

The last two chapters deal with integration. The first, relating to functions of one variable, covers the usual topics. But the second contains some new material, including a discussion of the parts of algebraic topology which enter into the formulation of the main results on the integration of differential forms. The book, oddly enough, concludes with a down to earth section on "the calculation of content, surface area, centroid and second moments".

From this brief survey it is evident that the book is not for the applied mathematician or the engineer. But it is an exciting book for the student of pure mathematics, and its method of approach is most valuable for anyone who hopes to do postgraduate research in mathematical analysis.

L. S. GODDARD

ADVANCES IN POLYMER SCIENCE

Stereoregular Polymers and Stereospecific Polymerizations

Edited by Giulio Natta and Ferdinando Danusso. (The Contributions of Giulio Natta and his School of Polymer Chemistry.) Vol. 1: Pp. xxii + 1-466. Vol. 2: Pp. xx + 467-888. (Oxford, London and New York: Pergamon Press, Ltd., 1967.) 315s. net per set of two volumes.

Heteroatom Ring Systems and Polymers

By H. R. Allcock. Pp. xi + 401. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1967.) 132s.

THE announcement on December 11, 1954, by Professor Giulio Natta and his co-workers of the synthesis of a new class of polymers, obtained by the polymerization of alpha-olefins and with an exceptional regularity of structure, opened up an immense field of research which has brought remarkable fruits to both polymer science and to industry. In recent years the interest in the subject of stereoregular polymers and stereospecific polymerization has increased steadily and development of this subject continues. It is thus of some significance to have collected together in a single work the papers of those researchers who made these discoveries. Apart from its historical interest, this collection is very useful to scientists working in this field. Many of the original papers, which were published in Italian or in a language other than English, are translated in *Stereoregular Polymers and Stereospecific Polymerizations*. The first two volumes comprise the 170 papers, in chronological order, submitted for publication, from the discovery of stereoregular polymers (March 1954 to 1959 inclusive). All the important papers and reviews are unabridged but the others are reported as abstracts.

Among the papers will be found the first announcement of the discovery and the description of the first syntheses and industrial production of stereoregular polymers of alpha-olefins and diolefins. Other papers describe the kinetics and reaction mechanisms, the study of the structure of stereoregular molecules, of their properties in solution and in the solid state, and the industrial application of the polymers. The new polymers described in the period covered by these volumes were predominantly hydrocarbons. It is the editors' intention to publish the corresponding works on non-hydrocarbon monomers and polytactic polymers in subsequent volumes.

Another branch of chemistry in which there has been striking advances in recent years is that of heteroatom ring systems and polymers, particularly those in which the skeletal systems consist of silicon, phosphorus, sulphur, aluminium or carbon, bonded to oxygen, sulphur or nitrogen. The impetus to this subject has been provided by the requirements of aerospace technology for unusual polymeric materials, and in particular for materials of high thermal stability. The series of compounds such as

the siloxanes, phosphazenes, borazenes and s-triazines have received considerable attention, and in the second book, *Heteroatom Ring Systems and Polymers*, an attempt has been made to present a unified picture of the very wide and diverse subject of heteroatom systems. The first part of the book (first four chapters) is devoted to the general and theoretical background of the subject. The second part (fifth to seventh chapters) deals with the fundamental chemistry of these compounds and the final section (eighth chapter) is concerned with the high polymer chemistry of hetero-compounds.

The book is not devoted predominantly to the "inorganic concept" and this particular aspect of the subject is considered as part of the more general chemistry of these compounds. The general approach of the authors is a comparative one and the different heteroatom systems are compared with respect to bonding theory, aromaticity, ring-polymer equilibration, synthesis, polymerization, reactions and polymer chemistry. References up to the early part of 1966 are included in the body of the book and some important papers which appeared later are reviewed in an appendix. A second appendix contains a valuable compilation of bond angles and bond length for heteroatom compounds.

The book is a most excellent introduction and review of a new and important branch of chemistry and will be of value to the inorganic, organic and polymer chemist.

C. E. H. BAWN

CYCLOBUTADIENE AND RELATIVES

Cyclobutadiene and Related Compounds

By M. P. Cava and M. J. Mitchell. With a Chapter on Theory by H. E. Simmons and A. G. Anastassiou. (Organic Chemistry: a Series of Monographs, Vol. 10.) Pp. xiii + 503. (New York: Academic Press, Inc.; London: Academic Press, Inc. (London), Ltd., 1967.) 176s.

EVER since 1865 when Kekulé put forward the cyclic structure for benzene, chemists have been interested in the preparation of homologues of this compound in order to find out whether or not they possess an aromatic character. The next higher homologue of benzene, cyclo-octatetraene, was synthesized by Willstätter in 1911, but the lower homologue, cyclobutadiene, proved to be much more elusive. Despite the discouraging predictions of molecular orbital calculations an ever increasing number of chemists are making contributions to the field of cyclobutadienes and related compounds. Cyclobutadienes have been postulated, with varying degrees of probability, as transient intermediates in several reactions and some very elegant and sophisticated methods have been used to try to prove their existence. The most compelling evidence for the successful synthesis of cyclobutadiene itself was provided by Watts, Fitzpatrick and Pettit in 1965.

The history of attempts to prepare benzocyclobutadiene and biphenylene is also of great interest. Finkelstein was the first to prepare benzocyclobutadiene (as a transient intermediate). He also made the first derivative of biphenylene, namely 5-bromobenzo[*a*]biphenylene. Actually Finkelstein himself did not elucidate the structure of the biphenylene but his work was repeated and enormously extended by Cava and his co-workers. It is therefore very appropriate that Cava and Mitchell should write an account of cyclobutadiene and related compounds.

The quest for stable derivatives of cyclobutadiene has led to the preparation of many novel types of small ring compounds and to the discovery of many new reactions. According to the preface: "The aim of this monograph is to present in readily accessible form all of the information available on four-membered carbocyclic compounds having only trigonally hybridized carbon atoms in the ring". Thus there are chapters on cyclo-

butadiene: the cyclobutadiene-metal complexes; cyclobutadiene divalent ions; cyclobutadienequinone; methylene analogues of cyclobutadienequinone; benzocyclobutadiene; benzocyclobutadienequinone; methylene analogues of 1,2-benzocyclobutadienequinone; higher aromatic analogues of benzocyclobutadiene; biphenylene; benzobiphenylenes; and theoretical aspects of the cyclobutadiene problem. The monograph includes all relevant material published up to January 1, 1964, and there is an appendix containing abstracts of papers published in 1964 and 1965. In addition to published work much information has also been extracted from unpublished theses. The text is excellently written and is profusely illustrated with formulae, diagrams and tables.

The authors have admirably succeeded in their task and the book will be of great interest and value to workers on carbocyclic and on aromatic polycyclic compounds. It will be an essential work of reference for specialists in the field of four membered unsaturated rings and their benzo derivatives.

J. F. W. McOMIE

CHEMISTRY OF ALKALOIDS

An Introduction to the Alkaloids

By G. A. Swan. Pp. viii + 326. (Oxford and Edinburgh: Blackwell Scientific Publications, 1967.) 63s. net.

THE problems facing an author who wishes to write an introduction to the alkaloids "suitable for advanced undergraduate and postgraduate students or for others wishing to begin a study of the subject" are daunting indeed. To make a reasonably comprehensive selection from the many classes of alkaloid, to include sufficient detail and thus avoid a sense of remoteness but at the same time to give a satisfactory general picture—these are just a few of the difficulties to be overcome. The present author has tackled these and other problems in a straightforward way and has produced a book which is instructive, up to date, comprehensive and extremely readable. Apart from an introductory chapter and a final chapter on biogenesis, the main body of the book is devoted to a description of the major classes of alkaloid, illustrated with carefully selected examples. The historical background is often described and accounts of classical degradative and synthetic work are complemented by numerous illustrations of the application of modern physical techniques such as ultraviolet, infrared, nuclear magnetic resonance and mass spectroscopy to problems of structure elucidation.

Aspects of the pharmacology of the alkaloids are also included and give added interest to the purely chemical sections.

The final chapter on biogenesis is up to date and very clearly written. The author has shown (for example, in the section on indole alkaloid biogenesis) how biogenetic studies can help to clarify and rationalize the relationships between alkaloids of apparently diverse structural types.

In a book of this nature, it is inevitable that some errors should have crept in—these, however, are very few in number and are usually of minor importance (for example, the formula for chaksine, page 275, which lacks a methyl group). Nowadays, however, when so many publications of this type show obvious signs of having been written in great haste and with little thought, it is a real pleasure to come across one in which the author has combined experience, careful planning, accuracy and style, to produce a book which fully accomplishes the intentions quoted at the beginning of this review.

A book of this kind has been long needed and this volume can be thoroughly recommended (especially in view of the very reasonable price) to everyone interested in alkaloid chemistry, specialists and non-specialists alike.

D. H. G. GROUT

WORLD KEY TO ANGIOSPERMS

Key to the Families of Flowering Plants of the World
By J. Hutchinson. Revised and enlarged for use as a supplement to *The Genera of Flowering Plants*. Pp. vii + 117. (Oxford: Clarendon Press; London: Oxford University Press, 1967.) 30s. net; paperback edition 18s.

HOWEVER controversial Dr John Hutchinson's well known system of classification of flowering plants might be, the key to families included in the two editions of his *Families of Flowering Plants* has proved to be of outstanding value to botanists throughout the world. This latest book is simply a revised and rearranged version of the family key included in the 1959 second edition. The author intends it to serve as a complement to the most ambitious yet of his publications, *The Genera of Flowering Plants*, of which two volumes have so far been published in 1964 and 1967, respectively. There is no doubt that it will be widely used in the field and herbarium as a working key quite independently from the *Genera* or any other works. As the author says in the preface, "by means of this key it should be possible to determine the family of most of the flowering plants to be met with on a day's march in any part of the world, from the north and south poles to the equator or from Greenland's icy mountains to India's coral strand".

The book consists almost entirely of the keys. A short glossary is appended and there are two pages of diagrams illustrating terms used in the keys. There are separate keys to the Dicotyledons and Monocotyledons. The Dicotyledons are divided into thirty-two artificial groups, a larger number than in the *Families*, because the main ones are subdivided into smaller units so as to ease the task of identification. Many of these smaller groups are made on the basis of the presence of opposite or alternate leaves. Although the keys are deliberately artificial, Hutchinson cannot refrain from adding that alternate leaves are usually a more primitive character and opposite leaves more advanced.

A disastrous error occurs on page 102 when about half the key to group 1 of the Monocotyledons (about twenty-two lines to judge by the key on page 528 of Vol. 2 of *The Families of Flowering Plants*) is omitted, so that ten families (Typhaceae, Sparganiaceae, Lemnaceae, and so on) cannot be run down.

Mechanically the keys are good and the contents usually clear. They are not, however, always dichotomous: three or four contrasting leads are common—quite unnecessarily so in most cases—and are often confusing. There are a few misprints but seldom significant, except perhaps "Leaves compound of 1-foliolate, pellucid-punctate" on page 14. Another that will baffle foreign readers is "often 'healthy' plants" in the key to Ericaceae. The punctuation is careless in many places and should be revised in any reprint that is issued.

The keys as a whole represent an intellectual achievement of a very high order. It is difficult to imagine any competing versions being offered in the future, when, in any case, alternative methods of preparation and presentation of keys using electronic data processing will be available. Even today, it would be valuable to have the information given in Hutchinson's key available as a set of punched cards.

The brief glossary is somewhat scrappy and the definitions are often over-simplified: for example, "monoecious, unisexual flowers on the same plant"; "embryo, rudimentary plant still enclosed in the seed"; "pollen, the powdery contents of an anther (the male element of the flower)". It is difficult to believe that any serious user of the key will need to consult such an elementary list. It could well be omitted in a further edition.

Hutchinson's *Keys* will be a deservedly popular work, and both he and his publishers are to be commended for making it available as a separate and relatively inexpensive book.

V. H. HEYWOOD