course, has no standard deviation because it is a fixed number.)

Such confusion of distinctly different concepts makes impossible clear and accurate exposition of the sampling distribution of $X$—and a fortiori, of the law of large numbers, of the central limit theorem, and of confidence intervals for the parameter $\mu$. Failure to make and preserve important conceptual and notational distinctions gets the author into many such difficulties.

In addition, the author makes misleading statements of fact. For example, he implies (at the top of page 96) that the validity of the formula

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

(for the standard deviation of the distribution of $\overline{X}$) is sensitive to the form of the "parent" distribution of the $X$'s, but "is true for the Gauss distribution, as may be proved from a theorem known as the *central limit theorem*." This is putting the cart before the horse! The central limit theorem (and the law of large numbers) are consequences of this formula, not vice versa! Furthermore, the formula is valid whenever the $X$'s are independent and have a common finite standard deviation. Independence of the $X$'s is an essential requirement. The author makes no mention of the critical role of independence, here or elsewhere in the book.

An individual who seeks "some elementary knowledge of statistical methods for treating experimental errors and analyzing experimental observations" will be much better advised if he consults the lucid, up-to-date treatment of these matters in chapters 7, 8, and 9 of E. Bright Wilson, Jr.'s, *An Introduction to Scientific Research*, which is also available in the same McGraw-Hill paperback series.

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## Science and the Humanities

**The Role of Science in Civilization.** Robert Bruce Lindsay. Harper and Row, New York, 1963. x + 318 pp. Illus. $6.50; text ed., $5.50.

This book is an attempt to clarify the nature of science and its relations to other ways of describing and understanding human experience. It makes some unusual and compelling observations in a style whose clarity and balance make it immensely readable and stimulating.

Lindsay, a physicist and the dean of the Graduate School at Brown University, stresses the role of creativity in what he terms the "essentially arbitrary character of scientific theorizing." What is usually considered "the discovery" of truth is here interpreted as the "invention" of some brilliant and imaginative scientist. The scientist indulges in preferences and prejudices not merely in his nonprofessional life, but in the very act of creating new knowledge.

A successful theory represents a selection of materials available in the prevailing culture, and the evolution of scientific theory follows cultural laws as well as necessities implicit in nature. The predictive power and economy of a "scientific truth" is, in Lindsay's view, not the only basis upon which the theory becomes established. More important is the role of the creative scientist, a role not at all alien to the process that gives rise to literature, philosophy, and art. Lack of understanding of this leads to dogmatism, to unwarranted assignment of larger meanings to formal hypotheses, and to "scientism," a pseudoreligious faith which often obstructs scientific progress.

From this point of view, the author undertakes to relate the essential facts of science and technology to all of the various artifacts of civilization, including mathematics, logic, the humanistic disciplines, communication, and ethics. He dwells on similarities as well as differences and finds an essential kinship, despite the historical alienation between Science and the Humanities. He does not hesitate to essay an ethical system based on the laws of thermodynamics (energy and entropy), although this results in nothing more concrete than the golden rule. It is a pleasant, if not idle, conceit whose exploration one is willing to grant in an otherwise hard-headed philosophic work. There are several interesting sorties into symbolic logic, mathematics, and communication theory.

This is a literate and graceful volume, full of much solid science and good sense. It belongs in the category of the philosophy of science, and it should appeal to the scientist who wishes to test his world outlook, the humanistic scholar aware of the challenge of the scientific method to his discipline, and the layman buffaloed by the myths of "Scientism."

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## Science for the Layman

**View From a Height.** Isaac Asimov. Doubleday, Garden City, N.Y., 1963. xii + 252 pp. $4.50.

Speculative essays which touch upon the various horizons that embellish the farflung realms of science, are not wholly new to scientific literature. Yet, Asimov's choice of material and the imaginative uses to which he puts it, are novel, refreshing, and rewarding. He consistently selects items that are of the latest vintage, diverse in origin and content, and, glory be to the laws of nature, his themes are seldom stultified by the often stereotyped mannerisms of many science fictionists with whom he occasionally associates.

The present volume contains 17 essays that deal with problems gleaned from modern biology, chemistry, physics, and astronomy. Each one is well written, informative, and above all, generates a theme or idea that is challenging and original. Some of the biological essays merely organize such known data as animal sizes, egg volumes, molecular or atomic numbers per cell, and the like, but Asimov has arranged his facts in a manner that affords new perspectives and suggestive reorientations. The other essays are also intellectually most enjoyable and they are packed with both interesting data and exciting ideas. Few readers, one may venture to predict, regardless of their status as scientists, will fail to derive some new information from more than one of these essays, and hardly a single person, even though he is familiar with all the data here called upon, will put down the book without feeling that he has gained new insight into many frontiers of science.

Asimov offers the reader a host of fascinating and lucidly described tidbits from recent researches in the spheres of isotopes, radioactivity, nuclear particles, entropy, RNA and organic molecules, chromosomal replication, heat and temperature, stellar