are of the medusoid type. An excellent discussion of extinct medusoid forms is given by Harrington and Moore, and this seems to be the first occasion on which this information has been brought together and systematized.

Boschma has given a satisfactory account of *Milleporina* and *Stylasterina*. The Stromatoporoidea by Lecompte are placed under Hydrozoa, although admittedly their position here is not firmly established; that they are coelenterates appears acceptable. Bayer has given an exceptionally clear introductory account of the alcyonarian or octocorallian anthozoans, illustrated with original figures, and the account has been worthily completed by Eugenia Montanaro-Gallitelli, also with numerous original figures.

The rugose corals by Dorothy Hill probably presents as good a classification of these difficult forms as has been published, even if perhaps not final; the account is well illustrated. The stony or scleractinian corals by Wells begins with a long introduction that is often not very clear and seems to multiply technical terms; the well-illustrated systematic account of the stony corals practically follows that of Vaughan and Wells (1943). The book concludes with an account of the tabulate corals by Hill and Stumm.

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Handbuch der Physik. vol. 1, *Mathematical Methods*. S. Flugge, Ed. Springer-Verlag, Berlin, 1956. 364 pp. Illus. DM. 72.

The first volume of the new *Handbuch* contains five articles. The first three were prepared by J. Lense and deal with the principles of analysis, ordinary differential equations, and theory of complex functions (90 pages), partial differential equations (30 pages), elliptic functions (27 pages). The last two articles are by J. Meixner and F. Schlögl. They deal with the special functions of mathematical physics (71 pages) and boundary-value problems (135 pages), respectively. There are short bibliographies and, in addition to the subject index in German, there is an English index.

A comparison of the wealth of the material treated in the articles with the space that was available shows that only a compendiumlike treatment of the subject was possible. I approached the volume in a somewhat skeptical spirit. I was doubtful whether an adequate treatment of the material is at all possible, whether it is desirable for the physicist to learn mathematics from a compressed treatment, as the present one has to be, and, if not, whether a mere statement of mathematical results without proofs or examples is at all helpful. Certainly, one must fear that it invites misunderstandings and errors.

On the whole, these apprehensions were not justified. Most of the material is clearly presented; even where proofs are omitted, the statement of the theorems is clear so that misunderstandings are not likely to arise. Whether a physicist who faces a mathematical problem with which he has no familiarity can advantageously use this book remains doubtful. However, there may be many instances in which this "Nachschlagewerk" will help him recall developments which he once knew but on which his memory is vague, and in some cases it may carry him beyond the limits of his previous knowledge. The book is well worth possessing, and I often found it more stimulating and striking than some of the standard textbooks.

The amount of material presented or reviewed is truly surprising. The first article reviews the standard material of elementary analysis, including the basic theorems on complex functions. It contains short tables of the properties of elementary transcendentals, their derivatives and integrals. It also gives some more esoteric facts concerning the convergence of power series on the circle of convergence, describes the properties of gamma functions and a few transformations in the complex plane, and ends up with a brief discussion of ordinary differential equations. The second article, on partial differential equations, gives the theory of characteristics and, hence, of linear first-order differential equations rather completely. It also defines the complete integral of a first-order equation—a theory that is very important for the understanding of the Hamilton-Jacobi equation but is nearly universally forgotten. The third article, on elliptic functions, is perhaps the most elegant and, considering its length, remarkably complete.

The treatment of the special functions of mathematical physics also goes much beyond the material usually considered. It defines and describes hypergeometric series and the limiting cases, such as Bessel functions and spherical harmonics. It then proceeds to a rather extensive theory of linear second-order ordinary differential equations, the coefficients of which are rational functions of the independent variable. The hypergeometric functions are reviewed again as solutions of differential equations of this type. The next two sections of this article, referring to addition and multiplication theorems as well as to difference equations involving the hypergeometric functions, will be new for most readers. The last section treats the same functions from a somewhat more modern point of view.

The last article, on boundary-value problems, is the only one which contains parts that I feel compelled to criticize. The treatment of the spectral theory of self-adjoint operators is antiquated in its methods and many of the statements are misleading. At places there is a pretense of proofs, which is worse than no proof at all; at other places the theorems, without proofs, are inaccurately formulated. It is regrettable that this happens with the spectral theory, the basis of quantum mechanics. Few easily readable treatments of this subject are available, and a real opportunity was missed to acquaint the theoretical physicist with a subject of great concern to him. The rest of the article is, on the other hand, modern and stimulating. It contains a discussion of variational calculus and several examples of integral and differential operators. It ends with a discussion of Green's functions and the various D functions used in modern quantum field theories.

On the whole, the book appears to be useful and sets a fine standard for the rest of the *Handbuch*. The minor inadequacies are no doubt at least partially due to lack of space in a very condensed volume.

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Electrochemical Affinity. Studies in electrochemical thermodynamics and kinetics. Pierre Van Rysselberghe. Hermann, Paris, 1955. 109 pp. F. 1250.

Recent books on the thermodynamics of irreversible processes (De Groot, Denbigh, Prigogine) do not contain detailed treatments of electrode reactions. The monograph by Pierre Van Rysselberghe fills this gap very satisfactorily. As the author points out, this book can be regarded as an extension of the work on the chemical affinity he wrote in collaboration with De Donder (1936).

The book is divided in five chapters covering the following topics: galvanic and electrolytic cells, reversible and irreversible electrode processes, simultaneous half-reactions at the same electrode, the Tafel equation and some aspects of electrochemical kinetics, and thermoelectricity. The approach is original and, in many instances, cannot be found elsewhere. Recent developments in the thermodynamics of irreversible processes, particularly the concept of entropy production and Onsager's reciprocity relations are fully exploited. They provide a rational basis for the study of electrode reactions in general, and they are especi-

ally useful in the discussion of coupled electrochemical reactions and cells with thermal gradients.

Experimental implications of the theory are discussed throughout the book. For instance, the reader will be much interested in the treatment of corrosion reactions and the new idea that currents cannot be added algebraically in all rigor in the case of coupled electrode reactions.

This timely and well-written book should prove most interesting and stimulating to electrochemists and physical chemists.

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Introduction to Mathematical Logic. vol. 1. Princeton Mathematical Series, No. 17. Alonzo Church. Princeton University Press, Princeton, N. J., 1956. 384 pp. $7.50.

The first volume of Alonzo Church's projected two-volume textbook on mathematical logic is now available as No. 17 in the Princeton Mathematical Series. Its excellence in every respect requires no comment. A revised and greatly expanded edition of the author's well-known contribution of 1944 to the *Annals of Mathematics Studies,* the work is addressed to beginners in logic who possess a respectable mathematical background. As the preface notes, it is also intended for use "within limitations as a reference work." The principal business at hand is formalizing an object language, with theoretical syntax treated informally and semantical matters introduced primarily to motivate interest in the uninterpreted logistic systems. Generous footnotes together with special sections of the text give sources and fill in the historical background. A noteworthy feature is the large and varied collection of exercises. The problems range from those suitable for routine practice through others that are, in effect, "brief sketches of difficult developments to which whole sections of the main text might have been devoted."

Volume I consists of an introduction and five chapters. In the introduction the reader makes the acquaintance of proper and improper symbols, the logistic method, and the world of abstract objects—"meanings," propositions, truth-values, and functions—with the treatment of proper names, and of sentences as names of a special kind, adopted with minor modifications from Frege. Chapter I develops the various theorems and metatheorems of the propositional calculus in a formulation in which the primitive connectives are implication and a constant f, the O-ary connective denoting the truth-value falsehood in the intended principal interpretation. Chapter II offers an alternative formulation in which the primitive connectives are implication and negation. The two systems are shown to be equivalent, other formulations are developed, and various partial systems are considered.

Chapter III develops simultaneously the various functional calculi of the first order, the device of axiom schemata making unnecessary the use of primitive rules of substitution. The subjects treated include consistency, the deduction theorem, and duality. Chapter IV examines the pure functional calculus of first order, a system whose primitive symbols include all the propositional and functional variables but neither individual nor functional constants. Most of the developments apply in both the previous formulation and in an alternative formulation in which a finite number of axioms replace the axiom schemata. The subjects treated include Gödel's completeness theorem. Löwenheim's theorem, and the solution of the decision problem in special cases.

Chapter V offers proofs of consistency and completeness for some of the functional calculi of second order. It also considers certain axioms, including various axioms of infinity, that can be expressed in the notation of the system under investigation, and closes with a note on the ramified functional calculi of second order. A digression, occupying more than a third of the chapter, shows how postulates, either as added axioms of a logistic system or as propositional functions, may serve as a basis for a special branch of mathematics.—J.T.

Chemistry of Carbon Compounds. vol. III, pt. B. *Aromatic Compounds.* E. H. Rodd, Ed. Elsevier, Amsterdam–Princeton, 1956 (order from Van Nostrand, Princeton, N.J.). 1669 pp. Illus. $25.

This book is a direct continuation of volume III, part A, completing the survey of aromatic compounds. The high standard of the previous volumes in the series is maintained, and there is a remarkable uniformity in the presentation of chapters by different authors. The literature seems to have been well covered up to about 1954 with occasional references to material published in 1955.

The chapters in this book serve as an excellent introduction to the study of a particular class of compound and for one seeking analogous reactions in a field other than his own. This subvolume covers the chemistry of benzoquinones; oxygen-containing derivatives of phenols (salicylic acid, hydrolyzable tannins, and so forth); polyhydric aromatic alcohols and their oxidation products (phthalic acid, mandelic acid, and so forth); unsaturated benzene derivatives (styrene, cinnamic acid, and so forth); phenylbenzenes; di-, tri-, and tetraphenylmethanes; di- and polyphenyl alkanes (paracyclophanes, benzilic acid, chalkones, and so forth); quasi-aromatic compounds (tropolone, diazocyclopentadiene, and so forth); bicyclic condensed nuclei (naphthalene, azulene, indene, and so forth); and finally compounds with three or more condensed aromatic nuclei (anthracene, phenanthrene, and so forth).

Historical accounts of the elucidation of the structure of natural products have, in general, been omitted and wisely so. It is good to see brief accounts of the biological aspects of various compounds or class of compound in the text. The mechanistic aspect of organic chemistry is not emphasized, but topics such as the Claisen rearrangement, ketene reactions, and tropolone chemistry are dealt with competently and with restraint. Ample references are given throughout to recent work on the physical-organic aspects of the subject matter.

The chapters on naphthalene, anthracene, and the more complex hydrocarbons are inevitably condensed, and it is probable that a person desiring information on compounds in this section will consult the published volumes of Elsevier's *Encyclopedia of Organic Chemistry.* However, this treatise is more pleasant to read than an encyclopedia, with numerous clear structural formulas breaking up the text. Misprints are few, the binding is good, and the book should withstand frequent consultation. It is a book that all organic chemists will wish to possess.

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New Books

Synthetic Polypeptides. Preparation, structure and properties. C. H. Bamford, A. Elliott, W. E. Hanby. Academic Press, New York, 1956. 445 pp. $10.

Chemical Process Economics in Practice. J. James Hur, Ed. Reinhold, New York; Chapman & Hall, London, 1956. 115 pp. $3.95.

The Person behind the Disease. Julius Bauer. Grune & Stratton, New York, 1956. 136 pp.

Your Child's Speech. A practical guide for parents for the first five years. Flora R. Schreiber. Putnam's, New York, 1956. 256 pp. $3.50.