynamicists only recently, but is a classical one in physics. Many applied mathematicians and theoretical physicists have contributed greatly to the progress made and Carlo Cercignani is one of them.

Another well known worker in the field, Harold Grad, has said, "In trying to project from the past, we can distinguish three qualitatively different eras: transport coefficients, ad hoc polynomial and moment methods, and the blossoming of more precise mathematical investigations." It is with the last that Cercignani is concerned. As the author says, he is primarily interested in methods not results. Since Kogan's book, *Rarefied Gas Dynamics*, has recently been translated into English and is mostly concerned with results and their application as well as other topics (such as polyatomic gases and mixtures) Cercignani rightly feels that his book and Kogan's are complementary.

A short concluding chapter on results has some very good correlation between theory and experiment, but his book is mostly devoted to the boundary value problems in the Boltzmann equation. He starts with the basic principles of kinetic theory, derives the Boltzmann equation carefully and rigorously, and discusses its basic properties. The linearized collision operator is introduced and studied in detail, and model equations and solutions are given. There is a brief discussion of the Hilbert and Chapman–Enskog theories together with a more extended treatment of the linearized Boltzmann equation. Most of the author's own work is embodied in the treatment of these topics. The book is an excellent summary of recent research in the mathematical theory, and should be of great value to those physicists interested in the mathematical problem.

ROBERT E. STREET
*University of Washington*

## Elements of Advanced Quantum Theory

**By J. M. Ziman**
269 pp. Cambridge U. P., New York, 1969. $9.50

Although there are few physics graduate schools where a second year of quantum mechanics is not taught, there is remarkably little consensus about the content of such a course, and very often the personal preferences of the lecturer dominate. In this useful little book, John Ziman states his case in his usual eloquent way. The book's main emphasis is on the methods of nonrelativistic many-body theory, with examples culled principally from the physics of solids. The final two chapters discuss relativistic quantum mechanics and the theory of symmetry operations.

A great deal of physics is crammed into these pages at the expense of most of the intermediate steps in the algebra and a few uncrossed "t's" and undotted "i's". One tends to be referred to "the proper books" when the going gets rough, although there is no bibliography to say which books are proper. The more experienced reader will recognize some of the material and will compliment Ziman on brewing a happy mixture of the difficult parts of his own previous books with the easy parts of some other people's writings. Perhaps the quotation at the start of the book should have been the Bellman's—"I have said it thrice: What I tell you three times is true."

PHILIP L. TAYLOR
*Case Western Reserve University*

## Astrophysics and Stellar Astronomy

**By Thomas L. Swihart**
229 pp. Wiley, New York, 1969. $9.95

The subject of astrophysics, as the name implies, is based on the methods of physics. Among the branches of physics that are especially useful are those concerned with radiation, and the introductory chapter of this book outlines the basic ideas of radiation. It touches also on nuclear reactions, to the extent that these supply the energy that keeps the stars radiating. In subsequent chapters the author describes the measurement of distance, brightness and motion of ordinary stars and additional information from observation of binary and variable stars.

Up to this point the presentation is intended to furnish the background material for understanding the two major chapters. The first of these is titled "Astrophysics" and deals with several topics. Two sections investigate the physical makeup of stars by comparing them with model stars and adjusting the model parameters so that the calculated brightness, spectra and other properties match those that are observed. As a star uses up its nuclear fuel, it gradually changes its appearance. The section on stellar evolution discusses this "aging" and how it fits into the observed grouping of stars in the Hertzsprung–Russell diagram. Another section deals with various types of interstellar matter and their effect on traversing starlight. The final chapter describes what is known about the structure of our own galaxy as well as others and presents some current ideas on the nature of the universe as a whole.

The book is intended for science majors and is the result of Swihart's teaching the second semester of a general-astronomy course at the University of Arizona. His own research is in radiative transfer in stellar atmospheres.

ROLF LANDSHOFF
*Lockheed Palo Alto Research Laboratory*

## Dispersion Relation Dynamics

**By Hugh Burkhardt**
289 pp. Interscience, New York, 1969. $18.50

Hugh Burkhardt's intention is to provide "a lowbrow exposition of S-matrix theory." He thus attempts to solve an exceedingly difficult pedagogic problem, that is, to present in a coherent manner a large body of phenomenological material in the absence of applicable physical theory. The problem is analogous to writing an introduction to modern physics without having wave me-