citation spectra of atomic nuclei. This speculation has led to a new theory of nuclear structure, which is rich in physical content. Although this theory is based on the familiar shell model, it uses field theoretic methods new to nuclear structure and has developed a terminology all its own. Unfortunately, this has made the field difficult to study.

Now at last we have a treatment of the subject which should make it far more accessible to students. In this book Lane presupposes a knowledge of nuclear shell structure and some familiarity with field theory. With these tools the role of the pairing forces in producing an energy gap, and the subsequent effect on collective motions, is thoroughly investigated.

The text is presented in two parts, with separate bibliographies for each. The first part is devoted to explaining how the pairing force comes about, and then to comparing the results with the experimental features of nuclei. The second part develops the theory of the collective motion, with strong emphasis on the random phase approximation. Very little is said about the effect of long range (P_2) forces, and no time is devoted to Elliott's work on SU_3. The bibliography is excellent, and a few of the most significant papers are reprinted at the end of the book.

The book was prepared as a series of lectures delivered at Harwell in 1962. Like most volumes of lecture notes, it contains quite a few misprints. But these should merely tend to sharpen the attention of the careful reader, for they are not serious. Theoretical students and lecturers will find this book of great value. Experimentalists will probably want to skip a large number of theoretical sections that make frequent use of such sophisticated mathematical tools as Wick's theorem.

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Analytical Chemistry

Ionic Equilibrium. A mathematical approach. James Newton Butler. Addison-Wesley, Reading, Mass., 1964. xii + 547 pp. Illus. $8.75.

This is an amazingly good book. Butler has written clearly and brilliantly about a difficult subject, and it is obvious that he has thoroughly enjoyed doing so. The reader cannot help sharing his enthusiasm.

Right from the beginning the author declares his intention of unmasking the "hidden assumptions" common in analytical textbooks. He discusses complex equilibria and nonideality of electrolytes briefly in the first two chapters and in more detail later on. He presents the calculation of ionic equilibrium as an exercise in the art of mathematical approximation, and this theme runs through the book. First, of course, he states explicitly the conditions of mass balance, charge balance (or, as an alternative, the "proton condition"), and the free energy balances for the several equilibria and shows how exact equations for the hydrogen-ion concentration (and for other significant concentrations) can be derived. He then attacks the problem of solving high-order polynomials and explains Newton's approximation method as well as graphical and other methods. The most valuable method of all—"chemical intuition" followed by back-checking—is given the prominence that it deserves.

In chapter 5, on weak monoprotic acids and bases, there is a particularly good explanation of how approximations are made in practice. A logarithmic *p*H-concentration diagram illustrates the various approximations used to calculate the *p*H of a solution of a weak acid, and those concerned with *p*H-titration curves are carefully explained.

Logarithmic diagrams and semilogarithmic distribution curves are used to advantage throughout the book, and the discussion covers many different types of systems, including polyprotic acids, precipitation, complex-ion, and oxidation-reduction systems. The steepness of acid-base titration curves or "buffer index" is discussed in detail, and in this discussion the carping critic might recognize one trifling error—the equivalence point in titrating a weak acid with a strong base does *not* quite coincide with the point of maximum slope of the *p*H-titration curve, though the difference is negligibly small.

The author mentions many topics—among them the study of fast reactions by Max Eigen, Harned and Owen's measurements of ionization constants, Bates' study of *p*H scales, and Sillén's work on hydrolysis of metal ions. To some he gives more space than to others, but he always gives references; a distinctive feature of this book is the sentence or two of comment that accompanies every single reference cited—and there are many references. There are also many numerical problems, most of them having real practical interest.

The University of British Columbia lost an outstanding teacher when Butler decided to go into industry.

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Mathematics

Topics in Mathematics. 15 booklets: *Algorithms and Automatic Computing Machines* (112 pp.), B. A. Trakhtenbrot; *Areas and Logarithms* (56 pp.), A. I. Markushevich; *Computation of Areas of Oriented Figures* (64 pp.), A. M. Lopshits; *Configuration Theorems* (48 pp.), B. I. Argunov and L. A. Skornyakov; *Equivalent and Equidecomposable Figures* (80 pp.), V. G. Boltyanskii; *The Fibonacci Numbers* (56 pp.), N. N. Vorobyov; *How to Construct Graphs*, G. E. Shilov, and *Simplest Maxima and Minima Problems* (64 pp.), I. P. Natanson; *Hyperbolic Functions* (63 pp.), V. G. Shervatov; *Induction in Geometry* (112 pp.), L. I. Golovina and I. M. Yaglom; *An Introduction to the Theory of Games* (72 pp.), E. S. Venttsel'; *The Method of Mathematical Induction* (56 pp.), I. S. Sominskii; *Mistakes in Geometric Proofs* (64 pp.), Ya. S. Dubnov; *Proof in Geometry* (64 pp.), A. I. Fetisov; *Summation of Infinitely Small Quantities* (72 pp.), I. P. Natanson; *What Is Linear Programming?* (96 pp.), A. S. Barsov. Alfred L. Putnam and Izaak Wirszup, Eds. Published for Survey of Recent East European Mathematical Literature by Heath, Boston, 1963. $1.40 each.

These booklets were translated from the "Popular Lectures in Mathematics," a series of lectures delivered by well-known Russian mathematicians to groups of secondary school students in Leningrad, Moscow, and other Russian cities. The purposes of the booklets, which vary in size from about 50 to 120 pages, are ". . . to introduce the reader to various aspects of mathematical thought and to engage him in