linear algebra, iteration, and collation. This is admitted to be limited treatment in a relatively new field. However, there is a considerable amount of the theory on integral equations in this chapter including the derivation of integral equations, which again seems out of place in a book on numerical analysis, especially as the advantage or otherwise of obtaining integral equations is not discussed.

Of the five appendices, two contain tabular material, namely Lagrangian coefficients for numerical differentiation, and abscissæ and weights for Gaussian and other quadratic formulæ. The other three are devoted to Tchebysheff interpolation, operator methods, and algebraic equations, the first being by far the most important. D. C. GILLES

CULBERTSON, J. T., *Mathematics and Logic for Digital Devices* (D. van Nostrand Co., Ltd., London, 1958), 217 pp., 36s.

The main criterion of this book is that one is unsure to whom it is directed. The publishers and author describe it in terms of " a study of the special kind of mathematical reasoning essential to the use of computers ". Taking these words at their face value, they express a statement which, to the reviewer, is decidedly fallacious. The field covered by this book is not essential to *users* of computers ; it may, however, be of interest to those engaged in the design and construction of computers and the related biological field.

The book gives in fact an elementary account of certain branches of mathematics, namely permutations and combinations, probability, traditional logic, and Boolean algebra, together with two chapters on topics applicable to computers, number systems and switching circuits. This is preceded by an introductory chapter giving a résumé of ideas that are considered known—notably the definition and examples of algorithms, and an explanation of the notation for finite sums and products—and introducing the conception of a " neuron ".

The mathematical topics are treated with a slight bias towards computers ; for example, the chapter on probability includes a discussion of nerve nets composed of neurons. On the whole, however, the material can be found in any textbook within the field, and the treatment is in no cases more than elementary—witness the inclusion of a chapter on permutations and combinations.

Of the other chapters, that on numerical systems considers numbers of any radix. Arithmetical operations with such numbers are explained, and nerve nets for certain operations (including addition and subtraction) of binary numbers are included. These nets always consider parallel operation with consequently greater complexity in structure, but this is not mentioned.

The chapter on switching circuits is concerned mainly with the representation of circuits by Boolean algebra. The use of this method in the simplification of circuits is discussed, and the construction of some circuits satisfying given closure conditions described.

On the whole little is covered by this work that is not available elsewhere. Its one advantage seems to be that an account of certain fields of mathematics relevant to the design of computers occurs within one book. D. C. GILLES

ROY, S. N., *Some Aspects of Multivariate Analysis* (John Wiley & Sons), 214 pp., £3, 4s.

In contrast to Professor T. W. Anderson's recent book on multivariate analysis, this book by Professor Roy is not a textbook of standard multivariate theory. It is concerned with certain fairly recent developments in this field, due mainly to the author. These developments spring from the notion of simultaneous

confidence interval estimation of collections of functions of unknown parameters, an idea which, though not new in itself, is tied up with a new general test procedure called by the author his Type I test. While most " classical " multivariate theory is based on the likelihood ratio test, all statistical procedures in this book are based on this Type I test. In many univariate situations these two tests are the same. But as this is not always true in multivariate theory, the books by Professors Anderson and Roy do not cover the same ground.

In the opening chapters of his book, Professor Roy gives a general account of the Type I test and then considers its application to certain problems of multivariate normal theory, such as testing equality of mean vectors and of variance matrices. These applications involve the distributions of the latent roots of various random matrices and the book continues with the solution of distribution problems of this nature, under the appropriate null hypotheses. The powers of the critical regions of various Type I tests are then shown to depend on the latent roots of certain population matrices and lower bounds on the power functions of the tests are given in terms of these roots.

Thereafter the author deals with what he says is his primary object—the establishment of simultaneous confidence intervals for certain specific collections of parametric functions. These confidence intervals bear the same sort of relationship to the Type I tests discussed in the earlier part of the book as, for example, a confidence interval for an unknown mean bears to the t-test. They are obtained simply by " inversion " of the appropriate Type I test which is designed with this in mind.

A final chapter is concerned with " the statistical analysis of data in the form of observed frequencies in discrete (and finite) categories ", and there are nine appendices containing various results on matrices, transformations and integration used in the course of the book.

This book will be of interest mainly to research workers in statistical theory, as it is more in the nature of a progress report than a conclusive survey of the field. Those interested will no doubt already be acquainted with two papers * of 1953 which form the basis of the book. Professor Roy promises an extended edition or a sequel on further developments. S. D. SILVEY

ANDERSON, T. W., *Introduction to Multivariate Statistical Analysis* (John Wiley & Sons), 374 pp., £5.

This book is concerned with those statistical techniques in common use which are based on the assumption of underlying multivariate normal distributions. Professor Anderson classifies them into five categories and in the main part of the book he discusses methods in three of these, (i) correlation methods, (ii) analogues of univariate methods and (iii) methods involving suitable choice of coordinate system.

The theory of ordinary, partial and multiple correlation is covered under the first heading. Univariate methods whose analogues are discussed are these in everyday use which involve maximum likelihood estimates of means and variances, such as the t-test and analysis of variance. This second category includes quite a wide range of problems and involves, in particular, a full account of the generalised T^2-statistic and the Wishart distribution. Two main topics are discussed under the third heading, namely principal components and canonical correlations.

* S. N. Roy and R. C. Bose, Simultaneous Confidence Interval Estimation, *Ann. Math. Stats.*, **24**, 513-536.

S. N. Roy, On a Heuristic Method of Test Construction and its use in Multivariate Analysis, *Ann. Math. Stats.*, **24**, 220-233.