REVIEWS

An Introduction to the Kinetic Theory of Gases. By Sir James Jeans. (Cambridge University Press), 1940. Pp. 311. Price 15*sh.* net.

The credit of having presented in English for the first time the Kinetic Theory of Gases 'upon as exact a mathematical basis as possible' goes to Sir James Jeans. The first edition of his *The Dynamical Theory of Gases* appeared in 1904, and many students of Physics as also many mathematicians drew their sustenance from that book in spite of the stiff treatment of the subject. Other editions which appeared in 1916, 1921 and 1925 included more material such as the treatment of the Quantum theory. The present edition is less costly and is within the reach of the average serious student of the subject. This may perhaps be due to the size of the book being much smaller than before. It may look less imposing, but surely it is less forbidding, and is certainly more inviting to students of science. Evidently the appearance of many special treatises on the Quantum theory in recent times has induced Sir James Jeans to effect a thorough change in the scope of the present book, and there is hardly any reference to the Quantum theory. Even so, other subjects of interest such as Aerostatics are omitted.

To a very large extent the contents of the earlier editions are retained here often in the same words. New material has been included under the heads of the experimental tests of Maxwell's Law of Distribution of Velocities, and Perrin's work on the Brownian Movement. But it is surprising that Sir James Jeans has not touched on any of the more recent and the fascinating developments of the subject such as Low Pressure Phenomena, Fluctuations and the Electric and Magnetic properties of gases. There must have been very strong reasons for not including them, but we confess to a feeling of disappointment. His remarkable way of writing raises expectations in us; but he seems to have decided that they need not be gratified. The master mind which has given such an admirable treatment of the famous theorem of persistence of velocities could throw a flood of light on these newer phases of the subject much to the advantage of the student of physics and physical chemistry.

In this connection one recalls to mind the concluding sentences in the *Mathematical Theory of Electricity and Magnetism* by the same author. Referring to the newer concepts introduced by the Quantum theory he writes "..... the limiting case provides a bridge between the old mechanics and the new; on one side of the bridge the classical electrodynamics holds undisputed sway, but as we cross the bridge and advance into the territory on the other side, the additional restrictions imposed by the Quantum dynamics become ever more important, until finally they may be considered to govern the whole situation. The exploration of the territory on the far side of the bridge will provide work for a new generation of mathematical physicists; the present work attempts only to bring the reader as far as the bridge, and to make clear to him that if he crosses it he must expect to find different conditions prevailing on the other side". In the domain of Kinetic Theory of Gases we are now led by Sir James Jeans only as far as a similar bridge though his guiding hand in the new territory would have been invaluable and *unique*.

The Cambridge Press has as usual got up the publication quite nicely though it is hard to understand how some minor typographical errors have crept in, as for instance on page 160 duo/dx is printed instead of duo/dz, and this error occurs twice in rapid succession on the same page.

P. SRINIVASA ROW.

Mathematics of Statistics. By John F. Kenney. Part I. 1940. Pp. x + 248. Price 12*sh.* 6*d.*

Mathematics of Statistics. By John F. Kenney. Part II. (Chapman & Hall, Ltd., London), 1940. Pp. ix + 202. Price 11*sh.*

The author states that his object has been "to write an up-to-date text which will serve to prepare the student for the really mathematical part of the theory of statistics". He has succeeded in producing a useful compilation which will serve as a standard text-book for statistical teaching. Important aspects of the subject have been covered in an adequate manner on the whole;

and obscure and unfamiliar ideas have been clearly explained.

The book is divided into two parts. The first part deals with what may be called descriptive methods, and the second part with sampling theory. This relegation of the theory of distribution to the very end has resulted in some lack of definiteness both in notation and ideas in the earlier part. But this may be unavoidable in an elementary text-book; and the wise course may be to leave the beginner to get his ideas about statistical inference clear after he has become familiar with the more descriptive portions of the subject.

Part I starts with an introductory chapter in which the scope of the science of statistics is treated in a concise but lucid manner, with some interesting observations on the relation between mathematics and statistics. Chapter I deals with frequency distribution on familiar lines. The distinction between class limits and class boundaries is clearly explained, but the difficulty of boundary points is avoided by taking the class boundary to a higher place of decimal than that used in the primary material. The treatment of 'graphical representation' in the second chapter is rather meagre, and can be amplified with advantage.

Chapter III deals with averages of various kinds such as the arithmetic, geometric and harmonic means, modes, medians, etc., in the usual way on purely algebraic lines. In every case the results are given in the form of abstract theorems. This may be convenient for a purely formal development of the subject, but it is not clear how far this is either necessary or desirable for teaching purposes.

The fourth chapter on moments gives a useful summary of algebraic results including an elementary description of Sheppard's correction. Some reference might have been made at this stage to associated symmetric functions like semi-invariants and cumulants which are being increasingly used in theoretical investigations. It is worth noting that new symbols, namely, a_3, and a_4 for the Pearsonian $\sqrt{\beta_1}$ and β_2, are introduced presumably to avoid confusion with the so-called β-coefficients in correlational analysis which are extensively used in the United States. The β_1 and β_2 notation is, however, so deeply ingrained in Pearsonian literature that a change of notation is likely to be merely confusing. If the Pearsonian approach is to be given up, the simplest plan would be to adopt directly the cumulant and k and kappa notation of R. A. Fisher.

Chapter V gives a general description of measures of dispersion. Skewness and kurtosis are explained briefly in Chapter VI together with a fuller treatment of the normal curve and its important properties. The next Chapter VII deals with curve fitting in an elementary manner. Time series and exponential trends and ratio charts are also briefly discussed together with a useful description of the Gompertz curve in this chapter. The Pearson family of curves requires fuller treatment; and other well-known systems deserve mention. Perhaps the best plan would have been to discuss systems of curves in greater detail in Chapter VII, and devote a new chapter to the discussion of time series and other curves.

Chapter VIII is taken up with the elements of correlation theory and associated topics such as the coefficient of alienation. There is a general description of the normal bivariate frequency surface with an elementary treatment of non-linear regression and Pearsonian η^2, and a discussion of tests of linearity on older lines which is not adequate.

Part I is complete by itself. Special features are the large number of exercises at the end of each chapter, and the review questions and problems at the end of the book. There are two appendices giving the ordinates and areas of the normal curve to five places of decimal, and the common logarithms of numbers to five decimal places.

Part II deals with more recent analytic developments, and gives in a convenient form a useful summary of the essentials of the theory of sampling distributions. Chapter I starts with elementary topics of probability. No attempt is made to go into logical foundations. Thus the ratio of frequencies is accepted as the basis of the definition of probability, and the concept of the limit of the ratio is introduced without any discussion. This is followed by the usual theorems in permutations and combinations and a fairly full treatment of the binomial distribution. The approximation to the binomial with the normal curve is discussed in considerable detail. The simple sampling of attribute is then considered, and the probable error is introduced. The discussion of standard errors and correlation of errors in class frequencies is particularly

worth noting. The chapter concludes with a discussion of the Poisson exponential.

Chapter II supplies a convenient summary of results in integral calculus and γ and β functions which are constantly required in statistical theory. Chapter III deals with the Pearson system of curves. The connexion between the Pearson family and problems of sampling from urns is clearly explained. This is followed by a number of more advanced results relating to the normal curve with a brief treatment of the Gram-Charlier series. The joint distribution of two variables and the normal correlation surface form the subject-matter of Chapter IV. Important results are obtained with the help of calculus, and relevant formulæ for tetrachloric correlation are given at the end. Chapter V gives a general treatment of multiple and partial correlation together with a large number of results.

Fundamentals of sampling theory relating to the mean are given in Chapter VI. The treatment is broadly algebraic based on the method of mathematical expectations. The reproductive property of normal law is pointed out and emphasised; and certain algebraic results for moments of non-normal distribution are quoted without proof. This is followed by Tchebycheff's inequality and the law of large numbers. This forms the background for introducing the concept of "null hypothesis", tests of significance, and the significance of a difference in proportions.

The theory of small or exact sampling distribution is discussed in Chapter VII; and the η^2 distribution and statistical inference in Chapter VIII. The seventh chapter opens with an algebraic calculation of the expected value of the variance, which naturally leads on to a discussion of unbiassed estimates and the concept of degrees of freedom. This is followed by a discussion of Student's *t-distribution* by analytic methods. Fisher's method of geometrical representation is next explained and used to obtain the distributions of the standard deviation and variance, and of Fisher's t. The structure of analysis of variance is explained in the case of a twofold table as well as its use in testing linear regression. The multinominal law is used as the starting point for the discussion of the η^2 distribution.

The second part of Chapter VIII starts with a brief introduction regarding induction and Bayes' theorem on usual lines. This is followed by a concise treatment of fiducial limits with standard formulæ for the mean, difference between two means, and variance.

The last three chapters probably form the most valuable part of the book. Our only complaint is that the author has not gone far enough. The mathematics used is not quite elementary, and the student who understands thus far can be readily trusted with some of the more advanced work in the sampling distributions, and may be taken deeper into modern theories of estimation and of testing of hypothesis.

The appendix in Part II gives five per cent. and one per cent. points for the distribution of the ratio of variance, and also the χ^2-probability scale reproduced from R. A. Fisher's Table.

A large number of exercises and review problems are given in each part. References to published papers and hints for additional reading form a valuable feature. The book abounds in quotations of varying length and importance; these are always enjoyable and often stimulating. In many ways the book is an improvement on text-books of similar scope and aim.

P. C. MAHALANOBIS.

General Physics. By W. L. Whiteley, B.Sc. (Lond.). (The University Tutorial Press, Ltd.), 1940. Pp. viii + 590. Price 7*sh.* 6*d.*

This book represents a course of physics upto the S.S.L.C. standard with emphasis on the practical and technical applications illustrating physical principles. The mathematics required for perusing the book is very limited, only sparing use having been made of simple Algebra and Trigonometry. Illustrative figures and diagrams are plentiful, and the principles underlying many technical applications are briefly explained as often as possible. Illustrative examples are neatly worked out and a large collection of problems is distributed throughout the book. But on account of the large ground covered, the explanations are sometimes too meagre and sketchy. With so many everyday appliances, based on physical principles, which the citizen meets in common life, every educated person ought to possess at least as much knowledge of physics as is contained in this book. We feel that the book is particularly suited for students taking up Diploma courses in technical subjects in which a knowledge of physics is essential.

T. S. S.

Technique of Grassland Experimentation in Scandinavia and Finland. (Herbage Publication Series, *Bull. No.* 28. Published by the Imperial Bureau of Pastures and Forage Crops, Aberystwyth), 1940. Price 2*sh.* 6*d.*

The Technique of Grassland Experimentation is considered under two heads: (1) Quantitative measurement of grass production; and (2) Stock-grazing trials. These aspects are dealt with clearly in seven articles by various workers. The salient points brought out in the bulletin are:

(1) Instead of using permanent, fenced areas, which are expensive, movable "control cages" made from boards and barbed wire, 4 × 4 m. in size are employed. This method has proved advantageous especially in testing the yield of pasture leys in harvesting hay for winter fodder.

(2) The technique of stock grazing is of great value on large areas which are suitable for large-scale experiments.

(3) Climatic and soil conditions have a great effect upon the results. This point is of importance to India, where divergent climatic and soil conditions are encountered. Experiments on a large scale should be undertaken in various parts of the country in order to obtain results of practical value.

(4) For botanical analyses, the Hult-Serander method is employed. This gives an idea of the covering of each species. The method does not appear to differ from the method of Braun-Blanquet in any essential point. In the experience of the reviewer, this method cannot be applied with any accuracy for Indian grasslands where the number of grass species and weeds is great.

The Bulletin will prove to be a valuable guide to scientists in India engaged on studies relating to our grasslands.

F. R. B.

The Biochemistry of Symbiotic Nitrogen Fixation. By Perry W. Wilson. (The University of Wisconsin Press, Madison), 1940. Pp. xiv + 291. Price $3.50.

Nitrogen is one of the most interesting and important elements intimately concerned in the economy of life processes. It is considered to be an inert element in the sense that it does not enter into combination with other gases like oxygen and hydrogen at ordinary temperatures and atmospheric pressure, and cannot, therefore, be 'fixed' without having recourse to high temperatures and pressures. In nature, however, this fixation takes place in the soil and in plants at ordinary temperatures through the agency of micro-organisms. The fixation that takes place in the bodies of plants is called symbiotic fixation, as it is brought about by micro-organisms to the mutual advantage of the plants and the micro-organisms. This process of fixation is most evident in leguminous plants.

The chemistry of symbiotic nitrogen fixation is a fascinating subject for study and is relatively an unexplored field. In recent years there have been published several papers dealing with the fixation of nitrogen by bacteria and plants,—the biochemistry of bacteria, the mechanism of fixation and the enzyme systems connected therewith. These contributions to our knowledge of symbiotic nitrogen fixation are many and scattered in literature. The author has collected and reviewed these several papers in the publication under review. The book contains eleven chapters. The first chapter contains a discussion on the nitrogen economy of man and nature; the second is a survey of the work on leguminous plants; the next seven chapters deal with the bio-chemistry of the fixation process, while the last two chapters are devoted to a discussion on the practical and theoretical aspects of the subject.

The book is well written and neatly printed, and makes a useful addition to the library on the subject. B. V. N.

Catalogue of Indian Insects—Part 25. Thysanoptera. By T. V. Ramakrishna Iyer and V. Margabandhu. (Manager of Publications, Delhi), 1940. Pp. 64 + viii. Price Rs. 2–2–0 or 3*sh.* 9*d.*

Till recently very little work on any aspect of this comparatively generalised order of insects in India, had been done. A systematic treatment of this group had been a long-felt want among Indian Entomologists and the authors who have now brought out this volume, deserve their warmest thanks.

The *Catalogue* includes 232 species distributed among 94 genera. The classification adopted by Karny and Watson, has been closely followed by the authors in the arrangement of the different species.