

as the hetero-atoms taken singly and (for the larger rings) in pairs—together with their important benzo-derivatives and the fused systems of purines and pteridines. Naturally occurring compounds of relevant interest are discussed briefly or mentioned incidentally, but carbohydrates and alkaloids are excluded. Although the scope is therefore wide, the main theme is the inherent chemistry of the commoner heterocyclic compounds. This is treated in sufficient detail to allow comparisons to be made both within and between the various classes of compound. The presentation is clear and the discussion modern, being supported by pertinent physical data and based on mechanistic principles. Moreover, as befits an introduction, the reader is given adequate guidance to further sources of information.

Such books as this must surely put an end to those perfunctory postscripts with which exhausted writers of text-books usually dispose of the subject. If ultimately this is service enough, more immediately the service to students and teachers is immeasurable.

### Theory of Markov Processes

By E. B. Dynkin. Translated from the Russian by D. E. Brown. Edited by T. Kőváry. Pp. ix+210. (London and New York: Pergamon Press, 1960.) 60s. net.

THIS important and highly original work is devoted to a study of the foundations of the theory of Markov processes. It is written for the professional probabilist, and has little to offer to the non-expert, although any mathematician concerned with the teaching of measure theory will find it worth his while reading Chapter 1, in which the classical material is set out in a new and highly elegant form. This chapter also contains a careful account of conditional probabilities, some information about the new concept of "topological measurable spaces", and the best extension yet of the Daniell-Kolmogorov theorem on the construction of probability measures on function-space. The remainder of the book presents the first thorough formulation of the theory of Markov processes, starting with a whole collection of measures corresponding to all possible initial instants and all possible initial states, and allowing (as is now found convenient) the termination of the process at a random instant. The difficult theory around the concept of a 'strict' Markov process is set out in great detail. The present work is based on lectures given by the author in Moscow and Peking; it will be followed by a further volume devoted to the infinitesimal generators associated with Markov processes. It is very much to be hoped that the publishers will find it possible to translate this also.

D. G. KENDALL

### Combinatorial Analysis

Proceedings of Symposia in Applied Mathematics, Vol. 10. Edited by Richard Bellman and Marshall Hall, Jr. Pp. vi+311. (Providence, R. I.: American Mathematical Society, 1960.) 7.70 dollars.

THIS volume records the proceedings of the symposium held at Columbia University during April 24–26, 1958. It consists of twenty-four papers and covers a very wide range of topics, including finite geometry, algebra, and number theory in pure mathematics; and statistics, communication theory and transportation in the applied field. A fairly recent development has been the use of an electronic computer to investigate combinatorial

problems, and several of the papers describe results obtained. Some of these depend mainly on algorithms and others on somewhat complicated search techniques.

The papers on finite geometries include one by R. H. Bruck on "Quadratic Extensions of Cyclic Planes", one by D. R. Hughes "On Homomorphisms of Projective Planes" and one by A. A. Albert on "Finite Division Algebras and Finite Planes". Those on number theory include a paper by A. L. Whitehead on "The Cyclotomic Numbers of Order Ten" and the paper by O. Taussky and J. Todd on "Some Discrete Variable Computations". Thus pure mathematics is well represented in current activity in combinatorial analysis. But perhaps the main motive for this activity has come from operations research. Thus there is a paper by R. E. Gomory on "Solving Linear Programming Problems in Integers", one by M. Gerstenhaber on "Solution of Large Scale Transportation Problems", and a paper by M. M. Flood on "An Alternative Proof of a Theorem of König as an Algorithm for the Hitchcock Distribution Problem". There is also a paper by R. Bellman on "Combinatorial Processes and Dynamic Programming", and a paper by A. J. Hoffman on "Some Recent Applications of the Theory of Linear Inequalities to Extremal Combinatorial Analysis". These titles are sufficient to demonstrate the dynamic character of present-day research in combinatorial analysis. Anyone who moves in this field will wish to consult the proceedings.

L. S. GODDARD

### Ciba Foundation Symposium on Quinones in Electron Transport

Edited by G. E. W. Wolstenholme and Cecilia M. O'Connor. Pp. xii+453. (London: J. and A. Churchill, Ltd., 1961.) 60s. net.

THIS latest addition to the CIBA Foundation Symposia provides a most welcome review of recent work on the role of quinones in biological systems. As in previous volumes of this series, lectures by recognized authorities in the field are reproduced in full, the charts and diagrams often relating to hitherto unpublished material. Such treatment provides the atmosphere of the seminar rather than the formal lecture room, and the interest is further enhanced by the inclusion of the full discussion (diagrams again reproduced).

A detailed critique of a symposium volume of this type is quite out of place, but biochemists and organic chemists interested in the processes of biological redox systems will find stimulation and many useful references in this work. The symposium consists of the following lectures: isolation chemistry of ubiquinone (R. A. Morton, E. L. Crane, O. Isler and K. Folkers), coenzyme A and electron transport (D. E. Green); oxidation of quinones by mitochondrial preparations (E. C. Slater); oxidative phosphorylation (V. M. Clark, Sir Alexander Todd and P. J. Russell); biosynthesis of quinones (H. Rudney, A. J. Birch, O. Wiss and R. E. Olsen); biosynthesis of terpenoid side chains of quinones (F. Lynan); diet-induced changes in ubiquinone-levels (J. Green); function of vitamin K (C. Martius); spectroscopic observations of the redox reaction of ubiquinone in heart and kidney mitochondria (B. Chance); role of ubiquinone in the respiratory chain (E. R. Redfearn); histochemical studies (L. W. Wattenberg); role of plastoquinone in the electron transport system of photosynthesis (N. I. Bishop).

A. I. SCOTT