novel, but perhaps a bit artificial and forced; the treatment in both parts is uneven in level and thoroughness, and specific topics could have been placed as well in either part. The book was completed in early 1969; thus current algebra is treated in only a page and a half of small print, and there is no discussion of scale invariance or related high-energy problems.

There are useful exercises with each chapter, and, in the back, a very interesting chronology of particle physics from 1911 to 1968. The layout, print, and paper of the volume are exceedingly pleasant and conducive to study.

This work has been translated from the French by G. Barton (author of *An Introduction to Advanced Field Theory* and *Dispersion Techniques in Field Theory*). Like many translations, the text exhibits a certain inelegance and stiffness in style, and contains a number of misspellings. Certain mathematical expressions, such as "rot," "sh" and "ch" are left in European form. These features may be a drawback to the avowed pedagogical aim of the book.

This book is intended as an elementary introduction to particle theory for first-year graduate students, and has little interest for advanced workers. Supplemented by more thorough treatments of the material in Part II, it forms an accessible nucleus for a first course in particle physics, and I personally am likely to use it in my own teaching in this way.

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Applications of Green's Functions in Science and Engineering

M. D. Greenberg
141 pp. Prentice-Hall,
Englewood Cliffs, N. J., 1971.
$6.95

M. D. Greenberg, a member of the department of mechanical and aerospace engineering at the University of Delaware, opens this text book with the statement: "It is often felt that the Green's function method is too sophisticated to be widely available to engineers and scientists." Rejecting this premise (in which I see at least a grain of truth, but which Greenberg evidently offers as a straw man), he goes on to develop a self-contained treatment of Green's functions that "should be suitable either for advanced undergraduates or graduate students ... with only a modest background ... in ordinary and partial differential equations." I surmise, although the author does not explicitly state, that the book is intended either for a short course devoted primarily to Green's functions or as collateral reading for a longer course on methods of mathematical physics. It is significantly below the level of Arnold Sommerfeld's classic *Partial Differential Equations in Physics* (Academic, 1949) and, at least in its choice of examples, appears to be directed rather more to engineers than to physicists.

Part I is devoted to ordinary differential equations and develops such basic concepts as the adjoint operator and the delta function. The latter is introduced in the usual, heuristic manner, starting from the concept of a concentrated load, after which there is a brief discussion of generalized functions and limit sequences. The development of one-dimensional Green's functions is restricted to quite simple examples, but the author states that, even though he may appear to be "cracking peanuts with a sledgehammer, ... an understanding of these examples will leave the reader in a position to deal with more complicated applications." In fact, the treatment is so elementary that I was unable to find such an important result as the general construction of $G(x, \xi)$ for a second-order differential equation in terms of a given pair of linearly independent solutions of that equation; nor could I find the statement that the discontinuity in dG/dx at $x = \xi$ is equal to $1/p(x)$, where p is defined by the self-adjoint form of the differential equation, $(py')' + \ldots$.

Part I closes with a brief discussion of the eigenfunction method and Sturm–Liouville theory. This discussion serves to illustrate some of the difficulties that may arise when a particular problem admits an eigensolution; it also serves to suggest that a more thorough grounding in eigenfunction theory is a necessary condition for a proper understanding of the Green's-function technique (see above).

Part II is devoted to partial differential equations. It begins with the formal classification of a linear, second-order equation through the sign of its discriminant, but without any reference to characteristics (which are not mentioned even in connection with D'Alembert's solution of the wave equation or in the discussion of domains of influence and dependence). Green's functions for the Laplace, Helmholtz, and diffusion equations in two dimensions and the wave equation in one dimension are developed in some detail, after which additional examples are treated more briefly. The relation between the eigenfunction and Green's-function methods is illustrated by solving Poisson's equation for a rectangle.

On the whole, this book is clear and

well written, and I found only one important slip: the velocity potential for the subsonic flow past the flat-plate airfoil depicted on page 53 is *not* "an analytic function of x and y throughout the flow" (it is singular at both the leading and trailing edges and discontinuous across the wake extending downstream from the trailing edge). The exercises are ample in number and are closely coordinated with the exposition. I conclude that anyone intending to give an elementary course on Green's functions would do well to consider Greenberg's book; however, I am far from convinced that such a course is appropriate.

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Electronic and Ionic Impact Phenomena Vol. III: Slow Collisions of Heavy Particles

H. S. W. Massey, E. H. S. Burhop and H. B. Gilbody
819 pp. Oxford U. P., Oxford, 1971.

The high-power gas dynamic laser developed by AVCO was publicly described in the spring of 1971. This technological achievement marked a threshold where laser development ceased to be a trial-and-error practice and became a branch of engineering, in which design can be based at every step on a thorough knowledge of the collision cross sections and radiative processes involved. A construction of this magnitude could only be justified if its performance could be reliably predicted, but the reactions were too complex for any simple scaling. Consequently, all the relevant cross sections had to be known and used. It is a testimony to the accuracy and completeness of the body of knowledge available on the carbon-dioxide system that actual performance was within a factor or two of design predictions.

Lasers do not appear in Volume III of Sir Harrie Massey, Eric Burhop and Brian Gilbody's *Electronic and Ionic Impact Phenomena* except as a tool for exciting specific states in measuring cross sections. Indeed, the numerous applications of collision physics in technology or in other sciences such as aeronomy are not the subject of this book. This impressive volume of a monumental work does, however, provide a rich and authoritative description of the state of atomic-collision science at the beginning of the 1970's and will provide anyone who glances at it with reason to believe that this science is now capable of supplying in manageable form much of the information that practical men like the physicists and engineers at AVCO may need.

Massey has been publishing authoritative textbooks on atomic collisions, both theoretical and experimental, since 1933, and the present volume (the third of four) is part of the almost five-fold expansion of Massey and Burhop's book by the same title published in 1952. The new edition, like its predecessor, is a rich storehouse of information on a great variety of collision processes. In it information can be found on the most important experimental techniques and on the most important theoretical principles applicable to the understanding and prediction of various cross sections. The primary focus of the work is experimental, and a more detailed view of theory and calculational techniques is left to be found in other places, notably in Mott and Massey's *Theory of Atomic Collisions*, which has been a bible of the field since 1933.

The new edition of this work continues to follow the successful pattern of its predecessor, providing a well-balanced mixture including straightforward descriptions of the essential features of various experimental techniques, a very large (but not encyclopedic) presentation of information obtained from these measurements, and frequent descriptions of the appropriate theory and interpretation. This volume on heavy-particle collisions at low energies (mostly near thermal) is largely self-contained, and those who wish to can use it as such, although it occasionally refers back to volumes I and II (devoted to electron collisions with atoms and molecules) for descriptions of an experimental technique or a theroretical principle. Volume IV will be devoted to collisions of heavy particles at higher energies. Unlike the situation twenty years ago, when electron collisions dominated the first edition, Volume III is much fatter than volume I or II, and volume IV should follow its example. This reflects the great and rapid growth in the understanding of heavy-particle collisions that the last few years have brought; the effort that has been devoted so fruitfully to their measurement and understanding has been largely motivated and funded because of their technological importance in many fields.

During World War II, when Massey worked for the British Admiralty, eventually as Chief Scientist in the Mine Design Department, and before he went to Berkeley to work on other explosives, it is said that he and his long-time associate, David Bates, used their long commuting journeys to study, for recreation, a subject that