of the flux, assuming only that the basic nuclear-physics data are known sufficiently accurately. The next step is to break up the continuous energy dependence into a multigroup format with appropriately defined multigroup constants. This is in preparation for solution on digital computing machines. There is, however, no discussion of how such numerical procedures are carried out. At this point Henry proceeds to obtain approximate analytical solutions for some very simple cases, specifically the fission-source range, the intermediate "slowing-down" range and the thermal-energy range. The results are, of course, the same as in other texts. However, the order of presentation here is unconventional in that analytical results are discussed last to provide insights into the way the neutron flux behaves as a function of material composition and neutron energy. By starting with an infinite medium, the author is thus able to introduce fairly early many of the basic concepts of reactor physics, including an orderly development of the four-factor formula with carefully defined components.

Finite media are then treated with the introduction of diffusion theory based on the assumption of Fick's Law. The derivation of this law is deferred to the chapter on transport theory. (The author thus avoids the conventional one-speed derivation, which he considers to be misleading.) For a bare finite reactor the results of the infinite-medium case are directly applicable provided a leakage term is added to the absorption term. Generalizations to multiregion reactors are then made. Here again, as is the case throughout the book, the unconventional procedure is followed: general equations first, then preparation in a form suitable for computer calculations and finally some analytical results applied to simple cases to provide insight into the importance of various parameters in determining the flux distribution.

In the realistic case of heterogeneous reactors with resonance absorbers, methods are provided for the determination of "equivalent homogenized" few-group constants. Treatment of the consequences of fuel depletion, including conversion and the effects of Xe^{135} and Sm^{149} buildup, follows. Reactor kinetics is treated in a manner much closer to the conventional approach than applies to the rest of the book.

Transport theory is introduced to provide a derivation of Fick's Law as an approximation and to treat those cases where this law is not valid. Group-diffusion theory is then derived on the basis of transport theory.

The book concludes with a chapter on the generation of equivalent diffusion-theory parameters for realistic cases and a chapter on advanced methods for reactor analysis, such as several synthesis methods, variational techniques and the finite-element method, among others.

This book is the basis of a sequence of three one-term graduate courses in reactor theory at MIT. The author claims that the standard undergraduate-mathematics preparation is adequate and that previous knowledge of reactor theory is not necessary. This may be literally so, but in my opinion considerable mathematical sophistication is needed to follow the various developments. Similarly, the rigorous development and insights provided can be appreciated only by one who is already somewhat familiar with the basic features of reactor theory.

Other features that argue against this book as an introductory text are its relatively few diagrams (for instance, a graph of the thermal flux peaking in the reflector, resulting from a two-group calculation, would be helpful), the lack of worked-out problems and the omission of the customary appendices giving tables of various parameters of interest and summaries on various special functions. On the other hand, for the better prepared student there are many interesting problems at the end of each chapter, frequent summaries throughout the text to "help the reader to distinguish the forest from the trees" and indications on how some of the parameters encountered may be determined experimentally, as well as good motivation throughout.

In addition to use as a classroom textbook, this book will be of value to nuclear-reactor designers and to reactor analysts, giving them a clear idea of the virtues and limitations inherent in the theoretical methods in use. Indeed, this book can be read with profit by one already familiar with reactor physics who wishes to obtain a coherent account of the subject and to get the author's insights and interesting viewpoints.

* * *

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Atmospheric Diffusion, 2nd edition

F. Pasquill
429 pp. Halsted, New York, 1974. $39.75

There is little doubt that the levels of air pollution that now exist in industrial countries cause significant human-health effects, substantial property damage and serious environmental degradation. In order to be able to make rational choices among various technological options that face society, it is necessary to be able to predict air-pollution levels that would result.

The major tools for such predictions, and their scientific bases, are discussed in this book, which is a substantial revision of the first edition, published in 1961.

The author, Frank Pasquill, is a British meteorologist who has recently retired from a distinguished research career; he is a past president of the Royal Meteorological Society and a former editor of the Quarterly Journal of the Royal Meteorological Society, and he has held a number of leadership positions. He is currently an active consultant. This book, in spite of the rather inflated price, should be available to all serious workers in air-pollution meteorology.

The earlier chapters review experimental information on atmospheric diffusion, survey theoretical approaches used to describe diffusion and describe what is known about turbulence in the atmosphere. It is of course turbulence that controls the dispersion of material, and Pasquill's chapter on this subject and the associated micrometeorology is outstanding.

The strength of this book is the manner in which the underlying foundation of the methodology is developed. Chapter 5 discusses many of the complications associated with the release of pollutants at elevated temperatures from industrial stacks, the removal of particulate-matter deposition, precipitation removal, effects of terrain and various other practical considerations. A rather concise but reasonably complete summary of what is known is given here. One topic that receives rather sketchy treatment is the effect of chemical reactions on pollutants, and little mention is made of the effect of atmospheric conditions upon reaction rates—this omission largely reflects the lack of available information. The methods available for predicting long-distance transport could have been given a more complete treatment.

As the author states, Chapter 6 "deals with the application of all the ideas, results and experiences which has been discussed in the preceding chapters." In this final chapter he sets forth "engineering" procedures designed to allow one to calculate the expected pollutant concentration given the release rate, the nature of the terrain and the meteorological conditions. This is indeed a tall order given the complexity of the ever-changing turbulent atmosphere through which pollutants are transported. Pasquill understands, and explains well, the complexities and possible pitfalls.

I disagree with the author's suggestion that the final chapter might be studied and used without reference to the preceding chapters. Studied, perhaps; but used alone, only at one's own peril! Environmental-impact statements, safety-analysis reports and various other studies have all too many silly errors because someone felt that a handbook, summary or final chapter could be used without understanding the basic atmospheric processes that control the transport and

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Measurement of Irradiation-Enhanced Creep in Nuclear Materials

Proceedings of the International Conference Organized by the Commission of the European Communities at the Joint Research Centre, Petten, The Netherlands, May 5-6, 1976.

edited by **M. R. CUNDY, P. VON DER HARDT** *and* **R. H. LÖLGEN,** *Commission of the European Communities J.R.C. Euratom, Petten, The Netherlands.*

Special Issue of the Journal of Nuclear Materials, Vol. 65.

1977 xii + 338 pages
Price: US $101.95/Dfl. 250.00

These proceedings consist of 37 papers on a wide variety of aspects of the measurement of irradiation-enhanced creep in nuclear materials. The papers, presented at the 1976 international conference which was attended by some 120 participants from 15 countries, are by the foremost specialists in the field, and give the first comprehensive survey of current research in this increasingly important area.

The study of materials creep, as a phenomenon limiting components' life on the one hand, and relieving stress on the other, is one of the special research objectives of the Petten establishment of the Joint Research Centre. High temperatures and very small elongations make in-pile measurement of irradiation-enhanced creep of graphite and fuels particularly difficult, and to date, research results in this area have been scarce and scattered. Moreover, it is anticipated that today's nuclear power reactor safety programmes will result in requests concerning creep investigation under abnormal and transient conditions. Such research is discussed with a view to elaborating reliable interdisciplinary data necessary for the safe and economic operation of nuclear power reactors, and further encouraging the intense international collaboration which this field prompts.

Shell Model Applications in Nuclear Spectroscopy

by **P. J. BRUSSAARD** *and* **P. W. M. GLAUDEMANS,** *University of Utrecht, The Netherlands.*

1977 xii + 466 pages
US $65.25/Dfl. 160.00
ISBN 0-7204-0336-7

The amount of accurate experimental data in nuclear spectroscopy is rapidly increasing and, due to the use of large computers and sophisticated shell-model programs, much of the data can be interpreted or correlated in the framework of the nuclear shell model.

This book is devoted mainly to applications of the many-particle shell model rather than to its foundations. Formulas needed to perform a shell-model calculation are derived in detail. The theory is illustrated with calculations of observable quantities, such as energies, electromagnetic transition rates and moments, beta decay rates and spectroscopic factors, and many of these calculations are compared with recent experimental data.

The book is written at the level of a graduate course in nuclear physics and as most of the formulas are derived, it is suitable for use as a self-contained text for such courses, requiring only the knowledge of an one-year course in introductory quantum mechanics. The material has been arranged in such a way that various subjects can be studied separately and numerous examples enable the reader to check his own attempts at a description of nuclear properties in terms of the shell model. The formalisms of first and second quantization are employed to allow the discussion and evaluation of the various methods used for the treatment of many-particle systems.

CONTENTS: 1. Introduction. 2. One- and two-particle systems. 3. Perturbation theory and configuration mixing. 4. Interacting particles in one orbit. 5. Particles in two active orbits. 6. Effective interactions. 7. Determination of empirical effective interactions. 8. One- and two-nucleon transfer reactions. 9. Electromagnetic transition operators. 10. Electromagnetic transition rates. 11. Electric and magnetic multipole moments. 12. Allowed beta decay. 13. The second-quantization formalism. 14. Matrix elements in second quantization. 15. Further applications of second quantization. 16. Realistic and effective operators. 17. Applications of Wick's theorem. 18. Miscellaneous subjects. Appendices. References. Subject index.

Computing in Plasma Physics and Astrophysics

Proceedings of the Second European Conference on Computational Physics, Garching, 27-30 April 1976; Invited papers.

edited by **D. BISKAMP,** *Max-Planck Institut für Plasmaphysik, Garching.*

Reprinted from Computer Physics Communications 12 (1976), 1-124.

1976 x + 124 pages, 4 tables, 93 illus., over 200 lit. refs.
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ISBN 0-7204-0713-3

Many of the problems encountered in astrophysics are very similar to those with which plasma physics deals. Computational methods developed in both fields have therefore much the same character, and have reached a high level of sophistication. These computational methods formed the subject matter of the 1976 conference, and the invited papers are presented here.

The topics covered include stellar evolution and pulsars, particle stimulation, MHD equilibria, stability and nonlinear dynamics, and transport in stars and laboratory plasmas. Not surprisingly, most of the papers are devoted to plasma physics, since the computational efforts being made in fusion oriented plasma physics are particularly concentrated at the moment.

Thus, though short, this volume, containing the invited papers, presents a most comprehensive account of the latest developments in the computational physics and numerical analysis techniques which formally link astrophysics and plasma physics.

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dispersion of material. True, there are caveats in Chapter 6, and the recommended methods are much more complete than the "If it is sunny, use curve B" type that can be found in the literature. In fact, if one were really limited in the amount of knowledge one could bring to bear on an air-pollution problem, this chapter would serve as a better short summary than any other I have seen. However, air-pollution problems are sufficiently important that the analyst should do a complete job; and this entire book, if used intelligently, can help the meteorologist, engineer or chemist gain the required knowledge.

Throughout the book there are rather complete references to, and discussion of, research in the field; this aspect makes Pasquill's book useful to the serious student and, indeed, often leaves the reader with the decision as to which of several approaches should be taken. This ambiguity reflects the fact that atmospheric turbulence and diffusion are far from being a closed field.

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Optics and Information Theory

F. T. S. Yu
203 pp. Wiley-Interscience, New York, 1976. $14.95

Recent advances in optics, inspired by the availability of coherent laser sources, have given great impetus to the field of optical communications and information processing. The application of information theory to optics is of considerable importance in providing limits to what is possible in, for example, information transmission over a single-mode optical communications channel, or in the restoration of blurred photographic images. In this short book Francis Yu reviews the fundamentals of information theory and the properties of optical spatial channels, then discusses at some length the intimate and fascinating relationship between information and thermodynamic entropy. He concludes with sections on image restoration and quantum effects on information transmission.

Although the subject matter of this book is drawn mainly from the works of Leon Brillouin, Denis Gabor and Claude Shannon, I do not know of any other single text that covers this interesting juncture of the theories of optics and information. The book could be of considerable interest to a broad spectrum of scientists and engineers. Unfortunately I find the book lacking in adequate attention to pedagogy, and it contains an unfortunate conceptual error in the last section. Imprecise wording, such as occurs in the opening sentence of Chapter 6—"In the classical theory of light, an observation can be made as small as we please."—makes for difficulty in reading. In a section on detection of a signal by matched filtering, the author finds a matched filter that optimizes the signal-to-noise ratio at time zero, without a word about what is special about that particular time; the significance is lost, and the student is left simply puzzled.

In discussing Gabor's *perpetuum mobile* of the second kind, which uses a light beam to locate a molecule that in turn drives a piston to do work, the author ignores Gabor's clever point that if the machine is not to work, the energy used for each observation must somehow depend on the volume of the unobserved portion of the cylinder in which the piston slides. Yu contents himself with showing that if one accepts the usual entropy cost of information, then the second law of thermodynamics is upheld. The subtlety of Gabor's machine is thus lost.

In his treatment of the information capacity of a "photon channel" in the presence of thermal noise, the author makes a pervasive error in assuming that signal and noise photons are statistically independent. It is well known that, in