Classifying

Numerical Taxonomy. Proceedings of a colloquium, St. Andrews, Scotland, Sept. 1968. A. J. COLE, Ed. Academic Press, New York, 1969. xvi + 328 pp., illus. $9.

This volume presents the 18 papers given at a colloquium in which discussions centered on how one should classify numerically and not whether one should.

There are papers on the application of the techniques of numerical taxonomy to particular fields such as ecology, business, botany, paleontology, social geography, and molecular biology. Two papers are concerned with implementation of various techniques on digital computers. In addition, author and subject indexes and an appendix giving short descriptions of the programs used by the speakers are furnished.

A number of papers are of special significance because they give good reviews and evaluations of the techniques of numerical taxonomy or because they present new ideas.

A. J. Boyce presents a useful although not critical review of multidimensional techniques for displaying the patterns of diversity found in a numerical taxonomic study. He discusses similarity and distance coefficients, cluster analyses, and principal components analyses.

A. V. Hall describes his heterogeneity functions which have been developed for two-state and quantitative data and contrasts their use with that of Euclidean distances.

D. M. Jackson deals with techniques for comparing two classifications by measuring the extent to which each agrees with the initial data. The technique discussed is based upon a model of binary (presence or absence) characters. Class membership is, like the characters, a two-valued relation, in that an object either belongs or does not belong to a given class. Thus both the original information and the classification may be represented completely by binary arrays. Basically the method measures the monotonicity of similarity functions computed from the raw data and from the classification. Rather than computing a total index of discrepancy one uses a threshold so that one has a measure of discrepancy in classifications for varying values of similarity.

I. C. Lerman has investigated techniques for finding the partition of the total set of OTU's (operational taxonomic units) which best approximates the similarities among the objects (that is, which best separates the OTU's into two sets with maximum within-group homogeneity). He compares two criteria for the partitioning of a set.

L. Orloci presents a general introduction to information theory and its applications to taxonomy, both in nonhierarchic sorting and in hierarchial cluster analyses.

P. H. A. Sneath discusses the various concepts that could be used to develop techniques for evaluating clustering methods. He distinguishes between external criteria (where one compares a classification to some absolute standard) and internal criteria (where one performs some sort of comparison between the classification and the original data upon which it is based). He distinguishes the three general concepts (mass, density, and networks) involved in the definition of a cluster and stresses the desirability of statistical tests for the presence of clusters as well as considerations of the feasibility of actually carrying out the clustering algorithms on present-day computing equipment.

A paper by D. Wishart is an important contribution to numerical taxonomy. Wishart gives a concise survey of various clustering techniques that possess minimum-variance constraints on the clusters. The underlying axiom of these techniques is the intuitive idea that a resultant group of individuals should be homogeneous in relation to the total set of variables. Described in geometric terms, the cloud of points which constitutes a minimum-variance cluster should be hyperspheroidal in shape. The effects upon the minimum-variance solution of adding nondiagnostic and irrelevant variables to the character set are discussed. The major objection to partitions obtained by a minimum-variance method is that they may easily cut across a dense swarm of points with the result that on either side of the partition there will be a large number of individuals that are practically identical (which of course defeats the objective of the analysis). There are relatively few techniques that do not have this dependency. The most widely known exception is the technique of single-linkage cluster analysis, but this technique suffers from "chaining effect" when the clusters are very fuzzy as a result of a large amount of noise. Wishart proposes a technique called mode analysis which differs from previous techniques in that the data points which surround each OTU at a specified distance threshold are first counted and all the non-dense points—those for which the frequency is less than some critical value—are temporarily removed from the analysis. The remaining, "dense" points are clustered by means of single linkage cluster analysis, forming the mode nuclei. Then each non-dense point is allocated to a cluster according to some criterion (for example, each non-dense point may be assigned to the cluster associated with the nearest dense point). Unfortunately no example of the use of this program is given in the paper. But the technique has sufficient theoretical interest to warrant its being tested on numerous data sets.

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Transport Phenomena

Kinetic Processes in Gases and Plasmas. A. R. HOCHSTIM, Ed. Academic Press, New York, 1969. xiv + 458 pp., illus. $22.50. Reentry Physics Series.

This book consists of ten reviews by different authors of various aspects of the kinetic theory of gases and plasmas. It is written primarily to acquaint persons generally familiar with the field with recent developments and current research.

The subject matter of the book may be divided into three parts. The first consists of "textbook-like" derivations of the conventional sets of transport equations, among them the Chapman-Enskogg method, the Fokker-Planck equation, and the Lenard-Balescu equation. These derivations are lucid and carefully developed.

The second part consists of chapters by E. A. Mason and by A. R. Hochstim and G. A. Massel. Mason discusses applications of transport theory to neutral gases, whereas Hochstim and Massel describe applications to ionized gases. The chapter by Mason gives an excellent review of the role of inelastic collisions, including rotational excitation, in transport phenomena. This includes a survey of various calculational recipes and accuracy. Hochstim and Massel give a very detailed review of transport phenomena in ionized gases, including extensive numeri-

cal tabulation of transport coefficients. This includes a description of electron-electron collisions and of ionic contribution to the conductivity. Conditions for the validity of Onsager and Einstein relations are also studied.

The third part of the book contains several chapters on the calculation of rate coefficients and, more generally, of various molecular collisional phenomena. These reviews are of necessity somewhat terse but are well referenced.

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Spectropolarimetry

Optical Rotatory Dispersion of Proteins and Other Macromolecules. B. JIRGENSONS. Springer-Verlag, New York, 1969. xii + 168 pp., illus. $12.70. Molecular Biology, Biochemistry, and Biophysics, vol. 5.

The author has fulfilled the promise made in the preface in offering an introduction to the use of spectropolarimetry for the analysis of the structure of biological macromolecules and in keeping the presentation as elementary as possible. The companion techniques of spectropolarimetry and circular dichroism have been widely used since 1960 to probe the conformation of biological macromolecules, and the author demonstrates his wide acquaintance with such research. Although circular dichroism is not dealt with in depth, occasional spectra are discussed. In addition to giving an account of protein conformation in general, the monograph contains brief chapters on nucleoproteins, ribosomes, viruses, lipoproteins, membranes, and other substances which will acquaint the uninitiated with the vast literature that exists on the conformation of materials of biological interest.

The first chapters, which deal with the phenomena of optical activity and with theoretical considerations, must be considered minimal in their treatment of this sophisticated subject, but the author does give references to some of the original sources. The accounts of various instruments now in use are mostly descriptive rather than critical.

The main strength of the book lies in the extensive tables the author has compiled on the vast number of proteins that have been investigated. These tables are indispensable to one wishing to begin any investigation of the optical properties of biological materials. The author's attempt to evaluate the data often is sound but often is insufficiently critical by current standards. This, perhaps, is a consequence of the lack of a thorough discussion of the theoretical basis for interpretation, and therein may lie the main grounds for criticism of the book. One cannot fully assess the optical activity of macromolecules without taking into account circular dichroism. The explosion of research in this field would have made it difficult to contain a comprehensive account in a small book, and this criticism may be valid only in the expectation of the impossible.

The author proposes a scheme for the classification of proteins. It would appear that this new attempt is a precarious endeavor, as we have seen such attempts fail in the past. Time alone will pass judgment. Nevertheless, the thorough handling of the innumerable proteins in the various categories and the attempts to give them conformational assignments can only be viewed with admiration. The differences of opinion one may have with the author on specific problems do not diminish the magnitude of the endeavor. An addendum of references brings this part of the book up to date to some time in 1969.

Readers looking for a comprehensive theoretical and experimental review will find the work lacking, but as a source book it will find a wide and appreciative audience.

The publisher should seriously investigate the properties of the cover which make it next to impossible to lay this book flat on any surface.

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Elementary Processes

Theory of Weak Interactions in Particle Physics. ROBERT E. MARSHAK, RIAZUDDIN, and CIARAN P. RYAN. Wiley-Interscience, New York, 1969. xiv + 770 pp., illus. $29.95. Interscience Monographs and Texts in Physics and Astronomy, vol. 24.

The interactions among the elementary particles are generally classified in three categories: strong, electromagnetic, and weak. Our theoretical understanding of the electromagnetic interaction is most complete, built as it is on classical electrodynamics. Over the past dozen years, following the discovery of parity violation, a fairly complete theory of the weak interaction based on the early ideas of Fermi has been developed and verified by experiment. This is in striking contrast to the strong interactions, for which there still is no fundamental theory generally agreed upon.

Although there remain important open questions in the theory of weak interactions, it is highly appropriate at this time that a comprehensive account of its present status should be made available. Marshak and his coauthors have provided such an account. The major portion of this book provides a detailed theoretical treatment of every elementary weak process that has been experimentally studied, as well as of a number of interesting processes for which there are as yet few data. For most purposes the treatments are self-contained, although numerous up-to-date references are supplied.

The authors steer a reasonable middle course between a purely deductive approach in which the theory is assumed from the beginning and an approach which attempts to derive the theory from experimental results. Furthermore, some unresolved problems in the theory are explored in detail. In their attempt to be comprehensive the authors at some points are not sufficiently selective, and at a few points they appear overly optimistic about or uncritical of the theoretical treatments they present. An extreme example of the latter failing occurs on page 300, where it is stated that there is general agreement between theory and experiment for the neutron asymmetry from the capture of polarized muons by nuclei. In fact, the experimental result quoted is only one of several conflicting results that can be found in the references given, and the theory also is much more uncertain than the reader might realize.

Weak interactions are of importance to the study of nuclear structure and to astrophysical theory, but, with the exception of special processes (such as the conversion of electrons into neutrinos in stars) empirical information about which may help to establish the fundamental theory, the authors do not attempt to cover these applications. The book contains a fairly complete list of experimental numbers that describe elementary weak processes but does not attempt to provide any discussion or critique of the experiments on which they are based.

The first chapter presents a good