concept and that he claims for the probability theory an over-all importance as being "the nucleus of every theory of knowledge" (p. v).

The first chapters of the book are an introduction to the more or less elementary problems and methods of probability computation. Much use is made hereby of the modern notations of symbolic logic. What the reader finds here can be found in a more conventional form of notation in most mathematical texts. In fact, it is not difficult to prove that, if one writes down all natural numbers starting with 1, 2, 3, . . . and continuing up to the highest 100 digit number, only 20 percent of these numbers will include more than 12 fives. But it is a long way from this arithmetical fact to the statement that in putting down one set of 100 digits at random one has an 80 percent probability of getting less than 13 fives. This gap cannot be bridged by any display of formulas of symbolic logic. It would require a clear-cut definition of what is meant by random, but the author has not given such a definition. The examples he uses to illustrate the theory are of a different type. He goes to great lengths, for instance (pp. 254–257), in dealing with the case of a Dr. B., who was suspected of murdering his wife in order to collect insurance benefits. The starting point is a statement of the insurance company that four out of five husbands who take out large amounts of life insurance for their wives do so with criminal intentions. After a lengthy calculation which takes into account several instances of possible murder the result reads: "The probability of murder, on the basis of the known facts, is therefore 84%. What makes this value even higher than the antecedent probability of 80% is the fact that the insured person died, and not of a natural death" (p. 257). Computations of this type are often used to discredit the calculus of probability in the public eye.

The eighth chapter introduces a new idea under the heading "Theory of Probabilities of a Higher Level." Its main purpose is to justify the "inductive inference," i.e., the rule that the frequency observed for a finite initial section of a sequence can be identified with the probability controlling the sequence (p. 329). It is not quite clear to the reviewer why the inverse probability, discussed in the preceding sections, should not belong to the probabilities of second level (i.e., probabilities of a probability value).

The last three chapters—9, 10, and 11—are entitled "The Problem of Application," "Probability Logic," and "Induction." In this field lies what the author apparently considers to be the main original achievement of his theory. The multivalued logic is another form of presenting the most elementary probability relations. "Quantitative truth" and "quantitative negation" can, in the last instance, be interpreted only in terms of frequencies. Reichenbach thinks that he needs this new formalism for his theory of induction. Here he discusses such questions as why Newton's law of gravitation has been accepted as a general law when it was checked only by a finite number of tests; why it was discarded in favor of Einstein's theory on the ground that it disagreed with observations in one single instance. He rejects the idea that the unification of theories serves intellectual needs—it simply increases their probability (p. 433). All kinds of scientific statements, each single argument and each comprehensive theory, has a certain assignable probability value, and "all the questions concerning induction in advanced knowledge, or *advanced induction,* are answered in the calculus of probability" (p. 432). These quotations and the following one must be given here without comment. The reader might wish to know what Reichenbach calls the rule of induction and presents in prominent print on page 446:

"*RULE OF INDUCTION. If an initial section of* n *elements of a sequence* x_i *is given, resulting in the frequency* f_n*, and if, furthermore nothing is known about the probability of the second level for the occurrence of a certain limit* p*, we posit that the frequency* f_i $(i > n)$ *will approach a limit* p *within* $f_n \pm \delta$ *when the sequence is continued.*"

No indication is given in the book about the magnitude of δ.

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Introduction to the Theory of Probability and Statistics. Niels Arley and K. Rander Buch. New York: John Wiley; London: Chapman & Hall, 1950. 236 pp. $4.00.

The first sentence of the preface states that "the purpose of the present book is to give an elementary introduction to the theory of probability and statistics with special regard to its practical applications." Although the book has some excellent features, it is the reviewer's opinion that the authors have been only moderately successful in the objective stated.

In the first place, the treatment is far from elementary, and the style of exposition is condensed. It is doubtful whether it could be read with profit by many students below the postgraduate level, or by anyone who has not reached a considerable degree of maturity in mathematics. (It may be mentioned, however, that this is a translation of a Danish text, and perhaps the average freshman in a Danish university is much better prepared in mathematics than his American counterpart.)

Secondly, the emphasis seems to be very much on the theoretical, rather than the practical, aspects of the subject, and the practical illustrations included are taken from the so-called "exact" sciences—physics, astronomy, engineering, etc. This book would be an excellent introduction to the subject for a physicist (it is the author's impression that it is just the sort of book many physicists ought to read) or a mature mathematician without any previous knowledge of this field. It is difficult to see what other purpose it could serve, as it is too difficult for an elementary text, and not sufficiently comprehensive to be used as a reference book by one who has occasion to apply statistics and probability in his work.

The first seven chapters deal exhaustively with the theory of probability distributions, and the illustrations include a number of such distributions arising in physics, which are probably not familiar to most statisticians. Chapter 8 deals with probability limit theorems and Chapter 9 contains a brief but very able discussion of the relation of the theory of probability to experience and its practical importance. Chapter 10 develops the theory of estimation, following mainly the approach of R. A. Fisher. Chapter 11 is devoted primarily to the theory of errors, as applied to physical measurements, but includes a somewhat sketchy discussion of the theory of tests of hypotheses. Chapter 12 takes up the application of the theory of probability to the adjustment of physical measurements subject to one or more constraints. For example, measurements may have been made of all the three angles of a triangle, and it is desired to arrive at a set of adjusted values which will add up to 180 degrees. Appendices deal with the gamma function and elementary matrix theory, and tables of certain important distributions are included, followed by a list of 90 problems and a list of 44 bibliographic references.

The authors' statement of their philosophy of statistics is most refreshing and valuable. A highly commendable and unusual feature is the distinction clearly and consistently made throughout the book between the "mathematical model" and the "real world." Also noteworthy is the axiomatic approach to the theory of probability and the careful statement of the assumptions underlying various statistical procedures.

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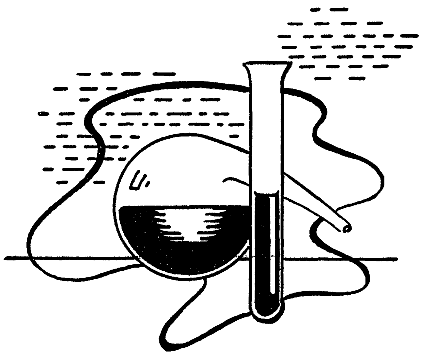

Infrared Determination of Organic Structures. H. M. Randall, R. G. Fowler, N. Fuson and J. R. Dangl. New York: D. Van Nostrand, 1949. 239 pp. $10.00.

The use of infrared spectra to identify organic compounds and characterize certain structural groupings in these molecules is not new, but recent developments in the technique of infrared spectroscopy (which make the recording of such spectra a routine matter) have caused such rapid development, that the appearance of a book on the method must be very welcome to many chemists and biochemists. To write such a book is no easy task; the method is still so new that, although certain principles can be very easily stated and exemplified, their detailed application to individual molecules presents many pitfalls for the unwary.

The fact that certain common chemical bonds and groupings have characteristic vibration frequencies which, to a first approximation, are independent of the rest of the molecule and so are always observed in approximately the same position in the infrared, makes the method, at first sight, a very attractive and powerful one. The difficulties lie in the degree of constancy of each characteristic frequency and in achieving a clear understanding of the reasons for the small but very important variations. Thus C=O frequencies are generally lower than C=C and C=N frequencies, but in most amides the C=O frequency is in the position normally occupied by C=C or C=N frequencies. It follows that it is just in those cases where the chemist most needs help from the spectroscopist (i.e., when he is on unfamiliar ground) that the spectroscopist is sometimes least sure of his characterizations.

In order to establish a new structure by infrared methods, it is generally necessary to have the spectra of series of model compounds in which the key groupings used in the spectroscopic analysis of the unknown structure have environments closely resembling those of the key groups in the various structures under consideration. This was very well exemplified in the use of infrared spectroscopy to establish the structure of penicillin. The present book derives directly from the work done by the authors on penicillin. The state of the method at that time was such that an extensive investigation had to be made of the frequencies characterizing many chemical bonds, especially those of the C=O, C=C, C=N, and NH bonds in a wide variety of compounds.

The authors make it very clear that their treatment of the subject must in no sense be regarded as definitive or even comprehensive. This is very wise, for it will be several years before the chemist can be given his handbook for the use of this structural tool. As a first step in the right direction, this book can be highly recommended. After a general discussion of the underlying principles, a most useful catalogue is given of frequencies occurring in the range 5 μ–7 μ, commonly known as the "double bond" region, since the key frequencies of the C=O, C=C, C=N, and N=O bonds occur here. A more general catalogue of characteristic infrared and Raman frequencies between 2.6 μ and 70 μ follows, preceded by a short discussion of the methods of assignment and how these are based on complete analyses of the infrared spectra of very simple molecules. A very valuable chapter is then devoted to illustrative examples of the method drawn from the authors' own experience. The experimental techniques employed by the authors are next described in detail and, finally, reproductions are given of the actual tracings of the spectra of over 350 compounds.

The only serious slip noticed is that in the final catalogue of spectra (p. 195) the spectrum of morpholine is wrong and this vitiates the discussion concerning morpholine on page 7. (The spectrum given for morpholine appears to be that of nitromethane.) It is not possible to agree with every one of the assignments proposed but detailed discussion of these cases is not practicable here, and in general only further work would show which view was correct. It might have been advisable, however, to indicate by special marks that certain assignments are beyond question, others are fairly certain, and a few are still open to question. The treatment of the theoretical interpretation has some omissions. In particular, the