will find some very interesting examples of wave acoustics, which should relate to various nonmilitary problems. A careful study of the numerous graphs and clear explanations, which Eckart and his associates have provided, will impress the reader with the excellence of the book and will also suggest many areas where additional precise and detailed data should be found. Research in these areas has continued actively since the end of World War II, and I hope that other similar books will be forthcoming. Nevertheless, this book is most welcome and may be the only authoritative one available for many years. It can be highly recommended to all those interested in underwater sound or wave acoustics in general.

ROBERT S. SHANKLAND
Ambrose Swasey Professor of Physics
Case Western Reserve University

Basic Equations and Special Functions of Mathematical Physics

By V. Ya. Arsenin
361 pp. American Elsevier, New York, 1969. $13.50

Although he wrote for physicists, V. Ya. Arsenin maintains a reasonably high level of mathematical precision in this book based on his lectures at Moscow University. It is a concise and up-to-date introduction to the mathematical methods and the special functions that a physicist will encounter in partial-differential equations.

After displaying a few examples of second-order partial-differential equations in physics, Arsenin devotes the first part of the book to the basic methods for solving the typical equations. The criterion for primary classification is the method (characteristics, separation of variables, Green's functions, potentials, integral equations) rather than the type of equation (elliptical, parabolic, hyperbolic) that is more usual in textbooks. (Of course, the classification according to the type of equation is maintained in the second order.) This approach appears to render good results from the pedagogical point of view, but the success is largely due to the remarkable clarity of the exposition and the excellent quality of the translation.

The second part deals with the properties of special functions involved in solving partial-differential equations in physics: gamma function, cylindrical functions, spherical harmonics and Chebyshev–Hermite and Chebyshev–Laguerre polynomials. An appendix discusses the definition of generalized functions and the delta function, which is freely used in the book. Although it is also clearly and neatly written, the second part does not appear to provide as remarkable an account of its subject as the first. However, this impression may be a matter of personal taste regarding the selection of topics. A noteworthy feature of the book is the large number of problems (150), all of which have full answers.

JACQUES E. ROMAIN
La Thébaïde, Faux,
Court-St-Etienne
Brabant, Belgium

Principles of Quantum Electronics

By William S. C. Chang
540 pp. Addison-Wesley, Reading, Mass., 1969. $17.50

Even more than the invention of the transistor, the advent of masers and lasers has helped establish quantum mechanics in the electrical-engineering curriculum. The term "quantum electronics" has become popular to describe the applications of masers and lasers, nonlinear optics and the resulting new electroöptical devices. It is good to keep in mind that the so called "classical" electronics curriculum included such topics as the photoelectric effect, luminescence and contact rectifiers. The distinction between the new "quantum" and the old "classical" electronics is based more on the greater, current emphasis on discrete energy levels rather than on the properties of quasicontinuous-energy bands.

The title of this book conforms to present fashion and market trends, but a more informative title would have been *Intermediate Quantum Mechanics, Group Theory and Statistical Mechanics with an Application to Lasers.* The book is based on a graduate course for electrical engineers that William Chang developed at Ohio State University. He is now professor and chairman of the electrical-engineering department at Washington University, St. Louis.

His first six chapters are on quantum mechanics, energy levels of atoms and molecules, crystal symmetry and group theory, energy levels of transition-metal ion in crystals, interaction of radiation and matter and quantum-statistical density matrix. These are followed by two chapters on lasers and then twelve appendixes, including one that contains 60 pages of laser bibliography updated to about the beginning of 1967.

The strong point of the book is the condensed, and yet fairly rigorous, exposition of the quantum-mechanical calculation of energy levels of free atoms and ions in crystals, which is accompanied by numerous tables and diagrams. The tables include Clebsch–Gordan coefficients, characters of irreducible representations of point groups, laser wave lengths and operating characteristics of solid-state, semiconductor, atomic, molecular and ionic lasers.

The question is whether a beginning student can really learn quantum theory, group theory and statistical mechanics from such a condensed exposé. If he has taken separate courses in these subjects, the first six chapters may be useful as a refresher and as a reference for standard theorems and equations. He can then turn directly to the last two chapters on lasers. These chapters could, of course, be understood without the preceding detailed knowledge of wave functions, energy levels and crystal-field splittings.

The organization of these two chapters is somewhat rambling. Eigenmodes of the electromagnetic field are discussed at the end of the chapter on basic laser theory instead of before it. Although the amplification of a pulsed signal is treated in the general laser chapter, the pulsed operation of a Q-switched oscillator is postponed to the special section on solid-state lasers. Although the spontaneous-emission probability into a single mode, and into a frequency band df and solid angle $d\Omega$, is carefully distinguished in the chapter on interaction of radiation and matter, this question is confused in discussion of the noise power of a diffraction-limited amplifier. At the end of this section the reader is led to believe that this noise is proportional to f^3. The concept of coherence remains vague in contrast to the mathematical development of other concepts.

The compilation of the large amount of laser material would have been more valuable if it had been better integrated with previously developed theories. Nonlinear coupling of