detail in its treatment of the subject matter, but rather that some degree of attention should be paid to various practical applications of the subject matter. Such applications will tend to stimulate the student and better orient him with respect to the role of mathematics in modern science. This remark holds particularly for Boolean Algebra, where the eventual application will more likely than not be the basis for the reader's interest in the subject.

ROBERT S. LEDLEY

National Biomedical Research Foundation
8600 Sixteenth Street
Silver Spring, Maryland

44[G, S].—BENJAMIN E. CHI, *A Table of Clebsch-Gordan Coefficients*, Rensselaer Polytechnic Institute, New York, 1962, xi + 335 p., 27.5 cm. Price $3.00.

We have recently had a flurry of interest in the tabulation of values of the Clebsch-Gordan coefficients for ever higher numerical values of the angular-momentum parameters. These coefficients are the quantum-mechanical vector-coupling coefficients denoted by Condon and Shortley [1] as $(j_1j_2m_1m_2 \mid j_1j_2jm)$, with j_1, j_2, j restricted to nonnegative integers or half-integers satisfying the "triangle" conditions, with m_1 ranging from j_1 to $-j_1$ in integral intervals, m_2 similarly from j_2 to $-j_2$, and with $m = m_1 + m_2$.

Three tabulations, of different types, have recently been reviewed in this journal [2, 3, 4]. The present volume contains, in its introduction, a useful bibliography of all the tables that have been computed. These tables are of three types:

(a) Algebraic tables: if j_2, m_2, and $j - j_1$ are given fixed numerical values, the coefficient can be written as a relatively simple algebraic function of j_1 and m.

(b) Numerical tables in which the coefficients are expressed as square roots of rational numbers.

(c) Numerical tables in which the coefficients are expressed as decimal numbers.

The present table is of the third type and extends the available decimal tables to all values of j_1 and j from 0 to 10 in steps of $\frac{1}{2}$, but only for $j_2 = 1$ to 6 in steps of 1. The coefficients are given to 7 decimal places. No apology is given for the restriction of j_2 to *integral* values.

GEORGE SHORTLEY

Booz, Allen Applied Research Inc.
Bethesda, Maryland, 20014

1. E. U. CONDON & G. H. SHORTLEY, *The Theory of Atomic Spectra*, Cambridge University Press, New York, 1935.

2. B. J. SEARS & M. G. RADTKE, *Algebraic Tables of Clebsch-Gordan Coefficients*, Report AECL No. 746, Atomic Energy of Canada Limited, Chalk River, Ontario, 1954. See *Math. Comp.* v. 13, 1959, p. 318, RMT **51**.

3. M. ROTENBERG, R. BIVINS, N. METROPOLIS & J. K. WOOTEN, JR., *The 3-j and 6-j Symbols*, Technology Press, Cambridge, 1960. See *Math. Comp.* v. 14, 1960, p. 382–383, RMT **71**.

4. TARO SHIMPUKU, "General Theory and Numerical Tables of Clebsch-Gordan Coefficients," *Progr. Theoret. Phys.*, Kyoto, Japan, Supplement No. 13, 1960, p. 1–135. See *Math. Comp.* v. 16, 1962, p. 114–115, RMT **3**.

45[G, X].—T. L. SAATY, Editor, *Lectures on Modern Mathematics, Volume I*, John Wiley & Sons, Inc., New York, 1963, ix + 175 p., 22 cm. Price $5.75.

From the editor's preface: "The six expository lectures appearing in this volume are the first in a series of eighteen lectures being given at George Washington University, jointly sponsored by the University and the Office of Naval Research. Two subsequent volumes will contain the remaining lectures. Our intention was to invite each of the eminent men represented here to delineate a substantial research area, to describe it broadly and comprehensively for an audience of mathematicians who are not specialists in that area, and to contribute to this description his individual evaluation of the esthetic and practical aspects of the field, its position in mathematical development as a whole, and its future, as that might be implied in the conjectural exposition of its unsolved problems."

The six chapters are:

"A Glimpse into Hilbert Space," by P. R. Halmos

"Some Applications of the Theory of Distributions," by Laurent Schwartz

"Numerical Analysis," by A. S. Householder

"Algebraic Topology," by Samuel Eilenberg

"Lie Algebras," by Irving Kaplansky

"Representations of Finite Groups," by Richard Brauer.

The lectures are at an advanced level and would not be of much benefit to undergraduates or the general scientific public, but for trained mathematicians and graduate students of mathematicians, the present volume, together with the two to appear, must be regarded as a valuable and stimulating collection of introductions.

Halmos and Brauer emphasize unsolved problems. Halmos, in his usual lively style, listed ten, mostly concerning algebraic aspects of a single bounded operator. Three of these ten problems have already been solved, and one is not sure whether congratulations or condolences are due the author. Brauer's chapter is more extensive; he lists 43 problems, and he adds much supplementary comment plus an appendix of definitions.

Eilenberg, Kaplansky, and Schwartz emphasize known results. Eilenberg starts with a concrete problem (vector fields on a sphere) but spends most of his time developing the definitions of concepts. Kaplansky has more of a survey of results, including five connections between Lie Algebras and several types of groups, and a classification of simple algebras. Schwartz (a brilliant lecturer) has less ground to cover, and after a survey of fundamentals gives applications to the fundamental solutions of partial differential equations, and to the "problem of division," due, primarily, to Hörmander and Łojasiewicz respectively. Schwartz makes the interesting remark: "It appears more and more that some of the greatest mathematical difficulties in theoretical physics, for instance, in quantum field theory, proceed precisely from this impossibility of multiplication [of distributions]."

Householder states that numerical analysis, as a recognized discipline, originated in three events during 1947. He indicates that the two problems which concern the numerical analyst, namely, truncation error and roundoff error, require quite different techniques. The latter problem is due to the differences between real-number arithmetic and the much more difficult pseudo-arithmetic using finite precision. These latter, "dirty," problems are discussed first, starting with the von Neumann-Goldstine paper on matrix inversion (one of the three events), and continuing with work of Turing, Gastinel, Bauer, Givens, and especially Wilkinson. Turning to the "clean" problems—the development of techniques—he indicates that many of these may be discussed on the basis of several organizing principles:

the concept of a norm, an effective notation for particular types of matrices, and the so-called König ratio and its generalizations. The emphasis throughout is on matrix problems, and presumably much of this material will be developed in greater detail in his forthcoming book on matrices.

D. S.

46[K].—A. E. Sarhan & B. G. Greenberg, editors, *Contributions to Order Statistics*, John Wiley & Sons, Inc., New York, 1962, xxv + 482 p., 24 cm. Price $11.25.

If the random observations X_1, X_2, $\cdots$ x_n of a sample drawn from a continuous population are arranged in ascending order of magnitude, $X_{(1)} \leqq X_{(2)} \leqq \cdots \leqq X_{(n)}$, then we have the order statistics of the sample and $X_{(i)}$ is called the ith order statistic. Order statistics are inherently much more informative than the ordinary random sample alone, and therefore have considerable practical value. It is probably for this reason that within the last fifteen years there has occurred a rather large-scale attack on the theory of order statistics.

Interest in order statistics runs high. For example, are the least or greatest values, or both, "outliers" which perhaps should be discarded? What are the distribution properties of the order statistics and how efficient are the order statistics (in particular, various linear combinations of them) in estimating population parameters? The great, practical point regarding order statistics is that computations involved in their use are rather minimal compared to that for the "most efficient" statistics, while the loss in efficiency is not very significant.

The present volume brings together the more pertient theoretical background, applications, and tables required to use order statistics. Indeed, it provides a very worthwhile manual, which is sorely needed at the present state of progress in this area of Mathematical Statistics. As examples of topics covered, we mention in particular the exact and approximate distributions and moments of order statistics from normal, exponential and gamma populations, the range $X_{(n)} - X_{(1)}$, best linear estimates of population parameters, theory and applications of extreme values, tests for suspected outlying observations, the maximum variance ratio for several independent samples, multiple-decision and multiple-comparison techniques for ranking treatment means, optimum grouping and spacing of observations, short-cut tests, and tolerance regions. From this list alone, we get a general idea concerning the over-all value of the book as a welcome addition to the statistical library. The editors of the book are to be congratulated for a job well done.

Frank E. Grubbs

Ballistic Research Laboratories
Aberdeen, Maryland

47[K, X].—Edward O. Thorp, *Beat the Dealer: A Winning Strategy for the Game of Twenty-One*, Random House, New York, 1962, xiii + 236 p., 21 cm. Price $4.95.

Although volumes have been written about blackjack, the first mathematical attempt to obtain an optimal strategy was made in 1956 by Baldwin, Cantey, Maisch, and McDermott. To simplify the computations, they assumed that all