Molecular Spectroscopy

The Structure of Molecules. Gordon M. Barrow. Benjamin, New York, 1963. xii + 156 pp. Illus. Paper, $1.95; cloth, $3.95.

This introduction to the concepts of molecular structure which are derived from spectroscopy was written for readers who have had at least one year of college chemistry. Students who have progressed to the study of physical chemistry are prepared for a more quantitative presentation. This paperback is one of a series of approximately 15 monographs proposed by the publisher; each volume will deal broadly with one subdivision of general chemistry and will constitute a complete unit within the limitations of the preparation of the students for which it was intended. In theory the textbook used for the course would thus be liberated from having to present a fragmentary treatment of many exciting topics. The editor hopes that "teachers of elementary science will find these volumes invaluable aids to bringing them up to date in the various branches of chemistry."

In this volume the selection of chapter headings is the conventional one, based on the sequence of characteristic energy gaps between levels for rotation, vibration, and electronic excitation. The author should be complimented for concentrating on essential principles and for not attempting to introduce too much material. He did include a few selected topics in electronic spectroscopy, specifically those dealing with simple gas molecules and with metal ions in crystals. The problems and exercises are at the second year level; they are not particularly imaginative, but they will give students a feeling for orders of magnitude. To this end the author has also prepared a number of tables. Most of the illustrations are standard; a few are misleading, and the artist was not sufficiently ingenious in his attempt to give a correct impression of a molecule vibrating in a normal mode. The text was written with evident enthusiasm for the subject, but it appears that this enthusiasm has led to a major difficulty, in my opinion.

The proliferation of misconceptions is a teacher's worst sin. Because there are too many careless statements that can be easily misinterpreted, particularly by students who do not know the implied meanings of the terms used, because there are misleading diagrams and serious errors, I cannot recommend this book to anyone. In his attempt to impress the reader with the fact that "molecules are real, intricate, structural arrangement of atoms in space," the author was needlessly imprecise. It is incorrect to imply that the *models* for molecules, which he describes, are more than just models. His treatment of the term *bond length* is one example: compare the statements on pages 1, 45, and 104. The discussion of Planck's relation (pages 8 and 9) is historically and conceptually in error. The so-called Boltzmann distribution (page 25) is not quite right; and there are many other inaccuracies.

It is regrettable that a serious and worthwhile attempt to present the exciting facts and theories of molecular spectroscopy to undergraduates has come to nought, possibly due to hurried writing and failure to appreciate the difficulties that a beginner may have with the accepted jargon.

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Statistics

Statistical Treatment of Experimental Data. Hugh D. Young. McGraw-Hill, New York, 1962. x + 172 pp. Illus. Paper, $2.95.

Starting from the premise that "every scientist and engineer needs some elementary knowledge of statistical methods for treating experimental errors and analyzing experimental observations," and a "firm belief that some of these techniques should be introduced early in the undergraduate curriculum in science and engineering, so that they may be used in later courses which incorporate laboratory work," the author has written this little book "in an attempt to present these techniques in a form which is understandable, palatable, and even enjoyable for sophomore science or engineering students with little mathematical sophistication and no previous exposure to the subject." The author's premise is unquestionable. I endorse his "firm belief" and commend his objectives. His prose is very readable. His selection of problems for class and homework exercise is good. But I cannot recommend this book to undergraduates in the physical sciences, nor to anyone else, because much of what the author says by way of explanation is confused, inaccurate, misleading, or completely erroneous. This is merely one more of those little books (or chapters) on probability and statistical methods written for physicists, by physicists, with a shocking and inexcusable disregard for the many notable advances which have been made in the mathematical theory of probability and the theory of statistical inference during the past half century and which have led not only to fundamental changes in, but also to considerable clarification of, statistical theory and practice.

Many of the faults and deficiencies of this book stem from one major defect: the author fails to make conceptual and notational distinctions between a *random variable*, X, and a specific number, x, say, that is the realized value of X in some particular instance; and he similarly fails to distinguish between *parameters* of the probability distributions of random variables, *estimators* of these parameters (that is, functions of the random variables used to obtain estimates of parameters from observed values of the random variables), and the *estimates* yielded by these estimators in particular instances.

Any discussion of the statistical interpretation of experimental data that does not carefully and consistently make and preserve such distinctions cannot avoid becoming hopelessly confused. For example, the author uses "σ" not only to denote the standard deviation σ of the probability distribution of X's, but also to denote the sample function

$$S = \sqrt{\sum_{i=1}^{n} (X_i - \bar{X})^2/n}$$

and the value of S in some particular instance,

$$s = \sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2/n},$$

with the result that the reader may gain the impression that the standard deviation of the sampling distribution of the sample function $\bar{X}$ (or, worse, of $\bar{x}$) is

$$s/\sqrt{n},$$

whereas it is

$$\sigma/\sqrt{n}.$$

Not only are σ, S, and s very different conceptually, but s may differ considerably from σ numerically. ($\bar{x}$, of