of sacklike containers; the entries under "bind" fill nearly three pages. This sort of thing will be of great help to the desperate systematist in search of a new name in some large genus, or to anyone else in search of a root on which to graft a new word in this day of complex molecules and disintegrating atoms. A further aid are the special sections here and there in the lexicon, such as the discussion of diminutives (under "little") and figures of speech; these are listed in the index. A typical entry gives the derivation, combining forms, and gender of the word. Pronunciation has been omitted, since this is debatable for Greek and Latin, but the author's recommendations are to be found in some sprightly passages (with amusing examples) in the introduction. It does not seem possible that a book this size should be innocent of typographic error, but after several days of dipping into it here and there, I have been unable to find one.

In short, this is the dictionary that many of us have long been waiting for, and it should be on the shelf of all who want to understand the words they use.

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An Autumn Gleaning. Occasional lectures and addresses. Henry H. Dale. Interscience, New York; Pergamon Press, London, 1954. x + 225 pp. $4.25.

This is a collection of lectures and addresses delivered between 1935 and 1952 by the venerable British medical scientist, Henry Hallett Dale.

This volume presents a wealth of material on the development and nature of the intellectual, moral, and social aspects of science during the last century, particularly in medical research. It reflects the valiant struggles of man with life under the increasingly confusing impact of rapidly growing science and technology.

Typical of these essays is the Huxley memorial lecture on viruses. Dale discusses the controversial literature by Tyndall, Pasteur, Buffon, Huxley, Needham, and others on spontaneous generation and its relation to the modern researches on the generation of ultramicroscopic viruses and bacteriophage.

Extracts from his five wartime presidential addresses to the Royal Society present such problems as the relatively long-range advantages of freedom in individual research and of organization in group research; the dangers of entangling science with politics; the dangers of neglecting fundamental in favor of applied research; the importance of recognition of achievement in the more fundamental and academic ranges of science; the significance of the numerous meetings held during the war in commemoration of the tercentenary of the birth of Newton, not only in English-speaking countries but also in such out-of-the-way places as Novosibirsk: "Newton's achievement is a part of the common heritage of all peoples"; and the evils of secrecy forced upon science and government by the new conception of "total war."

Dale's other lectures include history of the discovery and use of insulin; freedom and function of science (Benjamin Franklin's question to candidates for admission to the scientific junto was: "Do you love truth for truth's sake, and will you endeavor impartially to find and receive it for yourself, and communicate it to others?"); science in education; accident and opportunism in medical research; medical research as an aim in life; Thomas Addison as a pioneer of endocrinology; the mechanism of anaphylaxis; and transmission of effects from nerve endings.

This book should be of interest to the numerous professional admirers and friends of Henry Dale as well as to philosophically minded laymen not overwhelmed by the implication of the equation $E = mc^2$.

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Physics and Mathematics

Concepts of Space. The history of theories of space in physics. Max Jammer. Harvard Univ. Press, Cambridge, Mass., 1954. xvi + 196 pp. $3.75.

This is a scholarly history of the concept of space, starting from antiquity and extending to contemporary times. The great scientists and religious leaders pass in rapid kaleidoscopic procession, each contributing his concept of the space which forms the universe. In early times, and even in much of Newton's philosophy, contemporary theology restricted the notions of cosmology. Gradually the experimental approach became predominant. One sees how Isaac Newton considered geometry as a phase of mechanics, but insisted that the center of mass of the sun's planetary system must be at absolute rest. Leibnitz and Huyghens argued for relative motion. The argument was finally settled by the Michelson-Morley experiment. Then Riemann became the prophet of non-Euclidean space. To test this hypothesis, Gauss hauled surveying equipment up to the tops of three high mountains, and when he did not detect any deviation from 180° for the sum of the interior angles of the triangles formed by the three mountain peaks, he concluded that space was indeed Euclidean. Lobachevski tested the hypothesis using astronomical triangles, and so began our modern attack on cosmology.

In a brilliantly written foreword, Einstein divides the basic concept of space into two viewpoints: "(a) space as positional quality of the world of material objects; (b) space as container of all material objects." One gathers that general relativity merges the two concepts into one. That is, space can be thought of as boxes but the size and shape of these boxes are modified by the presence of matter.

Max Jammer is to be congratulated on the large and interesting selections of excerpts that he has given from original documents. Most of these are given in Latin, French, or German. Although for true scholars the subtle meanings might be lost in translation, for more casual readers footnotes providing the transla-

tion would have been very helpful. For example, I missed a number of the key points because of my lack of linguistic proficiency.

I believe that the author missed a great opportunity in not stressing the interlocking of space and time. In many ways, time seems more mysterious than geometrical space. I had hoped that this book would shed some light on the Eddington Peter-Paul paradox (the time-shortening journey), but this topic is not considered. As a matter of fact, the last chapter, "Concepts of space in modern science," is much too condensed. There is an obvious effort to give the names of all the people who are engaged in the philosophy of cosmology and only one sentence or equation summarizing the views of each.

Because the author cites the work of hundreds of people in the order of their appearance on the historical stage, the text seems somewhat jumpy and it is hard to follow any thread of continuity. However, the treatment is extremely thorough, especially with respect to pre-twentieth century work. The author has done an excellent job of explaining the significance of each of the different contributions. Undoubtedly this book will serve as a very valuable reference to philosophers.

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Advances in Electronics and Electron Physics. vol. VI. L. Marton, Ed. Academic Press, New York 10, 1954. xi + 538 pp. Illus. $11.80.

With the present volume the title of this excellent and authoritative series has been modified from *Advances in Electronics* to *Advances in Electronics and Electron Physics.* Since more than half of the papers are in the domain of solid-state physics, we can infer that the editor and publisher are interpreting electron physics in the pleasant and broad sense that J. J. Thomson might acknowledge.

The volume opens with a well-written review (46 pp.) by A. B. Pippard (Cambridge) of interesting recent developments in metallic conduction at high frequencies and low temperatures. An account is given of conductivity in the region of the anomalous skin effect, where the electronic mean free path exceeds the classical skin depth. Recent interpretations of infrared reflectivity measurements are discussed. The unusual position of bismuth is pointed out; the mean free path of conduction electrons in bismuth is of the order of several microns at room temperature, whereas in simple metals it is necessary to cool to liquid helium temperatures to attain comparable values.

E. Abrahams (Urbana) has provided a clear report (23 pp.) on relaxation processes in ferromagnetism—a subject that is increasing in importance with the recent practical interest in the use of ferromagnetic ferrites at high radio and microwave frequencies. It is clear that we do not yet have a complete understanding of relaxation mechanisms, but a number of suggestive calculations have been made by Akhieser, Abrahams, Keffer, Van Vleck, Luttinger, and others. The review was prepared too long ago to include accounts of recent relevant work by Galt, Uehling, Stevens, Rado, and Bloembergen.

The physical properties of ferrites are reviewed by J. Smit and H. P. J. Wijn (Eindhoven). This 63-page paper contains only an abridged account of the Néel theory and of the pertinent neutron diffraction experiments. The discussion of magnetization curves and losses under various conditions is particularly comprehensive and is the outstanding feature of the article. The fascinating and unique applications of ferrites at microwave frequencies are touched on in passing.

H. F. Ivey (Westinghouse, Bloomfield) has written a 120-page paper on space-charge limited currents, treating in detail and with great care the general theory of the principal geometric arrangements. This review should be of considerable use to designers and to research workers who are concerned with electron-beam devices.

W. M. Webster (R.C.A., Princeton) has made an interesting comparison of the behavior and properties of analogous semiconductor and gaseous electronics devices. The article is quite condensed but will be of value to anyone with a fair background in both fields. An important section is devoted to a discussion of the theoretical limitations of semiconductor devices.

M. E. Haine (Associated Electrical Industries, Aldermaston) reviews in 74 pages the current state of our knowledge of the electron microscope. He treats resolving power, image contrast, magnetic and electrostatic lenses, spherical corrections, astigmatism, the projector lens, the electron gun, the object stage, alignment, and a number of other practical design features. The article is intended for designers and for the users of the more than 1000 electron microscopes now in operation.

R. G. E. Hutter (Sylvania, Bayside) has contributed a 90-page review of the rapidly developing field of traveling-wave tubes, intended to bring out common, as well as distinctive, features of the various types of traveling-wave tubes. The general theory is developed at some length, following the method of J. R. Pierce. The broad band width of some of these tubes as amplifiers and as oscillators is of unusual practical importance. The recent backward-wave tubes are discussed.

The volume closes with a 55-page review of paramagnetism by J. Van den Handel (Leiden). This article is far too compact to be of real value. No fair impression is given of the tremendous postwar activity in the field.

The general educational usefulness of most of the articles would be enhanced if the introductory sections were enlarged considerably and written in elementary physical and pictorial terms at the level of a beginning graduate student in physics and engineering. The editor has done a splendid job in gathering together distinguished and interesting contributors; he should now ask them to throw more scraps to the

man in the street. The cumulative length of all the introductions to the eight review articles in this volume is about 20 pages; the volume contains more than 500 pages. The fruits of this fine effort would be enjoyed more widely if there were at least 100 pages of introductions.

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High-Energy Accelerators. M. Stanley Livingston. Interscience Tracts on Physics and Astronomy, No. 2. R. E. Marshak, Ed. Interscience, New York–London, 1954. viii + 157 pp Illus. $3.25.

This is a very useful book introducing the reader to the various types of electronuclear machines. The circular machines are discussed in some detail and the mathematics of the more elementary problems of orbit dynamics are given. Otherwise, the text is principally descriptive. The book contains an initial survey chapter indicating the various energy thresholds successively passed in the advance of the accelerator art. This section contains a very helpful outline of the more prevalent meson and hyperon reactions. The final section contains an illuminating graphical representation of the energies attained by the various machines in relation to the time.

High-Energy Accelerators reflects, of course, the author's own interests and experience. For this reason, the degree of detail devoted to the various instruments is somewhat subjective.

The book is very well written and fills a very real need. It will be a great help to the reader in evaluating the comparative properties of the various devices.

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Existence Theorems for Ordinary Differential Equations. Francis J. Murray and Kenneth S. Miller. New York Univ. Press, New York, 1954. (Distrib. by Interscience, New York.) x + 154 pp. Illus. $5.

In this book the authors have collected several of the important existence theorems for differential equations. Beyond the obvious usefulness of having such theorems discussed in a logical sequence, the authors' principal aim is to show the role that such theorems play in computational aspects of differential equations. The development of high-speed computers and their use in numerical solutions of differential equations have proceeded at a rapid pace. Existence theorems are essential if one is to understand in what sense such solutions are reliable. From this point of view the authors have, in my opinion, done a creditable job.

The book begins with the existence theorems of Peano for the differential equation $\frac{dy}{dx} = f(x,y)$, continues to a system of equations and, hence, to implicit equations. These first theorems are strictly existence theorems without uniqueness. The methods are the usual ones of approximation by line segments, equicontinuous functions, and the Ascolis theorem. They then proceed to equations with more restrictive conditions (Lipschitz condition) and show, as a result, how one obtains uniqueness. Solutions of the important equations $\frac{dy}{dx} = f(x,y,\lambda)$, or systems of such equations containing a parameter, are discussed as a function of λ and also as a function of the initial conditions. In particular, theorems are given concerning continuity and differentiability of solutions of such equations with respect to the parameter or initial conditions. The book concludes with theorems in the large for linear equations and finally equations with constant coefficients.

The theorems discussed in the book are all well known to those who have studied existence theorems of Peano, Picard, Bliss, and others. However, the authors have rendered a service to those not so familiar with the field in bringing these theorems to their attention. The book is well written and can be read and understood by one with a reasonable foundation in the classical real variable theory.

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Sonics. Techniques for the use of sound and ultrasound in engineering and science. Theodor F. Hueter and Richard H. Bolt. Wiley, New York; Chapman & Hall, London, 1955. xi + 456 pp. Illus. $10.

The aim of this book is to bring together in a unified presentation the basic principles and techniques of a young technology, here appropriately designated as *sonics*, now just coming of age. This new field of applied science deals with mechanical vibratory energy (whether of high or low frequency) as it is now being applied to such varied problems as oil-well drilling, medical diagnosis, gas analysis, and metals testing. The authors recognize that of the many persons who are interested in this field only a few have had advanced training in acoustics, and have therefore aimed (successfully) at making most of the material understandable to anyone with college training or the equivalent in any branch of science or engineering.

A wealth of pertinent and very up-to-date technical material on sonics has been assembled and skillfully integrated, much of it from technical reports and other sources not conveniently available. Four of the eight chapters are packed with developments of formulas and principles from well-established theory of sound propagation and transducer design; another chapter reviews knowledge on physical mechanisms for effects caused by sound. Two extensive chapters describe devices, techniques, and design principles found to be effective in typical processing or testing problems; an appendix contains an informative review of the contributions of acoustical relaxation studies to

basic physics. Many graphs of important formulas and tables of pertinent data are provided throughout the text, making it a valuable and reasonably self-contained sonics handbook.

This attractive, well-organized book, by eminent authorities in its subject, is highly recommended to anyone seriously interested in physical, chemical, or biological applications of vibrations, sound, or ultrasound.

WESLEY L. NYBORG
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Higher Algebra. vols. I and II. Helmut Hasse. Trans. by Theodore J. Benac. Frederick Ungar, New York, Eng. transl. of rev. Ger. ed. 3, 1954. 336 pp. $6.50.

Exercises to Higher Algebra. Helmut Hasse and Walter Klobe. Trans. by Theodore J. Benac. Frederick Ungar, New York, Eng. transl. of rev. Ger. ed. 2, 1954. 212 pp. $4.

The English-reading mathematical fraternity is fortunate in now having available an excellent translation of Helmut Hasse's famous *Höhere Algebra* and its accompanying volume of exercises by Hasse and Walter Klobe. Both the translator and the publisher are to be congratulated on a valuable job well done. The two parts of *Higher Algebra* are bound together; the exercises are in a separate matching volume. Typography and format are very good. The translation, carefully made from the latest German editions, contains little of the stilted phraseology often found in English translations of German works.

The characterizing feature of algebra has undergone a transition since the days of Cardano and Tartaglia. In the early days algebra was generally understood as the theory for solving equations built up by means of a finite number of the four elementary operations performed upon real (or complex) numbers and unknowns. The material of this phase is neatly packeted now in almost any college textbook on algebra and the theory of equations. Next, in an effort to gain deeper insight into the operations involved, a greater generality was achieved by ignoring the intuitive significance of the numbers involved and by considering these numbers as mere symbols obeying certain formal rules. Thus, in this middle period of algebra, such concepts as ring, field, integral domain, and group came into being. Questions of solvability dependent upon a ground field were considered, and the Galois theory was developed. In modern times the center of interest has shifted from the solution of equations to a concentrated study and generalization of these concepts, and today we have college textbooks of modern, or abstract, algebra. Hasse's work adopts the point of view of the middle period. It thus appears as a blend of the classical and modern viewpoints. It considers as the basic problem of algebra the following: Given a field K and a set of elements $f_1, \ldots, f_m$ of the integral domain $K[x_1, \ldots, x_n]$, to develop methods for obtaining all solutions of the system of equations $f_i(x_1, \ldots, x_n) = 0$, $(i = 1, \ldots, m)$. Since the complete theory for the solution of this problem is too voluminous, Hasse restricts himself in volume 1 to linear systems of equations in K and in volume 2 to single algebraic equations of rth degree in K. The necessary field and group theory is developed as needed.

A citation of the chapter titles shows the specific content of Hasse's work: Vol. 1, "Rings, fields, integral domains," "Groups," "Linear algebra without determinants," and "Linear algebra with determinants"; for Vol. 2, "The left sides of algebraic equations," "The roots of algebraic equations," "The fields of the roots of algebraic equations," "The structure of the root fields of algebraic equations," and "Solvability of algebraic equations by radicals."

The accompanying exercises are valuable and are classified under the successive topics of the text proper, and contain, in most cases, helpful comments and hints. These exercises constitute one of the finest available collections in this field. The text contains no exercises, but is illuminated by numerous examples. An excellent advanced undergraduate or beginning graduate course can be based upon *Higher Algebra* and its accompanying collection of exercises.

Finally, I would like to mention the pleasure one can receive by reading this work. It is written by a master expositor in elegant style, and with meticulous care, and it contains many, many sidelights and mathematical niceties.

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Macroscopic Theory of Superfluid Helium. vol. II of *Superfluids.* The late Fritz London. Wiley, New York; Chapman & Hall, London, 1954. xvi + 217 pp. Illus. $8.

The exciting physical properties of liquid helium comprised a subject of consuming interest to Fritz London and his original writings on the theoretical aspects are known throughout the world of science. This book is outstanding and scientists everywhere will always be grateful to him for the thorough, well-written, summation of the quantum theoretical treatment of liquid helium. The book joins the first volume, *Superconductivity,* as a lasting monument to him. It has become an indispensable textbook for graduate-school courses and seminars concerned with the subject of low temperature physics. The volume on superfluid liquid helium has already demonstrated its enormous value to scientists—one finds it quoted so often in the original writings in scientific journals. Nothing I can say in further praise of London's book can equal the steady tribute paid to it by research scientists in their articles.

The first chapter gives a 13-page review of the remarkable properties of liquid helium. This is followed by a chapter that gives theoretical conclusions as to why liquid helium must remain a liquid all the way down to the absolute zero of temperature. In writing

the third chapter about the two-fluid concept and the application of Bose-Einstein statistics to liquid helium, London must often have recalled the happy days in Paris when these ideas came bursting out of him, and of his stimulating contacts at that time with L. Tisza and his many other colleagues. It is in this third chapter, too, that one finds the discussion of the fountain effect, the viscosity studies, and the thermomechanical experiments which were all a part of the prewar era.

The fourth chapter is indeed a great service to all of us because London has done a very capable presentation of Landau's theory about liquid helium, that is, the concept of rotons and phonons. Throughout all this he has enriched the theoretical treatment with well-displayed graphs of the experimental work. The last two chapters are devoted to special topics under the heading: "Two-fluid thermo*hydro*dynamics," and "The helium isotope He^3." It is here that one finds such things as the interpretation of the experiments with the Rayleigh disk using thermal waves (or second sound). The author had completed the manuscript for this book in the late winter of 1952, and I remember celebrating with him his revision of the galley proofs and their return to the publishers in late June of 1953 —again in Paris! During the month of December 1953, London attended an International Conference on Low Temperature Physics and served as chairman of the session devoted to R. P. Feynman's recent theory of liquid helium. Probably had his health not failed, he would have revised the page proofs to include at least a footnote of what he knew to be important and controversial. It would have been typical of London, for he was a thorough and great scholar. This book is a memorial to his genius and has been fittingly dedicated to his wife, Edith London.

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Chemistry and Biochemistry

Organic Chemistry. Lewis F. Hatch. McGraw-Hill, New York–London, 1955. vii + 324 pp. Illus. $4.50.

As a palliative for the onus of organic chemistry on "students majoring in home economics . . . agriculture . . . or . . . other fields who do not require a full year . . ." this textbook serves adequately in that it contains the basic elements of the subject, presented appetizingly in a simple readable manner, embellished by numerous photographs and diagrams, and sprinkled with homely bits of humor. The abbreviation necessary in a textbook designed for use in a one-semester or -quarter survey course is accomplished, probably wisely, through broad coverage at the expense of the attention to detail usual for the full-year treatment.

In the first chapter Hatch introduces the reader, by way of the hydrocarbons, to positional isomerism and the nomenclature of aliphatic and aromatic substances, and in subsequent chapters no formal division is made between members of the two broad groups. Of the remaining 19 chapters, 15 are devoted to the time-honored topics, including the simple classes of organic compounds as well as dyes, proteins, fats, waxes, and carbohydrates. The remaining four chapters, entitled "Enzymes, vitamins, hormones and antibiotics," "Medicinals and pharmaceuticals," "Polymers," and "Organic chemistry and agriculture," are noteworthy since the material included, timely and up to date, should be of special interest to the type of student for whom the textbook is designed.

In general, the number of reactions covered is adequate; the consideration given to the utilization and practical importance of organic materials is ample; and structural formulas, including those of, for example, terramycin, Aureomycin, streptomycin, and chloromycetin, are abundant. The more theoretical aspects of organic chemistry are, however, treated cursorily. For example, two topics that are likely to give trouble to most beginning students, the concepts of resonance and optical isomerism, are covered in two and six pages, respectively. The mechanisms of organic reactions are discussed on occasion.

On perusing the book, I uncovered no typographic mistakes; factual errors are at a minimum and are not of a serious nature—certainly a structure for α-pinene that violates Bredt's rule will not seriously hamper the desired development of the average student in the course.

The book, sturdily bound with an attractive cover, features with each chapter a short list of collateral reading topics and a group of about 10 to 20 problems, without answers, of a degree of difficulty consistent with the probable needs of the course.

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Electrometric pH Determinations. Theory and practice. Roger G. Bates. Wiley, New York; Chapman & Hall, London, 1954. xiii + 331 pp. Illus. $7.50.

Everyone measures *p*H, but relatively few appreciate what it is not. Since the original proposal of Sörensen, a number of suggestions have been made in the attempt to establish practical scales that would experimentally satisfy the ideal definition "negative logarithm of hydrogen ion activity." However, exact agreement has never been achieved because an exact measurement of the true activity of hydrogen ion, or indeed of any single ion species, has not been accomplished. The fundamental difficulty is the existence in any practicable cell of a liquid-junction potential whose magnitude is somewhat dependent on the composition of the test solution, and which is not amenable to rigorous thermodynamic interpretation. Consequently, practical scales of *p*H numbers necessarily involve nonthermodynamic approximations that render them distinctly empirical and only in approximate accord with the ideal definition. No one has a more keen appreciation of this situation than Roger Bates, and his discussion of the definitions of *p*H