that in the case of norlaudanosine and morphine at least, Robinson's biogenetic theory is correct, and that the plant actually synthesizes both compounds in a manner analogous to a Mannich reaction from 3,4-dihydroxyphenylalanine and 3,4-dihydroxyphenylacetaldehyde. More recently still, the syntheses of 1-hydroxymethylpyrrolizidine, *d,l*-epilupinine, *d,l*-lupinine and *d,l*-sparteine have been accomplished through Robinson-type condensations (Leonard, Bloom, *J. Am. Chem. Soc.*, **82**, 504 (1960); van Tamelen, Foltz, *ibid.*, **82**, 502, 2400 (1960)). Some of the alkaloids and related compounds that chemists have prepared in the laboratory by similar condensations *during the 40 years prior to the appearance of* "Die Mannich-Reaktion" include hygrine, cuskhygrine, lobelanine, arecaidine aldehyde, isopelletierine, N-methyl-isopelletierine, pseudopelletierine, the numerous natural and synthetic tropanone derivatives (*e.g.*, cocaine, meteloidine), salsoline, nor-salsoline, tetrahydroharmane, hexahydroyohimbol and desoxyvasicine.

Yet Dr. Reichert's book hardly even hints at all at this active field of biogenetic theory and alkaloid synthesis, though his preface acknowledges its importance from the point of view of the Mannich reaction. The book deals with Robinson's original work shortly on p. 51, but it does not mention the syntheses of tropanone from acetone or from free acetonedicarboxylic acid at all. And among other alkaloids or related compounds this reader found only lobelanine and arecaidine aldehyde cited as having been prepared through Mannich condensations. The Pictet–Spengler synthesis of tetrahydroisoquinolines, "Organic Reactions, Vol. VI," which is germane to the Mannich reaction is also omitted in this book.

In summary then, the major drawbacks of this work are the consideration of the Mannich reaction as a *specific* rather than as a *general* condensation reaction, and the slighting of physical-organic considerations and reaction mechanisms with regard to it. But it represents a great deal of work, and extensive assimilation of the subject matter; it also successfully synthesizes most of the widely scattered primary literature sources. Dr. Reichert's monograph is encyclopedic in nature, rather than a critical account. As such it is a worthwhile addition to chemical literature, and as a specialized reference work a recommended acquisition for well-equipped chemical libraries.

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**Advances in Inorganic Chemistry and Radiochemistry.** Vol. 2. Editors, H. J. EMELÉUS and A. G. SHARPE, University Chemical Laboratory, Cambridge, England. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y. 1960. viii + 392 pp. 16.5 × 23.5 cm. Price, $12.00.

The remarkable resurgence of interest in Inorganic Chemistry and the rapid parallel development of Radiochemistry within the past 20 years have made it increasingly apparent to every research worker or teacher in these areas that he can hope to keep abreast of publication only through reference to carefully prepared, critical reviews covering rather specific topics. In establishing the current series, the editors dedicated themselves to the task of providing such reviews while stressing the application of physical and physicochemical principles to inorganic problems and integrating these with descriptive chemistry. That they have been eminently successful in achieving their goals is attested by the excellence and breadth of coverage of both the current volume and its predecessor. No person interested in modern Inorganic Chemistry can afford to be without access to these summaries.

The present volume presents in order "Stereochemistry of Ionic Solids" by J. D. Dunitz and L. E. Orgel; "Organometallic Compounds" by J. Eisch and H. Gilman; "Fluorine-Containing Compounds of Sulfur" by G. H. Cady; "Amides and Imides of the Oxyacids of Sulfur" by M. Becke-Goehring; "Halides of the Actinide Elements" by J. J. Katz and I. Sheft; "Structures of Compounds Containing Chains of Sulfur Atoms" by O. Foss; "Chemical Reactivity of the Boron Hydrides and Related Compounds" by F. G. A. Stone, and "Mass Spectrometry in Nuclear Chemistry" by H. G. Thode, C. C. McMullen and K. Fritze.

Each summary follows a general organizational pattern but retains its own individuality. Each is particularly well documented, and the majority of the references are to the newer literature. In general, balance between theory and description is excellent. This alone adds much to the desirability of the volume, for it points up very well what many believe to be overwhelmingly important in Inorganic Chemistry and Radiochemistry.

In the opinion of the reviewer, this second volume in the series fixes the pattern set by the first and indicates clearly that future volumes will be welcomed with real enthusiasm.

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**Polysaccharides of Micro-organisms.** By M. STACEY, F.R.S., Mason Professor and Head of the Department of Chemistry, University of Birmingham, and S. A. BARKER, Lecturer in Organic Chemistry, University of Birmingham. Oxford University Press, 417 Fifth Avenue, New York 16, N. Y. 1960. ix + 228 pp. 14.5 × 22 cm. Price, $4.80.

It was over forty years ago when two distinguished American bacteriologists, Alfonse Dochez and Oswald Avery, published a paper which was destined to open a new era in the field of microbiology. The so-called "soluble specific substances" of pneumococcus which they first described were later shown by Avery and Heidelberger to be polysaccharides. To be sure, bacteria were known to elaborate carbohydrates, but these new substances were unique. Not only did they prove to be polysaccharides, but they endowed the microörganism from which they were obtained with type specificity and the ability to incite specific immunity in experimental animals. Now, some forty years later, there has appeared a book by two chemists, M. Stacey and S. A. Barker, entitled "Polysaccharides of Micro-organisms." This is a timely book for it has been ten years since a similar volume made its appearance in the English language, Burger's "Bacterial Polysaccharides."

As one peruses the pages of this new volume he can't help but be impressed by how vast our knowledge has become regarding these biologically important substances. The structure of this new book is conventional enough. It begins with a short chapter on carbohydrate nomenclature which embraces a description of the monosaccharides, the conformation of sugars, and a paragraph on oligo- and polysaccharides. This in turn is followed by a second chapter on the monosaccharide components of polysaccharides and antibiotics, and a word regarding their biosynthesis. In so far as it goes this is first rate, but this reviewer regards the introduction as rather thin fare.

After these brief remarks we come to the meat of the book. Three successive accounts, the function of polysaccharides, their isolation and the criteria of their homogeneity, and the determination of their structure, prepare the reader for that which is to follow—a description of the polysaccharides derived from a variety of microörganisms. These accounts, which constitute the remaining two-thirds of the book, form a good compilation of our newer knowledge concerning the polysaccharides of viruses, bacteria, molds, yeasts and protozoa. Their discourse on the structural determination of polysaccharides is very informative, for here the writers, both chemists, are treading on firm and familiar ground. They present an excellent review of the modern techniques employed in the study of the structure of carbohydrates. When we come to that portion of the book which is devoted to a description of microbial polysaccharides themselves, it is puzzling for the uninitiated to understand the rationale of the authors, for there is no chronological sequence. Certainly one cannot deny that the classical work in the whole field is that on the pneumococcus, yet the whole section begins with an account of the polysaccharides of rickettsiae and viruses—a newcomer to the field if ever there was one.

The book itself is well put together; the typography is excellent and each chapter ends with a bibliography. The subject index is good, but it is unfortunate that the references at the end of each chapter have not been further classified to form a cumulative author index.

Perhaps the most serious criticism which can be leveled at the book is the dearth of discussion pertaining to the immunological role of microbial polysaccharides and the

factors which govern their specificity. From the time of the discovery of the pneumococcal polysaccharides, the school of Avery was deeply concerned with the question of the relationship between specificity and the structure of carbohydrates. Some very pertinent and fundamental facts were disclosed in this regard during the ensuing decade, yet little or no mention is made of them here. Futhermore, the excellent and fundamental work of Kabat, dealing with the relationship between the specificity of dextrans and other polysaccharides and the size of the combining sites of anti-polysaccharide antibody, is not even mentioned. The few hundred words of discussion pertaining to the biological activity of bacterial polysaccharides, found at the end of the third chapter, are woefully inadequate.

In sum, it might be said that "Polysaccharides of Micro-organisms" is a book for chemists or for microbiologists who wish to learn something of the chemistry of the microbial agents with which they are working. It is a good summation of our more modern information regarding the chemistry of these agents, but it is a book written from a very restricted point of view. It offers but little insight into the great vistas which have been opened in the field of modern immuno-chemistry since the discovery of specific bacterial polysaccharides. Those who wish to know more of the immunological aspects of these important agents will have to read elsewhere.

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**Transport Phenomena.** By R. BYRON BIRD, WARREN E. STEWART and EDWIN N. LIGHTFOOT, Department of Chemical Engineering, University of Wisconsin, Madison, Wisconsin. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1960. xxi + 780 pp. 15.5 × 23.5 cm. Price, $13.75.

Over the last several years the undergraduate chemical engineering curriculum at many schools has undergone rather extensive revision, with additional courses in basic science and advanced mathematics replacing many of the more traditional courses in design and technology. This book dramatically reflects this trend and it is destined to have a far reaching effect on chemical engineering education.

The central feature of the book is the parallel development of the three transport processes, covering the subjects of momentum transport (viscous flow), energy transport (heat conduction, convection and radiation) and mass transport (diffusion). These topics have been organized in such a manner that the book is divided into three major parts, each of which covers a particular transport process. Within each part the material is further subdivided into chapters based on the type of transport, *e.g.*, transport by molecular motion, transport in an arbitrary continuum (the equations of change), transport in turbulent flow, interphase transport. The organization of the material very effectively emphasizes the analogies which exist among the various transport phenomena.

Several items are worthy of special mention. First, the method of presentation is more rigorous and mathematical than has been common in chemical engineering text-books. Second, much of the material, such as the treatment of non-Newtonian fluid dynamics and several of the topics covered in the section on mass transport, appears for the first time in text-book form. Third, the authors have given a systematic and thorough derivation of many of the equations used in chemical engineering analysis. Pertinent examples are the definitions of the interphase transfer coefficients and the development of the macroscopic momentum, energy and mass balances. Also, the book contains a wealth of illustrative examples and problems.

The authors have suggested that most of the topics in this book may be suitably covered in a three- or four-credit introductory course. It is the opinion of the reviewer that a course of at least twice the suggested length will be required for the average student to obtain a real grasp of the material. For example, the first section of the book, "Momentum Transport," contains material equivalent to an introductory course in fluid dynamics. Much of the book could be used very profitably in conjunction with the ordinary unit operations courses.

The book has been carefully planned and the writing is exemplary. The authors have successfully accomplished their purpose in presenting transport phenomena "as one of the key engineering sciences." Without question "Transport Phenomena" will become a standard in the chemical engineering field.

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**Synthetic Inorganic Chemistry.** By WILLIAM L. JOLLY, Associate Professor of Chemistry, University of California, Berkeley. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1960. ix + 196 pp. 15.5 × 23.5 cm. Price: Trade Edition, $8.00; Text Edition for Classroom Adoption, $6.00.

In paragraph two of the preface to this book, Dr. Jolly states his philosophy and approach toward synthetic inorganic chemistry. "The main purpose of a course in inorganic preparations should be to awaken synthetic talents in students. The student should be taught both theoretical principles and laboratory technique. He should prepare unusual, "exotic" compounds that may spark his curiosity and make him wonder about non-existent compounds." It is most gratifying to see that the author was able to write just such a book. In the limited space of this rather small book, the author has been able to mention many of the recent and more exciting developments in synthetic inorganic chemistry. These are described in such a way as to point out the fundamental significance of synthetic chemistry and to stimulate the student in this direction.

The book is definitely not a "cook book" type of inorganic preparations. The first five chapters deal with the theoretical principles of synthesis which includes such things as the significance of considerations of thermodynamic, kinetic, and acid–base phenomena. Following this there are ten chapters on laboratory technique which include electrolytic synthesis, high-temperature processes, inert atmosphere box, vacuum line, electrical discharge tubes, non-aqueous solvents, ion-exchange columns, autoclave, and liquid–liquid extractions. Excellent illustrations and detailed discussions are given for these techniques. The final chapter gives specific directions for eighteen syntheses which vary in time required and degree of difficulty from copper(I) chloride, the easiest, to ferrocene, the most difficult. These syntheses were chosen to illustrate the special techniques discussed in the previous chapters.

This book is enthusiastically recommended for chemistry students and for teachers of inorganic chemistry. It provides a stimulus for the need for synthetic chemistry by citing specific examples (with references) from the current chemical literature. Thought-provoking questions and problems are asked at the end of several of the chapters. Finally, the reviewer is prompted to suggest that the book be required reading for the members of the Committee on Professional Training of the American Chemical Society. This should convince even the most skeptic of skeptics that general chemistry is *not* inorganic chemistry.

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**Imperfections in Crystals.** By H. G. VAN BUEREN, Philips Research Laboratories, Eindhoven. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1960. xviii + 676 pp. 16.5 × 23 cm. Price, $16.75.

Although a large fraction of the solids composing the earth's crust are crystalline in structure, many of these materials owe their peculiarities of mechanical or physical behavior to departures from uniform crystalline regularity. Therefore the science of solids is in an appreciable measure the study of what may be called imperfections of crystal structure.

The book under review is a comprehensive and thorough survey of the present status of theory and observation concerning the nature and effects of point and line structural imperfections in a restricted class of solids. It is concerned chiefly with the study of dislocations, vacancies, interstitial atoms, and the interaction of these defects in combination. The influence of these structures upon the