

common properties of special functions. Thus, the proof of the addition theorem for spherical harmonics is omitted, and we are told that "There is a raft of other properties. . . that are straightforward, but messy, generalizations of the identities proved for Legendre polynomials." The treatment of tensor analysis is also quite rudimentary.

The central theme of the book is the theory of linear vector spaces, starting with a bit of vector analysis and carried through a full account of finite vector spaces to Hilbert space and culminating in three superb chapters on integral equations and Green's functions. Supporting this core of the work are two big chapters on the calculus of variations (including applications to Lagrangian field theory) and on the theory of analytic functions (82 pages of beautiful exposition). A chapter on group theory dangles at the end and suffers from the common handicap of being too much and too little at the same time.

Within the limitations of the subject matter that they have chosen, the authors have achieved an unusually felicitous balance between mathematical rigor and physical relevance. The physical applications are never lost sight of, and yet mathematical intricacies and proofs are not glossed over, nor does one ever get the feeling that they are extraneous embellishments. Important mathematical statements, like definitions and theorems, stand out clearly in the printing, and generally an effort has been made to aid the student who is encountering new concepts and ideas.

The writing is lucid but spiced by occasional witticisms that give the appearance of having been simply lifted from a set of informal lecture notes. An unintended joke is found in Section 1.8, where a remarkable attempt is made to distinguish between a Cartesian tensor and a Cartesian-tensor in a hilariously contorted paragraph worthy of the small-print department in the *New Yorker* magazine. It is also confusing to find the term "scalar" used both for a number and for a tensor of rank zero.

There are a few other inconsistencies here and there, but irritating as they can be to the beginning student, they are not serious enough to detract from the usefulness of the book as one of the major texts in its field. The reader is amply compensated by such good features as an illuminating discussion of the Laplacian operator, a clear explanation of Noether's theorem and a substantial introduction to Banach space. Much important material, including for instance the Fredholm theory, appears in the numerous meaty problems.

For no apparent reason, the book, with a manageable length of 659 pages, has been split into two separate volumes. Volume I contains three chapters on linear vector spaces, one on Hil-

bert space and complete orthonormal sets of functions, and the chapter on the calculus of variations. The authors suggest that this volume could be used for a one-semester course, but the reader will sense in almost every page that Volume I is primarily intended to set the stage for the heart of the book, the theory of integral equations in Volume II. Fortunately, the two volumes were published in quick succession.

The authors are two young theoretical physicists whose careers seem to have intersected at Columbia University. Byron is presently at the University of Massachusetts, and Fuller has recently become president of Oberlin College. They both deserve our gratitude for enriching the literature with this fine contribution.

Eugen Merzbacher  
The University of North Carolina

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## The Waves: The Nature of Sea Motion

By G. N. Hidy

150 pp. Van Nostrand Reinhold, New York, 1971. \$3.95

George N. Hidy has accomplished his objective of introducing "the basic principles of the complex but fascinating movements of the seas." This book will serve the physicist or engineer who wishes to acquire, within a few hours, a sense of what physical oceanography is about. The book scans the history, the observational techniques, the descriptive knowledge, and the dynamical understanding of ocean dynamics, especially the currents. The choice of title is rather misleading, something like "Ocean Dynamics" or "The Currents" would have been more suitable.

It is disappointing to see that the book is a bit dated, circa 1960, and that it is incorrect on several points. Editorial assistance by a member of the physical oceanographic community would have benefited the book. Also, a more complete and pertinent set of references

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should have been provided.

The author's professional background is in meteorology, and he has written *The Winds: The Origins and Behavior of Atmospheric Motion* (Momentum Book no. 19) and, with a coauthor, *The Dynamics of Aerocolloidal Systems*. From the text, there is no evidence of a personal acquaintance with the ocean. Hidy appears to have leaned heavily on his meteorological background and a rehash of material found in various oceanographic texts. He chooses to perform quite a few unnecessary manipulations of fluid-dynamical relationships, and he introduces geostrophic relations several times over in a fragmented way.

To be more specific, in outlining the trend to large research programs, the author mentions further meteorological programs such as GARP while omitting the oceanographically important IDOE (International Decade of Ocean Exploration). He dwells upon old instrumentation, such as Nansen bottles and Ekman current meters, while modern instrumentation, such as a salinity-temperature-depth profiling system, is omitted. There is nothing on the wide use of moored bouys with recording current meters and other sensors. On page 28 he mentions that no vertical velocity observations have been made, whereas published accounts of such observations have existed since 1968. On page 32, he infers that the subsurface, neutrally buoyant, Swallow floats are used with radio direction finding, whereas they are used with acoustic direction finding. He neglects to mention electromagnetic current sensors other than the GEK, giving the impression that electromagnetic techniques could only be used from ships. His definition of the density anomaly  $\sigma_t$ , on pages 38-39 is wrong. He defines it as  $\sigma_t = (\rho_{s,t,p} - 1) \times 1000$  rather than  $\sigma_t = (\rho_{s,t,0} - 1) \times 1000$ . On pages 42-45 he discusses static stability without noting the need for an adiabatic term, especially in deep water. The author states on page 81 that "motion in inertial circles is rather rare in the oceans;" but such motions have been widely reported since lengthy time series of currents have been observed in the 1960's. On page 90, he uses the term "undercurrents" when he appears to mean "countercurrents," and vice versa. Nothing is mentioned of oceanic microstructure in chapter 8, "The Fine Structure of Ocean Currents."

There are many other examples of inaccurate or careless statements. Nonetheless the casual reader will probably not be seriously misled. It is regrettable that this book could not have been more accurate and contemporary. If the style and content had been more exciting, the book could have more effectively served to attract physicists

and engineers to the rapidly advancing field of physical oceanography.

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## Flames: Their Structure, Radiation and Temperature

By A. G. Gaydon, H. G. Wolfhard  
401 pp. Barnes and Noble (Chapman and Hall), New York, 1970. \$19.00

Flames and flame phenomena constitute a major branch of combustion. The field is of practical interest, since combustion processes provide the major source of energy for industry, transportation and most other needs of society, while on the other hand unwanted fires present a major social problem. Flames are studied principally in the gas phase, but they are also important to solid-phase combustion, since the major exothermic stages in the burning of liquids and solids normally occur in gas-phase flames. Under the stimulus of interest in jet and rocket propulsion, studies in this area increased sharply in the years following World War II. As a result of world-wide scientific effort, there has been a revolution in the understanding of this phenomena. These efforts reached a peak in the 1960's, and the past few years have been a period of consolidation. Therefore, this is a desirable period for the production of a general text.

The authors, Alfred G. Gaydon and Hans G. Wolfhard, were pioneers and have remained contributors in the field of combustion during the past two decades in which combustion understanding has come to maturity.

The approach of the authors has been academic rather than practical. Therefore, areas of industrial interest, such as engine problems, industrial furnaces and burners, and pollution combustion receive little coverage. Related areas, such as flame stabilization, ignition, fire suppression and detonations also

have received minimal coverage.

The book provides a well written introduction to the study of flames. The coverage is not perfectly balanced. It is weak in recent information in the areas of flame structure and flame theory. By contrast, several specialized areas, such as acoustic interactions with flames, the formation of carbon temperature measurement and calculation and ionization receive quite detailed treatment.

The book is relatively free of errors, both typographical and technical, as befits a third edition. The only major criticism I would make is that the authors have not made as much use of the opportunity to bring the book up to date as would be desirable. This is particularly serious in the case of the chapter on flame temperature calculations, where the impression is given that these calculations are commonly made by hand. No mention is made of recent compilations of thermodynamic information, such as the JANNAF (Joint Army-Navy-NASA-Air Force) Thermochemical Tables or the availability of standard programs for such calculations (such as "Kinetics and Thermodynamics in High Temperature Gases,"—NASA Document NASA SP-239). In these days when even students have access to powerful computers, the comparison between a hand calculation of many hours and a machine calculation costing only a dollar or two makes hand computations obsolete.

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## Conceptual Physics: A New Introduction to Your Environment

By P. G. Hewitt  
558 pp. Little, Brown, Boston, 1971.  
\$9.95

My wife, who is a typical nonscientist, once took a summer course from a young astrophysicist. He told the class that it was not possible to learn any science without calculus, and that he personally could not remember when he did not know calculus. Many of my friends, although they have better memories, share his view that physics without calculus is not physics.

My own opinion is that it is possible to teach a great deal of good physics with very little mathematics. But what about physics with *no* mathematics? If you pick up Paul G. Hewitt's book, *Conceptual Physics*, and give it a cursory examination, you might conclude that he is trying to do exactly that. But this raises the question: What is mathematics? It is in fact more than algebraic equations and differentiation and