

supernatural. Whether this procedure will pass the test of being orthodox science or being orthodox religion may well be questioned, but progress and orthodoxy in either science or religion seldom dwell together in comfort under one ideological roof—Without discarding the traditional religious view, we may see the same set of facts and circumstances as an extension into human history of the process which for biological science accounts for the mysterious proliferation of life in the organic world. Traditional theology sees the introduction of Christian thought and ideals into the stream of human history as the supreme act in the dramatic story of man's fall and redemption, as set forth in the Hebraic-Christian scripture. We may equally well see the facts from the point of view of modern science as marking a mutation in the evolution of the spiritual side of man's nature."

"The belief that evolution is *not a chapter of accidents*, but that its operation in nature may be interpreted as an expression of purpose is an entirely rational attitude to take.—As a spiritual being, man can only be regarded as a mutation, a sharply decisive break in the course of the evolution that produced him. The *mind* of man can be regarded as the result of an act of pure creation—something new in the totality of organic life. Science has no explanation in its own terms to offer for the existence of the human mind. Christian faith ascribes it to the creative Will of God. The finite spirit of man is the developing image of the infinite Spirit of man's Creator.—At this point the critical reader will no doubt observe that the writer has failed in his attempt to maintain an entirely objective attitude toward the subject under discussion. This must be freely admitted. What has just been said is not a statement of scientifically demonstrable fact, but rather a profession of the writer's own religious faith that evolution in the human species is in the direction of the fulfillment of Jesus' vision of the Kingdom of God."

"It would seem that our almost hysterical fear of Communism within our own borders springs from a haunting anxiety that our form of democracy is not working. Racial discrimination, endless strife between labor and management, the struggle between economic groups over the distribution of material wealth, the presence of dire poverty in the midst of plenty, all conspire to create the uneasy feeling that somehow democracy has got off the track and is bumping along on the ties—that our spiritual strength falls far short of our material greatness. May it not be that this lack is our inability to bring into practical expression in the context of our individual lives and our mechanized society those ideals of human brotherhood, that sense of love and concern for our fellows which are the centre and core of the religion we profess and the only basis for a truly democratic way of life? And may not this failure arise from the fact that we have come to regard these ideals as the pious teachings of an outworn tradition, rather than the expression of truths as

deeply rooted in reality as are the truths of material science?"

Though this reviewer has a will to believe in a modified mechanistic hypothesis as an explanation of all the phenomena of both mind and matter with a minimum number of assumptions, he enthusiastically recommends this book as a most interesting and scholarly philosophical dissertation, to be classed with the writings of Sir Arthur Eddington and Sir James Jeans. On account of the broad interest in its subject matter, the sales of this book will probably be orders of magnitude greater than the sales of Dr. Sabine's textbook on Acoustics and Architecture. Many scientists give but little thought to religion, but when the scientist's child reaches the age when his friends are going to church, a day of decision has been reached. Dr. Sabine has skillfully explored the coupling between science and religion; the extent to which the reader agrees with the author's conclusions will depend on his personal coefficient of coupling.

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Methods of Statistical Analysis (Second Edition). By Cyril H. Gouliden. 467 pp. John Wiley and Sons, Inc., New York, 1952. \$7.50.

A physicist can usually make a least-squares fit of six points to a linear or quadratic formula; but does he know how to test whether the quadratic term is significant? A good guess is "Yes" if he talks about variance and "No" if he talks about probable error. For the exact solution of this problem is a part of the theory of small samples, which got its start in a British brewery in 1908. That date separates modern statistics from the older variety, and the jargon of "variance" from that of "probable error". The physicist who multiplies all his standard deviations by 0.67 is announcing, in effect, that he accepts stochastic truth as it was revealed to Gauss and Laplace, and that he will not tolerate the sacrilege of a new translation.

Until lately, a physicist had some basis for such fundamentalism; for the new translation of statistics was itself written in a language foreign to him. It was contained in books about plant fertilizers and dizygotic twins, and in articles in *Biometrika* and *Annals of Eugenics*. But now statistics has been embraced by the chemists, the engineers, and the ASTM, and new books have been written in a language reasonably intelligible to physicists. These books differ widely from one another. At one extreme are the cookbooks, full of specialized recipes, without theory or discernible motivation. At the other extreme are the theoretical treatments that reduce statistics to a rigorous mathematical model, uncontaminated by any contact with experiment. Within this variety of offerings, the physicist must search for a book that promises a tangible return for his time. He needs to understand the logical structure of modern statistical theory and the principles that underlie the practical techniques; he need

not verify all the integrations or study all the possible designs for a statistically planned experiment. He would like to know what assumptions go into the theory, what conclusions come out, and what use can be made of the results.

This book was not written especially for physicists, or even for chemists or engineers. Judged nevertheless as a book for physicists, it compares favorably with other books, in the following respects.

First, many of the fields covered are useful in physical applications. After three chapters on basic theory, there are three on simple applications such as significance tests and straight-line fits; four on more complicated applications such as nonlinear fits and correlation; four on experimental designs; and five on special topics such as quality control. Of particular interest to physicists is the fitting of data with nonlinear functions; when a polynomial approximation is adequate, tabulated orthogonal polynomials are very useful. This book devotes over ten pages to them; Hald's 783-page *Statistical Theory with Engineering Applications* gives them one sentence.

Second, the discussions are concrete. The methods discussed are usually introduced by specific problems and are always illustrated by numerical examples. Definitions also are concrete; for instance: "We make an error of the first kind when a good coin is classified as bad, and an error of the second kind when a bad coin is classified as good". Compare the traditional statement: "An error of the first kind consists in rejecting the test hypothesis when it is true, an error of the second kind in accepting it when it is false".

Third, the logical relations and motivations are kept clear. They are emphasized in the discussion of each topic, and the numerical examples are often followed by a critical discussion of the uses and limitations of the method exemplified. The author, in his own words (p. 328), is "concerned with understanding the principles of the methods . . . rather than with the mere elaboration of appropriate techniques." For such elaboration, references are given with each chapter.

The few lapses from clarity stand out because they are exceptional. The equating of equations on p. 9 is confusing as well as unconventional. The important terms "unequal weight" on p. 177 and "maximum likelihood" on p. 399 are used without explanation and are not in the index. The discussion on p. 355 leaves this reader more confused than it found him. There are a few slips in grammar and spelling, e.g. "efficiency . . . are" on p. 427 and "principle method" on p. 194.

What statistics book is most suitable for a particular physicist depends on his previous knowledge and on his problems. I do not recommend purchase of this book without previous inspection, but I do recommend investigation of its possible usefulness. That its author is a cereal agronomist does not preclude its use, with profit, by a physicist.

William Fuller Brown, Jr.
Sun Oil Company

Books Received

IONIC PROCESSES IN SOLUTION. By Ronald W. Gurney. 275 pp. McGraw-Hill Book Co., New York, 1953. \$6.50.

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PHYSICAL FORMULAE. By T. S. E. Thomas. 118 pp. Methuen and Co. Ltd., London, England; John Wiley and Sons, Inc., New York, 1953. \$2.00.

MR. TOMPKINS LEARNS THE FACTS OF LIFE. By G. Gamow. 88 pp. Cambridge University Press, New York, 1953. \$2.75.

REFRACTORY HARD METALS. BORIDES, CARBIDES, NITRIDES, AND SILICIDES. By Paul Schwarzkopf and Richard Kieffer in collaboration with Werner Leszynski and Fritz Benesovsky. 447 pp. The Macmillan Company, New York, 1953. \$10.00.

THE REVOLUTION IN PHYSICS. A NON-MATHEMATICAL SURVEY OF QUANTA. By Louis de Broglie, translated by Ralph W. Niemeyer. 310 pp. The Noonday Press, New York, 1953. \$4.50.

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PROGRESS IN BIOPHYSICS AND BIOPHYSICAL CHEMISTRY. Vol. III. Edited by J. A. V. Butler and J. T. Randall. 386 pp. Academic Press Inc., New York, 1953. \$9.50.