

REVIEWS.

The Evolution of Physics. By Albert Einstein and Leopold Infeld. (The University Press, Cambridge), 1938. Pp. 319. Price 8s. 6d.

This book is a welcome addition to that class of scientific literature which has for its aim the presentation of recent physical concepts to those who are not specialists in physics but who are nevertheless anxious to understand the advances in scientific thought. In the words of the authors their object in writing the book has been "to sketch in broad outline the attempts of the human mind to find a connection between the world of ideas and the world of phenomena". A perusal of the book makes it clear that they have succeeded in this attempt. The book is particularly free from the usual defects of books intended to popularise science; for instance, there is not a single misleading analogy in the whole book. One who wants to benefit by reading it must take pains and provided he does take pains there is nothing too technical in it that would stand in the way of his understanding the topics dealt with in the several chapters. The book is divided into four chapters. The first is styled "The Rise of the Mechanical View". Here we have a clear presentation of what may be called the older classical physics. In the second chapter with the heading, "The Decline of the Mechanical View", the reader is introduced to the electric and magnetic field theories and the wave theory of light. In the earlier part of the third chapter there is treated the field theory of electric phenomena, the result of the work of Faraday, Maxwell and Hertz. In the latter half of this chapter both the special and general theories of relativity are treated in a charmingly interesting and clear manner. Chapter four under the name "Quanta" contains an account of the more recent aspects of physical theory.

The aim of theoretical physics has been described by the authors as follows: "We want the observed facts to follow logically from our concept of reality. Without the belief that it is possible to grasp the reality with our theoretical constructions, without the belief in the inner harmony of our

world, there could be no science. This belief is and always will remain the fundamental motive for all scientific creation." The treatment of the subject has been so planned as to bring home to the reader that this aim runs throughout the evolutionary history of theoretical physics.

We have no hesitation in heartily recommending the book to the general reader who is anxious to get an insight into modern theories in physics. B. V.

The Fine Structure of Matter. By C. H. Douglas Clark. Vol. II, Part III. *The Quantum Theory and Line Spectra.* (Chapman & Hall, Ltd., London), 1938. Pp. lxxii + 459-643. Price 15s. net.

This is Part III of the second volume of a comprehensive treatise on atomic and molecular structure. It is the object of the author to bring together the various fields of research which have shed light on the structure of matter so that by their juxtaposition a more comprehensive outlook may be possible. Accordingly, he deals with crystal structure, electric moments, atomic and molecular spectra and the Raman effect, each of which is a vast field of specialised study. As the author says, "an individual author is apt to regard his own point of view as capable of explaining all the results of experiment, and a wider outlook is necessary". So "the present work has accumulated together in one place many of the facts which should be taken into account, references being supplied where the treatment is not full". The part before us deals with atomic spectra, with Bohr's theory and the vector model serving as the bases for the interpretation. The treatment is mostly descriptive and qualitative, some necessary mathematical derivations being relegated to an Appendix. The author is naturally fascinated by the music of numbers which permeates spectroscopy and some space is devoted to exhibit a large number of numerical relationships, particularly between the various energy units usual in this part of the subject. The exposition of Hund's theory of spectral terms is lucid and adequate. The experimental results obtained by the

analysis of the spectra of the elements in various stages of ionisation are set forth in detail. The whole existing literature up to the end of 1935 has been thoroughly combed and the extensive lists of references will be of great use to workers in the field. The discussion of the connection between the ground states of atoms and valency is fresh and interesting. The book is a very useful source of information to all those interested in knowing the results which have been obtained in various fields of research, without any great need of mathematical details.

We may mention a few oversights here and there. On p. 485 *a* and *b* are called major and minor axes instead of semi-major and semi-minor axes respectively. It is also there stated that for $n = 3$, $k = 1$ corresponds to a circular orbit and $k = 3$ corresponds to the most eccentric ellipse while the reverse is true. On p. 527 we find Russell, Shenstone and Taylor for Russell, Shenstone and Turner. On p. 546 it is stated that the separation of F terms is less than D terms, and that of D terms less than for F terms, where the last F should be P. There are also some misprints on pp. 491, 528, 531, 538, 610 and 638. In connection with Burger and Dorgelo's summation rule for intensities of spectral lines it would have been better if Sommerfeld and Hönl's formulæ were also given. These minor matters do not in the least detract from the merit of the book which may be recommended to all desiring a full account of the results achieved in the field dealt with.

T. S. S.

also in making him understand the essential principles of the subject. Though the standard of mathematics used is well below the attainments of an S.S.L.C. student, a very useful account of the most modern developments such as atomic structure, Radio, Talkies and Television is brought within his reach. The illustrations simply make one love the book, so numerous and beautiful are they. The problems and questions will surely make the student think, not from the compulsion of an impending examination, but from an inner necessity of satisfying a curiosity aroused in him. The binding will stand the roughest usage. On the whole, the book is admirably suited to give the student an intelligent understanding of his surroundings and may confidently be recommended for use in academic as well as technical courses involving an introduction to the principles of Physics. Some peculiarities in the book, *e.g.*, the use of gravitational units throughout, necessitating such formulæ as $F = \frac{Wv^2}{gr}$ for centrifugal force, or the

definitions of specific resistance and electrochemical equivalents, may look rather unfamiliar. The solution of a problem in impact on p. 221 by making use of the principle of conservation of energy may lead to misconceptions. The statement on p. 641 that Sir William Ramsay first discovered helium in the Sun is not quite correct. But these are minor matters which may be overlooked while recommending an excellent book.

T. S. S.

Elementary Practical Physics. By Newton Henry Black and Harvey Nathaniel Davis. (New York: The Macmillan Company), 1938. Pp. viii + 710. Price 8s. 6d.

This is not a text-book of laboratory experiments but a book which deals with the Physics met with in practical everyday life. This is the type of book we should like to see in the hands of every S.S.L.C. student to correct a bias towards cramming so easily possible in our examination-ridden country, where what a student studies in school has so little connection with his later life. The book starts with everyday appliances and builds up the principles of Physics by an appeal to the student's experience of these appliances. It succeeds admirably in arousing the interest of the student and succeeds

Electron and Nuclear Physics. By J. Barton Hoag. (Chapman & Hall, Ltd., London), 1938. Pp. 502. Price 20s. net.

The present volume is the enlarged edition of the author's *Electron Physics* published in 1929. The book is roughly divided into four parts. The first nine chapters covering 222 pages deal with Electron Physics. The next six chapters covering 132 pages deal with Nuclear Physics. The next four chapters covering 96 pages deal with modern experimental technique of high vacuum, high voltage, small currents and detection of particles and radiation, such as counters and expansion chambers and ionisation chambers. The last part in 9 pages

gives a large number of problems, under each of the 19 chapters.

Simple statements of the experimental facts and physical principles of both the newer and older concepts are recognised as being of great help in bridging the gap between the early study of physics and the specialization of advanced research.

A successful effort has been made to develop the subjects in such a sequence as to avoid reference at any point to discussions which appear later in the book. The early chapters treat of the electron, its charge, mass, wave-length and emission from hot and cold surfaces. These are followed by chapters dealing with electrical phenomena specific to the outer parts of the atom. In succeeding chapters there are discussions of the phenomena involving the nuclei of the atoms, such as positive rays, natural and artificial radioactivity, transmutations, etc. There is unity about the whole book, because many basic relations and experimental techniques are common to several of these fields of study.

A speciality of the book is a detailed description of some basic and important experiments at the end of each chapter. The apparatus has been simplified from the original research form to an extent which avoids the expenditure of too much time or effort, yet permits an insight into actual work.

No student of physics, engaged in advanced studies or research can well be without this excellent book, thoroughly practical but fully equipped with the necessary theoretical background.

B. DASANNACHARYA.

Hurricanes, their Nature and History.

By Ivan Ray Tannehill. (Princeton University Press, Princeton, New Jersey, U.S.A.), 1938. Price \$ 3.50.

The word "hurricane" is generally used by meteorologists and seamen in two different senses—one to denote any wind of speed of greater than about 65 miles per hour and another to denote the cyclonic storms of certain tropical and subtropical regions of the earth, for example, the South Pacific, South Indian and North Atlantic Oceans. The word is used in the latter sense in this book. In essence, the hurri-

canes of the West Indian Seas are not different in character from the cyclones of the Indian seas or the typhoons of the China Seas or the baguics of the Philippines. They all come under the general class of "tropical cyclones". Although there are many papers and memoirs on tropical cyclones, books on the subject are few, two of the best known being Eliot's *Handbook of Cyclonic Storms of the Bay of Bengal* and Cline's *Tropical Cyclones*. A new book dealing in a general way with the whole subject is therefore very welcome. The chief of the Marine Division of the United States Weather Bureau with his exceptionally large experience of cyclone warning work in America has here presented us with an authoritative and lucidly written account of this fascinating subject.

The book may be broadly divided into two parts—the first part dealing with the characteristic phenomena of tropical cyclones, their places of origin, direction and speed of movement, the changes of pressure, wind and rainfall associated with their passage and the nature of warnings issued by the Weather Bureaus for the safety of life and property on sea and land. Cyclones of different parts of the world come under consideration; those of the Indian Seas, being well-known and having been carefully studied for nearly a century, receive a good deal of attention.

Among the most terrible effects of some tropical cyclones is the inundation of low coastal areas or river-basins by the storm-wave which sometimes accompanies the passage of the cyclonic centre from sea to land. The risk of this is greatest in regions where there is an enclosed sea and a rising sea-bed and on occasions when the entry of the storm-centre happens to coincide with a high tide. Many instances of disastrous storm-waves have occurred in the deltaic area round the head of the Bay of Bengal, the most notable one having been associated with Backergunge Cyclone of 1876 when the storm-wave rose to heights of 10 to 40 ft. over the islands and low banks near the mouth of the river Meghna, and caused a loss of life of over 100,000. The author has not been forgetful of the beneficial effects of cyclones—he quotes an estimate of Newham that in the Puerto Rico hurricane of 1899, the total mass of water precipitated as rainfall on

that island alone was about 2,600 million tons. Some of the Bay of Bengal cyclones have been responsible for the distribution of over 40,000 million tons of water over a land area of 125,000 sq. miles!

The scientific study of cyclones began more than 100 years ago. The work done during the last century gave us the essential basic knowledge necessary for issuing useful warnings about their approach. The recent growth of wireless has given the meteorologist more data from sea areas, thus enabling him to improve his forecasts and quickly disseminating the available information. The development of upper air work is gradually adding new and essential data about the changing conditions in the higher levels of the atmosphere. These are very necessary for obtaining a fuller insight into the structure and mechanism of tropical cyclones. Studies of the available upper air data in relation to cyclones are being made in a few countries, including India. The extension of scheduled flying over sea-areas makes it imperative that such studies should be intensified and accelerated. The author has not touched on this aspect of the subject, perhaps, because he feels that the data are yet insufficient.

We offer a hearty welcome to this very readable and well-produced book on what is undoubtedly one of the major phenomena of the earth's atmosphere. K. R. R.

The Observational Approach to Cosmology. By Edwin Hubble. (Clarendon Press, Oxford), 1937. Pp. 68. Price 6s.

It is now generally recognized that the spiral and other extra-galactic nebulae are in reality stellar systems comparable in many respects to the system of the Milky Way of which our Sun forms a member. Herschel, by means of his star-gauges laid the foundation for the study of the structure of the galactic system and since his time, considerable progress has been made in that direction, so that the general outlines of the system have been determined with a fair amount of certainty. Very little was known about the vast number of extra-galactic nebulae until the beginning of the present century; the nature of the nebulae and their position in space were more or less subjects of speculation. The pioneer

work of Keeler at the Lick Observatory and of Slipher at Flagstaff represent the earliest attempts towards a regular study of these extremely remote objects. Our present knowledge of the nebular system is entirely due to the large telescopes at Mount Wilson and Dr. Hubble's work with these powerful instruments forms the chief contribution to the astounding progress that has been made in the subject during the last two decades.

The present book contains the three Rhodes Memorial Lectures delivered at Oxford by the author in 1936 and summarises from the observer's point of view, the general features of the Universe as revealed by the observational data so far accumulated. The first chapter deals with the several criteria that have been developed, step by step, for estimating distances of nebulae, ranging from the nearest to those that are at the limits of telescopic vision. An important fact established by the various surveys is the homogeneity in the distribution of the nebulae, that extends throughout the part of the Universe under reconnaissance. Dr. Hubble considers this to be a significant factor. The region that can be surveyed is about a thousand million light years in diameter, inhabited by about a hundred million nebulae and this observable region is taken as a fair sample of the Universe.

In the second chapter we have an account of the spectra of nebulae and of the behaviour of the H and K lines that are found displaced towards the red. Two possible methods of interpretation of these displacements are described; either the red shifts may be taken to be true velocity shifts due to recession or they may not be considered as velocity shifts at all, but may be attributed to some unknown physical principle. A discussion of the inferences leads to widely different pictures of the Universe according to the interpretation given to the phenomenon. The third chapter contains an exposition of the effects of the two alternative assumptions, on the surveys made in the regions of space within reach of our telescopes and their relationship to the concept of a stationary or expanding universe. Dr. Hubble concludes that, from the available data, it is not possible to affirm which of the two pictures more exactly conforms to observations.

The book gives a comprehensive account of the subject from the observational point of view. It is written in a simple lucid style and will be read with the greatest interest by all students of cosmology.

T. P. B.

The Application of Moving Axes Methods to the Geometry of Curves and Surfaces.

By Dr. G. S. Mahajani. (Aryabhushan Press, Poona, India), 1937. Pp. 60.

Several geometrical results can be proved by the application of the principles of dynamics and statics. Many of these proofs are quite instructive, but the philosophical principles or foundations underlying them are those of mechanics, not of geometry. In differential geometry, the principle of moving axes is often employed to derive results. Many geometers however fight shy of this method, and prefer the purely geometrical methods. In the present pamphlet, the author applies the principle to work out several standard results and problems of elementary three-dimensional differential geometry. Dr. Mahajani commands a clear style and method of exposition. The student of differential geometry who studies the above problems through the methods advocated will, doubtless, be led into much thought-provoking study that may be of benefit to him and to the subject.

C. N. S.

Agricultural Analysis. By C. H. Wright. (Thomas Murby & Co., London), 1938. Pp. 343. Price 16s.

"This book is a laboratory manual giving the details of the methods of analysis of fertilizers, feeding stuffs, milk, milk-products, insecticides and fungicides with references to the sources of information... It is intended for Agricultural Analysts with limited library facilities, etc." This book arose out of the author's personal needs when working at Fiji and Nigeria. The author has chosen to give for each subject methods recommended by the American Association of Agricultural Chemists, the British Official methods, and those in use at Rothamstead. The work would have been more complete and appeared unbiassed had he at least referred to books on Plant and Agricultural Analysis published in German and other languages. A mention

of one such book *Handbuch der Pflanzen Analyse* by Klein and co-workers is sufficient to show how the book can be enlarged and improved in future editions. The author has perhaps due to oversight forgotten to mention necessary details like the duration of heating, etc., in certain instances (e.g., estimation of sulphur by Ailken's method). In the estimation of sugars he has omitted even to refer to the Polariscopic method. This is usually the method adopted by most workers in the industry.

The book has been well printed in bold type, which makes the reading all the more pleasant and easy. The binding is in a subdued sombre colour which makes it attractive. The price (16s.) is perhaps a little too high for the Indian student but is worth it. It can be recommended without any hesitation to those interested in agricultural analytical chemistry. N. G. C.

The Intermediate Calculus. By Brij Mohan. (Mohan & Co., Moradabad, India), 1937. Pp. 189. Price Rs. 2-4-0.

The object of the author seems to be to make the book just meet the requirements of a certain examination syllabus. The average student, who wants to pick up the methods of differentiation and integration and apply them to simple examples, will find a helping hand in this book. He will find it elaborately worked out, for instance, that the same result is obtained whether the function $\frac{2x+3}{5x-1}$ is differentiated as a quotient or as a product or as a sum. We wish that the aim of the book was something more than this. It is late enough that text-books on the calculus, however elementary they might be, devoted some space for the definitions of convergent sequences and of continuity and explained them with striking illustrations. The author, who has, without compunction, made so free a use of infinite series to obtain limits, ought to have developed the idea of the limit of a function in a finer and more satisfactory way. One happy feature of the book is that the student is introduced to the notion of the definite integral before he is ushered into the methods of hunting after the primitives of certain functions—a feature rarely to be found in other elementary text-books.

B. S. S.