Books

Methods of Theoretical Physics. Parts I & II. By Philip M. Morse and Herman Feshbach. 1978 pp. McGraw-Hill Book Company, Inc., New York, 1953. ($15.00 each) $30.00. *Reviewed by E. U. Condon, Corning Glass Works.*

This is a monumentally thorough exposition of the wide variety of interrelated mathematical methods and special results of their use which are used throughout theoretical physics for problems in quantum mechanics, classical wave motion and diffusion, electromagnetic theory and other branches of field theory. It provides a careful working out of many special problems in applied physics with careful emphasis on the mathematical relatedness of problems arising in widely different parts of physics. It also provides an abundance of valuable reference material concerning the specific properties of the many specialized kinds of functions arising in this kind of work.

A tremendous amount of work has gone into the preparation of this book. The end result is one which will need to be in every physics library and which can be used to great advantage by anyone needing to find explicit solutions to problems of this kind.

The level of mathematical rigor used might be described as intermediate. The authors are much more careful about indicating the range of validity of the various limiting processes which they use than is usual in books written by physicists, while being much less meticulous about exact detail than would be necessary to satisfy mathematicians. Probably no style could be adopted which would satisfy everybody on this point. A good, happy compromise has been attained.

The emphasis on mathematical relatedness of different fields of physics produces a wide departure from historical order. Since the emphasis is placed on mathematical methods, the introduction of specific principles and concepts from various parts of physics is done with extreme brevity.

Perhaps the scope can best be indicated by running briefly over the twelve chapters. Chapter 1 gives the usual material about scalar and vector fields, defining the vector operators, presenting Gauss's and Stokes' Theorems, and introducing curvilinear coordinates. Unusual is a closely related development of the same material in tensor formalism, including early introduction of the covariant derivative and of Christoffel symbols. There is a careful treatment of dyadics in the Gibbs notation together with its relation to tensor notation, the ideas of the Lorentz space-time transformation, the properties of spinors, and the main ideas of the abstract vector space of quantum mechanics.

Chapter 2 is a wide-ranging presentation of the physical ideas underlying the field equations. Starting with the vibrating string it covers general elastic waves, fluid flow, diffusion, the electromagnetic field and quantum mechanics. Unusual here is the brief discussion of supersonic flow and shock waves, inclusion of both kinds of viscous loss in fluid flow, discussion of diffusion of light in turbid media, and inclusion of diffusion of particles which show age in order to provide an early introduction to fission chain reaction theory.

Chapter 3 gives a well-integrated presentation of the relation of all these field problems to the variational principles from which their field equations can be derived. This starts with an outline of particle dynamics. Noteworthy in this and the preceding chapter is the pedagogically clear discussion of problems associated with gauge transformations of the electromagnetic potentials.

Chapter 4 devotes fifty pages to standard function theory of a complex variable. This is a little puzzling for I would suppose that most students will have learned this material in mathematics courses before they undertake the study of a book like this. However, it is useful to have the material for handy reference.

Chapter 5 deals with ordinary linear differential equations. Here the emphasis is on those which arise by separation of coordinates in two- and three-dimensional field problems. There is an unusually thorough presentation of all the systems of curvilinear coordinates in which variables are separable for Poisson's equation and for the wave equation. Linear equations and the behavior of their solutions at singular points is fully illustrated with the theory of the hypergeometric function and the Mathieu functions. Noteworthy here is a thorough discussion of integral representations and a careful account of Stokes' phenomenon.

Chapter 6 introduces the theory of solutions determined by boundary conditions, sets of orthogonal functions and expansions in terms of them. Noteworthy is a full discussion of various types of partial difference equations and the relation of their boundary value problems to that of partial differential equations. The presentation is closely tied back to the introduction of the ideas of transformation theory of quantum mechanics as first formulated in Chapter 2.

Chapter 7 is a splendid account for physicists of the range and power and beauty of Green's function methods, including the application of this method in quantum mechanics. Chapter 8 is a clear account of the formulation of the same kinds of problems by means of integral equations, ways of solving them, and the relation of this to other methods. Thus ends volume 1.

Volume 2 consists of five chapters. Chapter 9 is a gold mine of unusual information about various forms of perturbation theory for approximate solution of boundary value problems. Chapter 10 is concerned with more familiar material on use of various methods for solving the boundary value problems of electrostatics.

There is much that is not found in other textbooks.

Chapters 11 and 12 are entitled The Wave Equation and Diffusion, Wave Mechanics, respectively. These include a good collection of interesting and useful special examples of the use of methods developed in the earlier chapters, including an unusual amount of attention to scattering problems. Chapter 13 is devoted to vector fields and is an excellent presentation of the special boundary value problems for vector fields, such as those particularly arising in electromagnetic theory, which are not derivable from a scalar potential.

The book is immensely valuable both as a textbook and as a reference collection concerning methods and special results. The authors have gone to considerable trouble to take the reader into their confidence, explaining as they go along the ideas back of every step they take. My one criticism of the book is that this leads them sometimes to be a little more wordy than necessary. In the preface they say that they make only the most sparing use of the irritating "it can be shown" device for elision of details, but is it any less irritating to be told this in these words (page 749): "By juggling these three equations around or else by further shuffling of the generating function, we can obtain. . . ."? The truth is, no matter how purely the pure mathematicians work, this quote does carry the flavor of the way in which most applied mathematical physics is done, so why not be honest about it?

Thomas Young, Natural Philosopher (1773–1829), a biography by the late Alexander Wood, completed by Frank Oldham. 353 pp. Cambridge University Press, 1954. $6.00. *Reviewed by Richard M. Sutton, Haverford College.*

The late Alexander Wood, Fellow of Emmanuel College and well known for his work in sound, spent forty years gathering materials on Thomas Young. At the time of his death in 1950, he had written ten of the fifteen chapters of this book and had outlined two more. It is fortunate that another admirer of Young, Frank Oldham, who had written a life of Young in 1933, was available to complete the work and give to the world this new estimate of an early nineteenth century genius. Their biography, together with that of George Peacock (1855), will doubtless remain the most definitive works covering the fantastically versatile Thomas Young who rightfully deserves a continuing place in the history of science and letters.

Thomas Young's precocity in reading, his early mastery of languages, and his speedy acquisition of various other skills have become legendary. At the age of thirteen, he knew English, Greek, Latin, French, Italian and Hebrew. His upbringing in a Quaker family and his schooling under a special tutor with his lifelong friend, Hudson Gurney, gave him respect for sound workmanship and for the value of time. He demonstrated an early interest in natural philosophy and medicine, and, at the age of 21, he was admitted as a Fellow of the Royal Society for his work on the power of accommodation of the eye. He ranks with Helmholtz as one of the great figures in that borderline field of physics and physiology, having first enunciated a theory of color vision which Helmholtz later revived (1873) and which now holds an eminent place as the Young-Helmholtz theory. Of this theory, James Clerk-Maxwell, himself a great student of color, once said, "So far as I know, Thomas Young was the first who, starting from the well-known fact that there are three primary colors, sought for an explanation of this fact, not in the nature of light, but in the constitution of man."

A few years ago, your reviewer browsed through Peacock's *Life of Thomas Young* and there was brought again to the connection of Young with the Rosetta Stone, a connection commemorated on the tablet inscribed to Young in Westminster Abbey near the tomb of Newton. The present authors go into that matter carefully and try to draw fair lines of the recognition due to Young and to his rival, Champollion, the French Egyptologist, who went farther than Young did, but whose initial progress was evidently made on the shoulders of Young's inquiries into the mysteries of the Egyptian hieroglyphics. No one, prior to Young, had ever read a single word of the hieroglyphics; and his work on the three-fold text in Greek, Coptic and hieroglyphics, his recognition of the possible phonetic value of the hieroglyphs as well as their ideological value, was the starting point in the highly successful unravelling of the great stone from Rashid.

Young was a medical man, having completed the work for his M.D. from Cambridge in 1799, after prior extensive studies in London, Edinburgh and Göttingen. One of the delights of this book is the insight it gives into the training of a young doctor in the late eighteenth century. As no dissenter could then study at Cambridge (or Oxford), Young joined the Church of England and threw aside some of the restrictive observances of his youth among Quakers, while retaining the more important attitudes and elements of character that were early impressed upon him. But as a doctor, Young was far from an outstanding success. Although for eighteen years he was on the staff of one of London's leading hospitals, he seems not to have made any significant mark as a doctor. There can be no question of his knowledge and skill; but he seems to have lacked those personal qualities in relation to his patients which make the good physician. He was "gentle and gentlemanly, but not genial." For many years, he covered up his scientific publications with pseudonyms and a cloak of anonymity, but one senses that his heart was not in medicine so much as in natural philosophy. However, his contributions relating to the eye, its accommodation, astigmatism, and color vision are of lasting value.

In natural philosophy, Young will be remembered as one of the handful of distinguished men who added lustre to the Royal Institution in its early years, soon after it was founded in 1800 by Count Rumford. During his two years of association with it (1801–1803), he gave a series of lectures on natural philosophy which he later whipped into a two-volume book on the sub-