

dent's first reading on the subject, but also for the astronomer who wants to refer back to original sources.

This book is an excellent summary of the astrophysics of HII regions and planetary nebulae. However, it should be pointed out that the astrophysics of supernova remnants is not completely covered in this book; nonthermal or synchrotron radiation is not discussed. I hope that a later edition or a second volume will more fully depict this important group of gaseous nebulae.

In addition to astronomers, many physicists may enjoy referring to this volume, especially those involved in classroom instruction or those interested in seeing the application of fundamental classical and quantum physics to a nearly ideal medium.

THEODORE R. GULL
Lockheed Electronics Co
Houston, Texas

Symmetry Principles in Solid State and Molecular Physics

M. Lax
499 pp. Wiley, New York, 1974. \$19.50

Rotational invariance, translational periodicity, time-reversal, and other symmetry principles play a prominent role in many branches of theoretical physics and chemistry. Accordingly, a knowledge of how to use symmetry in theoretical analysis is an important ingredient in a scientific education. Many graduate students have brief encounters with symmetry (group theory) in quantum-mechanics and physical-chemistry courses, but very few gain a working knowledge of symmetry analysis without devoting considerable additional effort to this subject. Increasingly, students are taking specialized courses in group theory, which stress physical and chemical applications rather than the underlying mathematical foundation. Melvin Lax's new book is eminently suited for such courses in applied group theory.

One of the distinctive features of the book is that it begins by stating and illustrating rather than proving the fundamental theorems of group theory. In this way the student gets down to the subject directly. After carefully discussing the relationship between group theory and quantum (or classical) mechanics, Lax treats the most important features of the full rotation group, crystallographic point groups, space groups and their associated double groups. Most of the book is devoted to instructive problems in a number of fields, including crystal field theory, macroscopic-crystal tensors, molecular vibrations, energy-band theory, lattice dynamics, and molecular-orbital theory.

Another distinctive feature—and one of its great strengths—is that the book examines many group-theoretical problems that have arisen in recent research as well as many traditional problems. The book also features detailed treatments of space groups and time-reversal symmetry. These accounts are among the best available anywhere. Lax presents full-scale symmetry analyses of the vibrations of the ammonia molecule and the diamond crystal. These and other in-depth discussions should prove particularly valuable to the serious student. The book also contains many excellent problems and reference material as well.

After spending many years at Bell Laboratories, where the early drafts of this book were written, Lax joined the City College of the City University of New York as Distinguished Professor of Physics. He has made many important contributions to theoretical physics, not the least of which is this outstanding book. Many sections are based on original research by the author, and most are illuminated by his mathematical and physical insight. I am happy to recommend the book to students of physics and chemistry as well as to research workers in these and related fields. This is one of the best books presently available on the physical and chemical applications of group theory.

FRANK HERMAN
IBM San Jose Research Laboratories
California

The Wave Equation on a Curved Space-Time

F. G. Friedlander. 282 pp.
Cambridge U. P., New York, 1976. \$39.50

In the last few decades, new methods have been developed in the theory of partial differential equations, methods based on the theory of generalized functions and, in particular, on the theory of distributions. The theory of distributions is not merely a convenient tool; it also enlarges the scope of the theory of partial differential equations in a useful way both mathematically and physically. *The Wave Equation on a Curved Space-Time* by F. G. Friedlander is an attempt to present to physicists the classical theory of the wave equation, developed mainly by Jacques Hadamard and Frigyes Riesz, using the modern language of distributions and differential geometry.

The first part of the book reviews differential geometry, the theory of distributions, and some basic aspects of characteristics and bicharacteristics of the wave equation. The second part is the main body of the book, which treats the general construction of fundamental so-

lutions of the scalar wave equation and their application to the Cauchy problem. In the remainder, generalizations of the theory to tensor wave equations in a space-time and to the corresponding equations in space-times of arbitrary dimension are developed.

The theory presented is local, because the classical theory of Hadamard and Riesz is constructive, and this book simply attempts to state it in a modern language. Also, the abstract approach involving Sobolev spaces is not touched. Hence this book might be disappointing for a physicist who wants a broad exposition of the modern theory of partial differential equations. However, Friedlander treats his rather narrowly chosen topic in an intensive, well organized way. One unsatisfactory point is that he does not include an example to illustrate the main theory of the book. As the author points out, there are very few examples. Nevertheless one could find, I think, some good illustration that would make this book much more attractive to physicists.

The main audience for the book will be general relativists, who often encounter problems involving basic aspects of the wave equation on a curved space-time. One instance is the Cauchy problem for Einstein's equations: how does one specify data on a space-like hypersurface or on a characteristic half-hypercone in such a way that at later times a solution of Einstein's equations can be found that is consistent with the given data?

On the whole, I would say that this is a well written book and that it clarifies the basic mathematical structure of the wave equation on a curved space-time. Friedlander's volume will be useful to graduate students in general relativity who want a deeper understanding of the Cauchy problem for Einstein's equations.

PONG SOO JANG
Syracuse University
New York

Solar-Energy Thermal Processes

J. A. Duffie, W. A. Beckman
386 pp. Wiley, New York, 1974. \$16.95

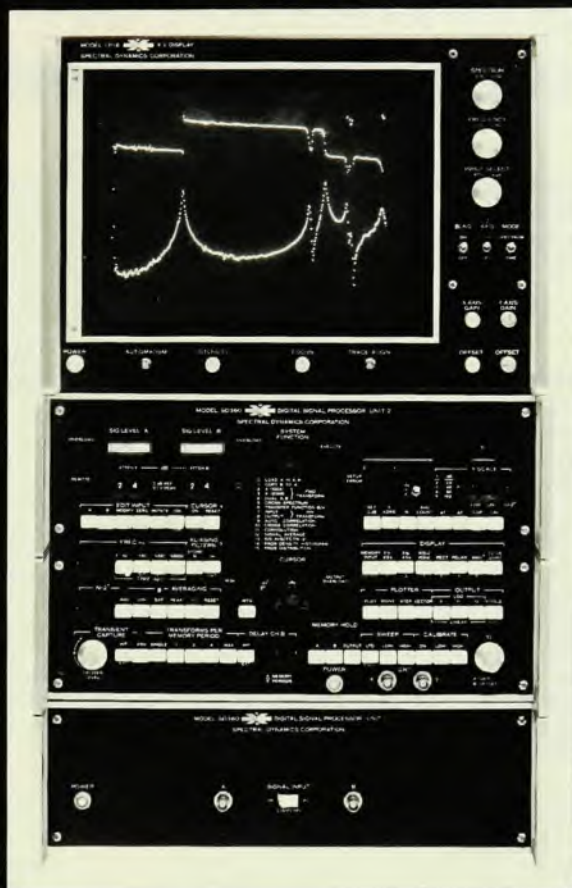
Given the current interest in the utilization of solar energy, this timely book meets an important need. According to the authors the purpose of this volume is to summarize the state of knowledge in the design of uses for solar thermal processes and to present this summary in a form that will be useful to engineers. Actually, the coverage in *Solar-Energy Thermal Processes* is restricted to thermal processes in which solar radiation is absorbed by a solid surface in

contact with a fluid, which is then heated and can be used as a working fluid at an elevated temperature; in other words, the book concentrates on the design and analysis of solar-driven heat-exchange systems and does not cover photovoltaic, photochemical, or photosynthetic processes. It appears that its main objective is to present the analytic background for the design of applications of solar thermal processes useful in heating and cooling of buildings. These processes are presented in a well organized manner, analyzed with great clarity, and articulated in a style that is easy for the reader to follow.

The first three chapters treat solar radiation, its origin, nature and availability. Chapters 4 to 6 review some basic topics in heat transfer that are important in solar design, and chapters 7 to 10 treat processes and system models for thermal devices such as flat-plate collectors, focusing collectors and internal energy-storage systems. Chapters 11 to 14 deal with applications to such processes as hot service water heating, comfort-space heating for buildings and air conditioning. The emphasis throughout the book is on system modeling and simulation in order to provide engineers with the tools to predict the thermal performance of solar thermal processes by means of a computer.

The book is addressed to an audience of graduate engineers with a background typical of that obtained in a Bachelor of Science program in mechanical or chemical engineering. The authors assume a prior knowledge of heat transfer, thermodynamics and fluid mechanics, and the book is therefore suited as a text for a senior elective course or a first-year graduate-level course dealing with solar-energy thermal processes in colleges and universities. Unfortunately, the book makes short shrift of such important applications in solar technology as solar-assisted heat pumps, thermal ponds, solar thermal electric-power generation and solar distillation. Expanded coverage of these topics would be welcome for a graduate-level course. Also, the chapter on focusing collectors could be improved by a discussion of the relationship between tracking and concentration ratio. A simple discussion based on the second law of thermodynamics could span the range from a solar furnace, which aside from atmospheric and system losses approaches the surface temperature of the sun (in principle), to a tracking east-west concentrator with a concentration limit of about 150, to a nontracking east-west concentrator with a concentration limit of about 10, to a fully stationary collector with a concentration ratio of about two. In addition a discussion of some of the more recent collectors, such as the stationary reflector with a tracking absorber and the various types of compound

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Bronx Community College

"It was with particular pleasure and interest that I received Volumes I & II and the Instructor's Manual to Volume II in the package that was generously sent to me, since one of the authors (F.L.) is well known to me from bygone days as a student in Switzerland. Some of the enthusiastic manner that he displayed in those days is conveyed in the lively presentation of the textual material and in such illustrative ideas as the "film-strip" Figures 8-7 and 12-26 in Volume II. I also very much commend the authors for the inclusion of brief chapter summaries, and for their choice of questions and numerical problems. The diagrams are very clear, and I find it particularly praiseworthy that you are issuing a set of slides to accompany this text. The use of multicolors enhances the clarity of the figures (e.g., Figures 8-13 and 12-5) and the pedagogical development of topics is exemplary."

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parabolic collectors would be of interest to physicists. The above remarks are more intended as suggestions for a future edition than as criticisms of the present treatment.

The style of the authors is clear, and the topics they cover are treated in sufficient detail to teach a graduate engineer how to construct analytical models and predict the performance of solar-energy thermal processes. The book illustrates this material with well chosen applications, particularly for the heating of buildings. This is an excellent volume, and it should be in the library of every engineer interested in solar-energy utilization.

ROLAND WINSTON
Enrico Fermi Institute
University of Chicago
Illinois

FRANK KREITH
University of Colorado
Boulder

Homogeneous Relativistic Cosmologies

M. P. Ryan Jr, L. C. Shepley
321 pp. Princeton U. P., Princeton, N.J.,
1975. \$15.00 hardcover, \$7.50 paperback

There are, broadly speaking, two types of theoretical cosmologists: those who do astrophysics on background Robertson-Walker geometries, which are spatially homogeneous (that is, all points in space are viewed as equivalent) and isotropic (all spatial directions equivalent), and those who work on more complex geometries, including the simplest (spatially homogeneous but anisotropic) non-Robertson-Walker geometries. The latter group, which has extensively studied such topics as the existence and nature of singularities and the observational constraints on permissible models, has operated over the last decade mainly in Great Britain, the US and the Soviet Union. In *Homogeneous Relativistic Cosmologies*, the authors review the work of the American school.

Michael Ryan Jr and Lawrence Shepley are active members of this school, and the book includes fairly full accounts of their own contributions to the study of generalizations of the closed and flat Robertson-Walker cases. Such a connected account is useful to workers in this field and will be of interest to researchers in physics and astronomy who seek some idea of recent developments.

The style is wordy, but readable and sometimes witty. Ryan and Shepley provide an extensive bibliography, but I dislike its chronological arrangement. Their flow charts of topics appear more useful to them than to readers.

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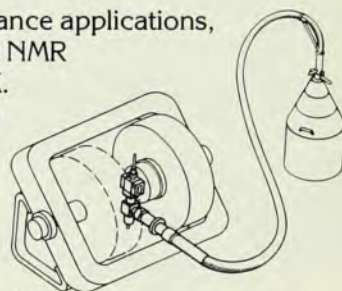
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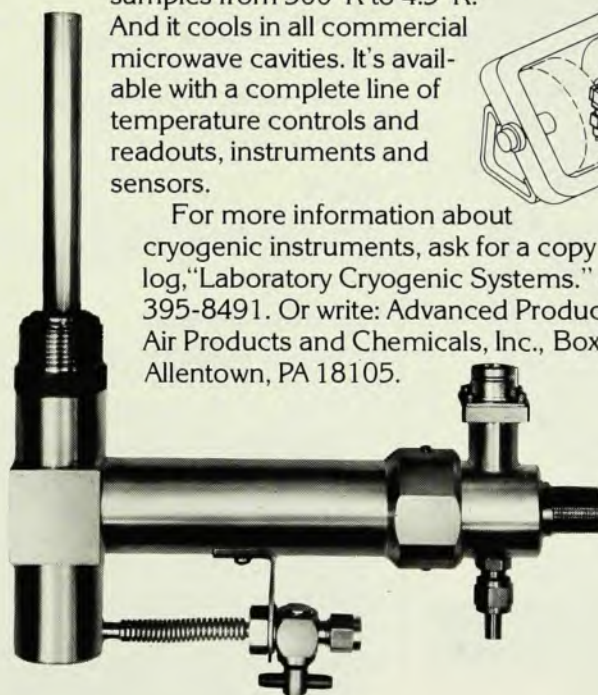


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