

REVIEWS

Modern Gas Turbines. By Arthur W. Judge. (Messrs. Chapman & Hall Ltd., London), 1947. Pp. xii + 311. Price 28sh.

The gas turbine has already proved itself to be a serious rival to the reciprocating engine in some important fields of use. Granted the requisite knowledge and facilities, it is cheaper to make than corresponding reciprocating engines; moreover, moderate metallurgical advances in certain directions will greatly increase the extent to which the gas turbine can outrival reciprocating engines. Thus, it may be good policy for India not to contemplate eventual manufacture of certain larger and more difficult types of reciprocating internal combustion engines but, instead, to go direct to gas turbines. It is thus patent that the subject of the book under review has a special interest for India.

To those who require to assess the possibilities and limitations of gas turbines for various fields of application, Mr. Judge's clear exposition will be of considerable help at the present stage. The author gives a brief history of the development of gas turbines and follows this with some general considerations. He then outlines the fundamentals of gas turbine thermodynamics and discusses gas turbine efficiencies and how to improve them. There follows a chapter on closed-cycle gas turbines and another on exhaust-gas turbines for supercharged engines. The next chapter deals with gas turbines for aircraft. This relates mainly to jet-engines as more experience has been gained with these engines than with those which deliver power through shafting. The concluding two chapters concern typical applications and performances of gas turbines, and materials for gas turbines. There are two short appendices which comprise notes on turbine-blade design and a description of some blade-fixing methods.

A considerable bibliography is given for the guidance of those who need to study particular aspects of the subject more fully. Important further contributions continue to appear in technical literature but the references given extend into 1946.

The book is not a design manual: it is largely descriptive, but fundamental principles and facts are stated, thus forming an excellent introduction to the subject.

Little is given concerning dynamical aspects of gas-turbine design, such as balance-whirling, vibration of turbine discs and blades, centrifugal and temperature stresses, high-speed bearings, and so forth. To a large extent these are covered by manuals on steam turbine design, but the gas turbine has its own special dynamical and stress problems. Again, heat interchangers for gas turbines are only referred to diagrammatically. However, it is to be realised that there is limitation to information released.

The book is clearly printed and is well illustrated with numerous graphs, drawings and photographs,

B. C. CARTER.

Electrons (+ and -), Protons, Photons, Neutrons, Mesotrons and Cosmic Rays. By R. A. Millikan. (The University of Chicago Press, Chicago. Agent: Cambridge University Press), Revised Edition, 1947. Pp. 642. 124 Illustrations. Price 30sh.

In 1917 the Chicago University Press published a small volume entitled *The Electron*, written by Prof. Millikan. Seven years later, a revised edition of the same book appeared. A book with the present title was first published in 1935. This itself was an expanded edition of the *The Electron*. The volume under review is the outcome of a revision and expansion of the 1935 edition, necessitated by the extra-ordinary advances made during the last twelve years, in our knowledge of these fundamental particles. The appearance of this book will be welcomed by many students of physics for whom the earlier edition has become a standard text. The first four hundred pages of the earlier edition have been reproduced in the present volume. Only minor changes, mostly in the values of units, have been made. Five new chapters (XVI-XX) covering well over 200 pages and containing entirely new material and a full discussion of the results of recent studies, especially in the field of cosmic rays and nuclear energy, have been added. It is a remarkable testimony to the author's presentation that new chapters could be added to the existing text, maintaining at the same time the continuity in the development of the subject. In order not to break the thread of the discussion in the body of the book, the author has collected the mathematical proofs and put them in Appendices at the end of the book, which are no less than ten in number.

The first eight chapters contain, among others, a detailed account of the experiments which led to an accurate determination of the electronic charge. The structure of the atom and the nature of radiant energy form the subject-matter for Chapters IX and X respectively. The next chapter on waves and particles gives a brief and clear account of the particle wave dualism in modern physics. The succeeding chapter deals with spinning electron with particular reference to the spectra of stripped atoms and the new spectroscopic rules. The discovery of the cosmic rays and the early experiments carried out to elucidate their nature and origin are described in detail in Chapter XIII. The next two chapters deal with fascinating topics such as the positron, neutron, and artificial transmutation. Only brief summaries of the experimental facts are given.

Chapter XVI, the first one of the new chapters, deals briefly with the release and utilisation of nuclear energy. Tracing the history of the discovery of nuclear fission and the possibility of large-scale release of nuclear energy, the author makes a strong plea for conserving rather than burning up a rare and precious element, namely, uranium, whose abundance is only a very small

fraction. According to him it is too valuable a material for scientific purposes to be wasted for major power projects so fully provided for by the inexhaustible supplies of solar energy. The succeeding three chapters with respective headings, "Geomagnetic Studies on Cosmic Rays at Low Altitudes", "The Discovery and the Significance of the Mesotron", and "The Nature and Number of Incoming Primary Rays", deal mainly with the different aspects of cosmic ray studies carried out since 1932. Results of airplane surveys of latitude effect and east-west effect, and of sounding balloon flights that carried the electroscopes practically to the top of the atmosphere, have been described in some detail and discussed. The atom annihilation hypothesis put forward by Millikan as to the origin of cosmic rays and the evidence in support of the same have been dealt with in the last chapter. Careful studies of the latitude distribution of incoming cosmic rays carried out by Prof. Millikan and his associates in India, South America, Canada, Mexico and the United States, have been referred to in great detail in this chapter. The conclusions derived from these studies have been shown to support the predictions of the atom annihilation hypothesis.

On going through the book, especially the chapters dealing with cosmic rays, a careful reader is bound to notice an indulgence on the part of the author in presenting a detailed analysis of particular investigations with which he has been intimately associated. No doubt, these investigations are extremely interesting and important. But, the usefulness of the book would have been very much enhanced if a more balanced and critical summary of all the contemporary investigations in the field of cosmic rays had been presented. In spite of this limitation, the present volume contains an extremely useful resumé of a wide range of investigations in atomic physics. It is profusely illustrated with many charts and Wilson cloud Chamber photographs. It is written in a simple and clear, though assertive style. The book is an important addition to the literature of modern physics and should prove to be a welcome companion not only to those working on cosmic rays but also to every student of physics.

R. S. K.

An Introduction to the Theory of Seismology.
By K. E. Bullen. (Cambridge University Press), 1947. Pp. 276. Price 18sh. net.

The author of the book is well-known in the field of seismology; his contribution in the form of the improved 'Travel-time Tables for seismic waves' remains an outstanding achievement. And now he brings out a new book, *An Introduction to the Theory of Seismology*, which includes in a nutshell a world of information. Coming from the Jeffreys school, the author naturally puts in the forefront the views and thoughts of that eminent school; he has not, however, neglected to mention, side by side, the accepted views, if any, of the American, Japanese or German seismologists. He has taken great pains in making the complex subject of seismology as interesting as possible, by gradually approaching the actual condition from the ideal, and by weeding out the non-essentials with utmost care.

In the earlier chapters of the book the author develops the mathematical theories of elasticity and of waves and vibrations. He shows how in the investigation of earthquake phenomena both the vibration theory based on normal mode considerations and the wave theory can be applied. The concept of rays is then introduced in dealing with the propagation of waves in three dimensions, and, on this consideration, characteristics of the waves are clearly brought out. Chapters dealing with seismic waves have been thorough and most useful. His method of presentation is clear and convincing. For example, in determining the cause of the oscillatory movements that are observed at the surface he introduces at first several factors which may contribute, but, after discussing one by one in detail, shows that the essential cause of the observed oscillatory movements must be sought in the heterogeneity of the Earth. Similarly, it has been shown how the possible effects of departures from isotropy due to initial stress become insignificant even when second-order terms are taken into account; logical conclusion that follows is that in seismology the first-order theory will lead to very accurate results in most problems. Bodily waves and surface waves have been considered in great detail and special attention devoted to Rayleigh and Love waves. Since seismic waves penetrate all parts of the Earth's interior and emerge at the outer surface, bringing evidence of the regions they have traversed, study of these waves would naturally lead to useful information. The book includes many advances that have been made in this direction. Indications have been given as to how the elastic parameters of the Earth's crustal layer as well as of the interior can be investigated, and several discontinuities and transition layers so far discovered within the Earth are included in tabular form. A good portion of the book is devoted to discussion on earthquakes, their causes, intensities, epicentral distance and focal depth; it includes the useful table of Gutenberg and Richter showing the distribution of deep-focus earthquakes.

One feels that the chapter on the principle of the seismograph has been rather brief. This part could probably be expanded with fully developed equations using terms of the second order for the benefit of those engaged in the design, and construction of instruments. If the principal features of all the modern types of seismograph were included together with their illustrations, perhaps the value of the book would have been further enhanced. A page on bibliography could also be usefully added at the end.

The author is to be congratulated in having succeeded in his attempt to present so elegantly the essentials of the theory of seismology in so few pages. The book will undoubtedly be endeared by all interested in seismology.

J. M. SIL.

Dissociation Energies and Spectra of Diatomic Molecules. By A. G. Gaydon. (Chapman & Hall, Ltd., London), 1947. Pp. xi + 239. Price 25sh. net.

While giving an appreciation of another book, *The Identification of Molecular Spectra* (*Curr. Sci.*, 1941, 12, 541), of which Dr. Gaydon was part author, we expressed a wish that

other data should have been included. The present book supplies part of the need thus felt: It brings together a critically assessed mass of information regarding the dissociation energies of some 263 diatomic molecules, the value being uniformly based on up-to-date values of the fundamental physical constants, c , h , k etc. As an introduction to this collection a description is given of the various methods by which dissociation energies are evaluated, viz., convergence limits, Birge-Sponer extrapolation, predissociation, electron impacts and thermochemical methods. The application of these methods is also illustrated in detail in the case of certain molecules like N_2 , N_2^+ , NO , CO , CO^+ , CN , F_2 , HF , C_2 , OH , S_2 , SO , Se_2 etc., where the author has suggested values which are free from some of the errors associated with older values. In discussing the data leading to the new values, Dr. Gaydon shows himself an impartial and discriminating critic. The first three chapters give a resumé of the theory of diatomic molecular spectra sufficient to follow the notation and the discussion in the later chapters. Reproductions of spectra are also given so as to illustrate some of the points discussed. The book not only serves a very useful purpose in itself but also provides an admirable model to be followed when a research worker wants to survey the existing literature and make up a list of data and results relating to any subject in which he is interested. Excepting that the price seems high according to pre-war standards, the book will certainly commend itself to all workers in the field of molecular spectra.

T. S. S.

Fundamentals of Photography. By Paul E. Boucher. (D. Van Nostrand Co., Inc., New York), 1947. Pp. 395. Price 22sh. 6d.

Although books on Photography are legion to-day, and attract unflinching attention on the stalls of any bookseller of standing, it is well known among senior workers in the field that the percentage of really dependable and worthwhile publications is very small. For the scientific worker or the serious student of photography, there have been on the market only two or three treatises on the subject which have proved authoritative, and reasonably comprehensive; Paul Boucher's *Fundamentals of Photography* is one of these books. It is undoubtedly a pleasure to notice that Messrs. Van Nostrand Co. have brought out recently a revised second edition of this already reputed text-book.

"A course in photographic technique should be pursued with the same systematic concentration both in theory and practice as any other scientific subject," stated Mr. Lockington Vial, one of Britain's leading scientists, who has made distinctive contributions to the progress of photographic science. The principle enunciated above has been fully kept in view in the preparation of the book under review. Every chapter has been written with such great care and clarity, that no statement is dubious or incorrect, while at the same time brevity and compactness have been attained by the elimination of unnecessary repetition and circumlocu-

tion. The entire ground of technical and scientific photography, including colour photography, X-ray photography and motion picture photography, is covered without omitting any relevant topics. A unique feature of the book is the series of laboratory experiments described at the end of the volume. These cover nearly 100 pages, and have been so systematically planned that any student who goes through the 25 experiments in a good photographic laboratory should gain a perfect mastery over the practical aspects of photographic technique, and the scientific basis of all photographic processes. The appendices and the glossary at the close of the book are indeed very useful and informative. The book is undoubtedly a boon to students and scientific workers who may be looking out for a really compact and up-to-date text-book on the subject, but that does not lessen the value of the book as a guide and reference manual for all amateur and professional photographers in general.

I cannot, however, fail to make one observation. It is usual in text-books on photography to devote the first chapter to the historical development of photography, since it makes not only interesting reading but also provides a definitely better understanding of the latest developments and modern methods. One well-known author of a text-book on photography has allowed 60 pages out of a total of 600 pages, to the history of photography, and there may be some difference of opinion as to whether such a detailed treatment is called for. Paul Boucher has, however, erred on the other extreme by dismissing the subject in less than two pages of his book. This is scant courtesy to a topic that covers a century of progressive developments, and it results in the omission of such great names as Fox Talbot, who made outstanding contributions to the development of photography in the first half of the 19th century. The book would increase considerably in usefulness if the historical outline is extended a little more.

Notwithstanding this criticism the book is an extremely valuable treatise that can be heartily recommended to every serious student of photography.

S. LAKSHMINARASU.

Frequency Modulation Engineering. By Christopher E. Tibbs. Foreword by Leslie H. Bedford. (Chapman and Hall, Ltd., London), 1947. Pp. 310. Price 28/-.

The present volume is a well systematised treatment of the subject of frequency-modulation engineering and makes the study of the subject as a whole easy by including wide range of topics covering every aspect of the subject within its pages. The author deals, in eleven chapters, with all the important aspects of the subject—fundamentals of frequency modulation, propagation of f.m. signals, aeri-als, f.m. transmitters and receivers, measurements on frequency modulation equipment and practical uses of f.m. signals. Chapter two presents the basic ideas relating to the frequency and noise structure and their suppression in a frequency modulation system, which are most appropriate and presented with great clarity. Chapter five

mainly discusses the points concerning the propagation of ultra-high frequency signals with some reference to those of frequency modulated type. Chapter six has been devoted in its latter pages to the consideration of ultra-high frequency aeriels specially for the frequency modulation system. Chapters seven, eight and nine, relating to transmitting and receiving equipment in frequency modulation systems, have been presented very well with sufficient theoretical considerations, circuit diagrams and details of commercial circuits. Chapter ten has increased the usefulness of the subject by including topics like method of measurement of frequency deviation, frequency modulation signal generator, measurement on frequency modulation receiver. Chapter eleven discusses briefly the use of f.m. systems for broadcasting, radio telephony, picture transmission, television, etc., and concludes by a reference to the recently developed pulse-time modulation system.

The author's approach to the various topics is that of a practical engineer. The work abounds in diagrams, figures, tables and information of a practical nature. The paper, printing and general get-up leave nothing to be desired. The reviewer recommends this excellent treatise on the subject to advanced students of electrical communication engineering as well as radio engineers concerned with broadcasting and communication projects.

S. P. CHAKRAVARTI.

Kemp's Handbook of Rocks—completely revised and edited by Frank F. Grout. (D. Van Nostrand Company, Inc., New York; sixth edition, third printing, 1946.) Pp. 300 + i-vii. Price 20sh.

This is a good text-book of Petrology although the author has set for himself the difficult objective of offering a fairly comprehensive knowledge of rocks without invoking the aid of the special techniques of the petrographic microscope. In the original form in which the book was written just about half a century ago, by the late Professor Kemp of Columbia University, it had been acknowledged as one of the most widely used text-books of the time for over a generation. However, text-books go out of date, sooner or later, and they have to 'grow' with time. Kemp's *Handbook of Rocks* has now reached in the sixth edition. The revisor and editor, Prof. Frank F. Grout, himself the author of the well-known book, *Petrography and Petrology*, has greatly enhanced the usefulness of the book under review, while retaining the charming style and method of treatment of the original author.

The fourteen chapters of the book cover all the important aspects in the study of rocks—their description, methods of classification and modes of origin. The determinative tables given in respect of the common rock-forming minerals and the igneous rocks, as also the several tabular statements listing the simple criteria for distinguishing between orthoclase and plagioclase feldspars, pyroxenes and amphiboles, phenocrysts and amygdaloids, phenocrysts and metacrysts, etc., are likewise very useful. The field and laboratory methods are dealt with in such a manner as to offer a direct and helpful guidance to the student. The latest deve-

lopments in the study of sedimentation, and the well-logging specialities have also been explained. Economic aspects of the various rocks have been pointed out.

In short, the book presents the study of rocks in a very clear and simple manner so that the average undergraduate student or any one interested in the subject, provided of course he has some previous knowledge of the fundamentals of geology, could easily follow and understand. Even the complicated and ticklish questions on the mode of classification and origin of the rocks are alluded to in terse statements. For instance, speaking of the metamorphic rocks it is said, "These excessively altered rocks are grouped into a separate, so-called 'metamorphic' division which is a sort of 'omnibus' of unsolved geological problems" (p. 23). "When dealing with metamorphic districts, the student must expect to find contradictory evidences, for a long series of events may have left in the rock a series of minerals and structures formed under a variety of conditions" (p. 250). "It is chiefly because the original cannot always be recognised that the metamorphic class of rocks was separated" (p. 253). "The dividing line between schist and gneiss is arbitrary and expert students may disagree" (p. 249). Again, look at the fine encouraging words to the students regarding the practical difficulty in distinguishing rock-types: "These errors must be expected by field workers at places, and the corrections made by laboratory study afterward are no reflection on the character of the field work" (p. 51). The text has numerous elegant expressions like these.

The book is finely printed, amply illustrated and well bound. The reviewer thoroughly appreciated reading the book with profit to himself.

M. B. R. RAO.

A Manual of Vacuum Practice. By L. H. Martin and R. D. Hill. (Melbourne University Press, Melbourne), 1946. Pp. 120.

Fundamental knowledge, in vacuum technique is as important as glass-blowing to any post-graduate student who has to start research either in physics or in chemistry. The book under review gives a nice introduction to the subject both in theory and in practice. Even to an experienced worker in vacuum technique, the book provides an interesting and illuminating reading. Theoretical portions like, molecular flow, impedance, flow through tubes, speeds of pumps and other measurements have been given in the first chapter. The usefulness of this chapter is further enhanced by the typical calculations in the design of vacuum systems at the end of the chapter. Subsequent chapters are devoted for a critical study of the measurement of pressure, description of vacuum pumps and vacuum plumbing.

The information given in the appendices is as important as the main contents of the book. Often a beginner in vacuum work will have to waste a lot of time in locating the defects of the system when the desired vacuum is not obtained. The choice of grease for the joints, the correct dehydrating agent in the circuit, the uncontaminated oil for the vacuum pump, the employment of purified mercury in the various measuring instruments, constitute but a few of

the many precautions to be taken in vacuum work. The first ten appendices give the details of manipulation in vacuum work while the next eight give useful data often required by the vacuum worker. The appendix dealing with the purification of mercury, however, is far from satisfactory. The author has omitted the cleaning of mercury with water after the nitric acid treatment. For the air distillation of mercury, a spiral of air-cooled condenser is preferable to the water-cooled condenser shown in Fig. 53. It is obvious that purification by vacuum distillation is essential when mercury has to be employed in instruments used in vacuum technique. It is surprising to find that this process has been completely omitted in the book.

M. R. A.

The Tuberculosis Association of India—Eighth Annual Report, 1946. By Lt.-General R. Hay and B. M. Cariappa. (Tuberculosis Association of India, New Delhi.) Pp. vii + 22 + 96.

Six months after the inauguration of the Tuberculosis Association of India World War II broke out, hampering much of the activities of the Association. The Association, however, has been able to build up during these critical years a network of non-official organisations in different parts of India and has moved public opinion in favour of accepted methods in the campaign against tuberculosis. There are today thirty-four Provincial and State Associations affiliated to the Central Organisation.

The Report gives an account of the various activities of the Association. The Association has built up two model institutions—The Lady Linlithgow Sanatorium and New Delhi Tuberculosis Clinic—both of which have been serving as training institutions in anti-tuberculosis work for medical personnel, health visitors and nurses. A scheme for organised home treatment has been increasingly popular at the above institutions. At the instance of the Association, tuberculosis diploma courses have been instituted at several University Medical Colleges, *viz.*, Mysore, Delhi, Calcutta and Madras.

It is gratifying to note that private individuals have evinced keen interest in publishing anti-tuberculosis literature. A pamphlet prepared by Mrs. Helen Thomas in a South Indian vernacular is a case in point, which the local Association may well utilise. Another notable feature is the appointment of corresponding members from other countries, a list of which is given on pp. 56-59. In this way, the authors hope to secure the benefit of contact with the best work and workers to be found abroad. There is also a proposal to publish an *Indian Journal of Tuberculosis* as a permanent feature of the activities of the Association.

The error on p. 7, line 6, "D.T.D. course", is to be read as "T.D.D. course". The Appendix gives an account of the various activities of the local associations together with some addresses at the Seventh Annual Meeting of the Association.

A. S. RAMASWAMY.

Festschrift zum 60e Geburtstag von Professor Dr. Embrik Strand (1936-1939). (Commemorative volume celebrating the 60th anniversary of the zoologist, Professor Dr. Embrik Strand.) Vols. I-V, pp. 3,438, 104 plates and 687 text-figs. Riga (Latvia, U.S.S.R.).

Those volumes, published in honour of the well-known scientist of Riga, Prof. Strand, the Director of the Systematic Zoological Institute and the Hydrobiological Institute of the Lettish University of Riga, contain 194 papers by 126 zoologists and palæontologists from 25 different countries of Europe, the Americas, Asia, Africa and Australia. Each volume is complete by itself, and may be purchased singly. The volumes may also be obtained by exchange from Professor Strand. The fifth volume (pp. 615-749), contains a complete index of all the Latin names of animals in the five volumes. Out of the 194 papers, 12 treat of general zoology, 3 of biographies of zoologists, 3 of natural philosophy, 3 of various invertebrata, 1 of protozoa, 12 of vermes, 3 of tunicata, 4 of echinodermata, 9 of mollusca, 1 of different arthropoda, 4 of crustacea, 42 of arachnida, 1 of myriopoda, 85 of insecta, 1 of various vertebrata, 1 of pisces, 3 of reptilia, 12 of aves, 5 of mammalia, and 10 of palæontology. Consequently, specialists in all groups will find something to interest them in these volumes. The contributors are usually well known scientists. Most of the papers are systematic, faunistic and zoo-geographical, but there are also some dealing with development, physiology, biology, etc.

These commemorative volumes differ from the general run of such writings in a variety of ways. Firstly, the quantity of matter they contain is enormous, and this, in its turn, is related with the fact that an unusually large number of contributors, from practically all over the world, have collaborated in the production of these volumes. It is striking that all the contributors are foreigners and apparently not under any debt or personal obligation to Professor Strand, which shows to what an extent Prof. Strand is held in esteem by his colleagues all over the world. The volumes are sumptuously produced, lavishly illustrated, and cover a very wide range of zoological subjects. We consider that no zoological library would be complete without them. They combine in them a well-deserved tribute to the energy and devotion of Professor Strand to the cause of Zoology, as well as a practical contribution to original zoological research.

M. L. ROONWAL.