

goods. Mandel's book explains how to apply some of these same concepts to evaluate and control the measurement process. Because examples are chosen from a wide range of scientific and engineering applications, the book is not a physics text. But it is a worthwhile read and a good complement to, though not a replacement for, texts such as *Random Data: Analysis and Measurement Procedures* by Julius S. Bendat and Allan G. Piersol (Wiley, New York, 1971), *Statistics for Experimenters* by George E. P. Box, William G. Hunter and J. Stuart Hunter (Wiley, New York, 1978) and *Exploratory Data Analysis* by John W. Tukey (Addison-Wesley, Reading, Mass., 1977). (Experimenters in every branch of science should read these books or their equivalents.)

The introductory material in the first few chapters—on basic statistics, precision, accuracy and variability—is generally clear and well illustrated. I found Mandel's treatment later in the book of the structure of data in two-way designs enlightening, and his use of h and k statistics for interlaboratory comparisons was completely new to me.

The book can be read by anyone who has mastered first-semester calculus, and it is intended for a broad range of experimental scientists. My most severe complaint about the book is that it neglects some important issues, such as blocking, randomization, nonparametric statistics and modern techniques for exploratory data analysis. Thus, if this is the only book you read on this subject, there will be serious gaps in your knowledge. However, there are limits to what can be presented in 200 pages. On a four-star scale, I give this book three stars.

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Advanced General Relativity

John M. Stewart
Cambridge U. P., New York,
1991. 228 pp. \$49.50 hc
ISBN 0-521-32319-3

The title of this book is slightly misleading: Rather than a comprehensive survey of all possible advanced topics in relativity, the book's subject is the mathematics required to discuss gravitational radiation (in which John M. Stewart is a leading expert). Recent progress in techniques of gravitational wave detection is bringing us to the sensitivities

at which, by all reasonable estimates, we should be able to detect some definite signals. Hence, the theoretical tools for detailed analytical and numerical prediction are becoming increasingly important. Stewart's concise and lucid summary, the only book of its kind, is therefore very timely. In addition to topics that have been treated in other texts, one finds here well-organized, clear discussions of material not readily obtainable

elsewhere—including some from Stewart's own research.

The book is self-contained, providing a comprehensive but terse introduction to the requisite differential geometry, as well as its use in Newtonian theory and in special and general relativity. A reader new to the subject, however, would probably find this section hard to read compared with the more leisurely treatments in introductory texts. The level of pre-

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sensation is aimed at graduate students and researchers, who would find such a summary of the field useful.

Stewart describes the two-component spinor formalism associated with Ted Newman and Roger Penrose, and reviews some of its applications. This part will become required reading for my graduate students. It is both an excellent survey of the technique aimed at the practical use

of the formalism and an introduction to the more extensive treatment in the two-volume *Spinors and Space-Time* (Cambridge U. P., New York, 1984) by Penrose and Wolfgang Rindler. The appendix, which contains complete sets of equations and transformation laws, is valuable in itself.

What makes the book unique among texts—as distinct from anthologies of review articles—are the dis-

cussions of “asymptopia” and the characteristic initial-value problem. Asymptopia, the geometry of conformal infinity, provides a rigorous way of discussing the “far field” that, for example, enables one to define mass loss by gravitational waves using the asymptotic four-momentum introduced by Hermann Bondi. Stewart describes tools such as spin-weighted spherical harmonics in a unified notation, avoiding the confusions that arise in the research literature.

The characteristic initial-value problem and methods for solving it are the ultimate theme of this text. In the characteristic initial-value problem the field equations for general relativity decompose in a rather subtle way, and the author's work, together with that of Helmut Friedrich on the conformal vacuum field equations, provide the most advanced framework available for solving the problem. The last point reached in this discussion is the relation of the possible caustics of gravitational waves with Vladimir I. Arnold's classification of singularities, which is nicely illustrated in this book.

One can always find minor quibbles with any text. For example, I think a clearer link between the book's definitions of hyperbolic equations and the ones familiar to many from elementary courses would have been useful. Also, the many problems and exercises, some extremely difficult, could have been accompanied by sketch solutions or suitable references to the literature. But dwelling on such minutiae would give a misleadingly negative tone to my review. This is a fine and very useful book, which I strongly recommend to all interested in the subject.

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