point but present the necessary formula without further ado." Similarly, the definitions are not always very precise, as the author recognizes: "It is not our intention to confuse the reader with a series of definitions. That would be the usual textbook approach."

The result is a book that is very easy to read, but unfortunately this ease is partly obtained by glossing over the subtle and difficult points, especially in the calculus. The author realizes this to some degree, for he writes (page 175), "The expert in pure mathematics will probably hold up his hands in horror at our exposition. We believe however that it is better to have a rough idea than no idea at all. In any case our method was good enough to satisfy the mathematicians of the seventeenth century and any enthusiastic reader who wishes can pursue the subject further in a more comprehensive book of higher mathematics." How true! But the mathematician, whether he is in pure or applied mathematics, may be excused for balking at the antiquated treatment of the calculus or at such statements as (page 57): "Zero is not in itself a number though it is often treated as if it were; it separates the positive from the negative numbers."

It is a pity that the mathematics is not more accurate and up to date because there can be no question of the author's skill at exposition. His writing is lucid and entertaining, and it seems certain that many people in no position to recognize the inadequacies will find in the book just the thing they had been looking for in mathematics—an easy style, a constant encouragement to continue, and an absence of problems or exercises.

IVAN NIVEN
University of Oregon

Essays in Linguistics. Viking Fund Publications in Anthropology, No. 24. Joseph Greenberg. Wenner-Gren Foundation for Anthropological Research, New York, 1957 (order from University of Chicago Press). 108 pp. $3.

This collection of essays will further the increasing awareness of the significance of so fundamental a trait as language to any general science of human behavior.

The first two essays, on "Language as a Sign System" (pages 1–17) and "The Definition of Linguistic Units" (pages 18–34), are the most immediately relevant to general linguistic methodology. Of particular interest is the discussion of the nature of the grammatical analysis of natural languages and of how, given samples of expressions in the system, the linguist attempts to produce an infinite number of additional expressions which belong to the same system. By definition, an infinite number of expressions cannot be listed and, consequently, can only be generated by some set of rules. Current research in syntactic analysis is aimed at clarifying the techniques for deriving such rules and for identifying the units to which the rules apply. In this connection, most linguists will not agree with Greenberg's segmentation of forms like *man* into /m-n/ and /-æ-/ for the singular; rather they would prefer the analysis to reveal the similarity of the singulars *man* and *pan*; Greenberg's suggestion projects onto the singular forms the differences which are apparent in the corresponding plurals, *men* and *pans*. And, indeed, this is Greenberg's purpose: to make explicit the premises on which linguistic analysis is based and to develop the consequences of a rigorous adherence to those premises.

The essays on "Genetic Relationship among Languages" (pages 35–45) and "The Problem of Linguistic Subgroupings" (pages 46–55) contribute to a clarification of the assumptions of historical and comparative linguistics. It has sometimes been maintained that the comparative method involves a fundamental circularity—namely, that one cannot establish phonetic laws without cognates but that one cannot establish cognates without phonetic laws. Greenberg indicates four causes of sound-meaning similarities which may be observed between languages. Of these, two are nonhistorical—chance and symbolism, the latter being Greenberg's cover term for the occasional nonarbitrary connection between sound and meaning as exemplified by onomatopoetic forms and by some nursery words like those for "mother" and "father." "The remaining two—genetic relationship and borrowing—involve historic processes. The two basic methodologic processes then become the elimination of chance and symbolism leading to hypotheses of historic connections and the segregation of those instances in which borrowing is an adequate explanation from those on which genetic relationship must be posited" (page 37). Essentially, the circularity disappears with the establishment of other-than-chance resemblances.

The remaining four essays include a number of original and fruitful notions on such topics as language and evolutionary theory, genetic and nongenetic classifications, function, efficiency and redundancy in language, linguistic universals, and so forth.

The essays in this volume are independent of one another and are in no way intended as a systematic over-all treatment of linguistics. Nevertheless they seem to share two features: a desire to explore the relationship between linguistics and other disciplines—particularly logic, mathematics, anthropology, and psychology—and, in the process, to apply some of the more rigorous techniques developed in these areas to the scientific study of language. The result is a stimulating book, revealing a variety of approaches for the analysis of linguistic phenomena.

SOL SAPORTA
Indiana University

Meat Hygiene. WHO Monograph Series No. 33. World Health Organization, Geneva, 1957 (order from Columbia University Press, New York). 511 pp. Illus. $10.

In this book on meat hygiene, the World Health Organization has compiled papers prepared by 16 of the world's foremost authorities on the subject. The book is interesting, instructive, and beautifully illustrated.

Three of the papers are scientific treatises: those by C. E. Dolman, of the University of British Columbia, on meat-borne diseases; by H. Drieux (Ecole Nationale Veterinaire, Alfort, France), on tuberculosis; and by G. Schmid (University of Berne, Switzerland), on parasites.

The highly authenticated and well-documented papers of Dolman and Drieux highlight the monograph. In his "Epidemiology of Meat-Borne Diseases," Dolman organizes the material in a way that permits a full, convincing and logical presentation. He brings together the many ramifications of the subject of meat-borne diseases in a way that enables the reader to understand the relationship between the many probabilities that tend to confuse the student and even the meat-hygiene practitioner.

Drieux's paper on tuberculosis is a masterpiece. What is remarkable about his paper is that he has taken a subject that many would regard as having been pretty well exhausted by an array of authors and has given it fresh treatment from the meat hygienist's point of view. His paper serves two purposes—the first, of course, to inform the reader fully on the subject matter and the second—which seems to me to be more important—to inform meat hygienists that the science of disease evaluation in terms of fitness for food of an animal carcass is a fascinating and exacting one.

M. M. Kaplan (World Health Organization, Geneva) has a paper on meat-hygiene problems in tropical areas. His account of what might be described as primitive conditions as he sees them from the point of view of a public health official shows how the official's problem is complicated by merging of hygienic, eco-

nomic, and social factors. Kaplan's paper demonstrates the fundamental nature of the relationship of these three factors to the subject of meat hygiene. As is brought out in the other papers of the monograph, the hygienic, economic, and social factors all exert a profound influence on what might be referred to as the European meat-hygiene story.

The remaining papers sparkle with history, narrative, and philosophy concerning European practices and programs relating to the handling of food animals, their slaughter, and the preparation and handling of meat products. Papers by R. I. Hood and H. H. Johansen of the World Health Organization Regional Office for Europe describe, in detail, European meat-hygiene practices.

A paper by M. J. J. Houthuis (director, Municipal Slaughterhouse, Rotterdam, Netherlands) emphasizes the importance of ante-mortem inspection as the first step in the proper processing of food animals through a meat-packing plant.

Very informative papers on stunning methods are given by T. Blom (department chief, Royal Veterinary Board, Stockholm, Sweden) and Phyllis G. Croft (biochemist, Mile End Hospital, London). Electrical stunning, a subject now receiving considerable attention, is covered in detail.

Municipal abattoirs are discussed by G. Scaccia Scarafoni, (Istituto Superiore di Sanita, Rome) and Roger Benoit (director of abattoirs, Lausanne, Switzerland). These papers contain a very interesting discussion of the history of the development of municipal abattoirs in Europe and of the problems connected with their adjustment to present-day needs and standards.

H. Thornton (chief veterinary officer, City and County of Newcastle-upon-Tyne, England), who is a recognized authority in the field of applied meat-hygiene practices, emphasizes the importance of meat-hygiene programs being in the hands of properly trained and experienced inspectors, functioning methodically.

A paper by A. Jepsen (Royal Veterinary and Agricultural College, Copenhagen) is a real contribution to the monograph. In his lucid style, Jepsen points out the importance of inspectors having available adequate laboratory services. At the same time he cautions that the laboratory cannot be substituted for the inspector. He calls for the closest possible coordination and cooperation between the laboratory and field staff.

The World Health Organization is fortunate in being able to include in its monograph a paper by a man of the stature of F. Schönberg (Tierarztliche Hochschule, Hanover, Germany). He draws attention to the controls that must follow the meat as it leaves the slaughtering department and pursues its somewhat tortuous route to the consumer.

Worthy of special mention is the paper by S. O. Koch (chief veterinary officer, City of Aarhus, Denmark). Koch develops the subject of local control, which is frequently the weak link in the total meat-hygiene program. He not only writes convincingly on the subject of hygienic controls applied locally but he also heads up, in the city of Aarhus, a program that effectively applies the principles he describes.

The paper by V. E. Albertsen (chief veterinary inspector, Danish Veterinary Service, Copenhagen) deals with the subject of disposal of by-products. His paper gives emphasis to what has been mentioned incidentally in other papers—that the official functioning in an effective meat-hygiene program must be prepared to discharge responsibilities that cover a wide range of subject matter.

The monograph is complete, with an array of references, an appendix consisting of 146 pages, and a selected bibliography on meat hygiene.

A. R. MILLER
Agricultural Research Service, U.S. Department of Agriculture

Advances in Enzymology and Related Subjects of Biochemistry. vol. 18. F. F. Nord, Ed. Interscience, New York, 1957. v + 435 pp. Illus. $9.

The 1957 volume of *Advances in Enzymology* lives up to the very high standards established over a period of 18 years. The present volume includes review articles by nine different authorities in various fields of enzymology and related subjects and will be of great value to chemists, biologists, and medical research workers as well as to biochemists.

In his review of cytochrome in higher plants, Hartree has pointed out the similarity of the cytochrome system of plants to that of animals, at the same time pointing out minor differences peculiar to plant systems.

Singer, Keaney, and Massey have reviewed the complex and controversial literature on succinic dehydrogenase and have related its function to electron carriers of the cell. They have also discussed the stepwise purification of succinic dehydrogenase from mitochondrial preparations.

Sir Rudolph Peters, in a review of the mechanism of toxicity of an active constituent of *Dichapetalum cymosum,* has shown that the toxic component is fluoroacetate, which in the animal organism undergoes a lethal synthesis to fluorocitrate, As a specific inhibitor of aconitase, fluorocitrate interferes with animal respiration by blocking the citric acid cycle.

The purification and properties of deoxyribonucleoprotein have been reviewed by Butler and Davison. In addition, these authors have briefly discussed its function in heredity and in protein biosynthesis.

Arthur Kornberg has surveyed the role of pyrophosphorylases and phosphorylases in biosynthetic reactions. In this outstanding review, a vast amount of diverse and apparently unrelated material has been correlated for the first time.

Wiame, in his review of the tricarboxylic acid cycle in microorganisms, has shown that this cycle is not only important in respiration but is also involved in the synthesis of many important biochemical compounds in bacteria.

James has reviewed the reaction patterns in the respiration of the higher plants and has shown the basic similarity of these pathways to those typical of animals. It is unfortunate that the role of cytochrome in higher plants, discussed by Hartree, is repeated in this article by James.

Reed has reviewed all of the literature on the chemistry and function of lipoic acid and has indicated certain enzymatic systems in which lipoic acid plays a role in living organisms.

In the final article, Schubert and Nord have examined the scattered and fragmentary literature on lignification and have considered the biosynthesis of lignin from vanillin, syringaldehyde, and *p*-hydroxybenzaldehyde, which are derived from shikimic acid.

With the number of enzyme systems now approaching 1000, it is unfortunate that an annual review can consider so few. In order to cover a wider diversity of enzyme systems, it would seem wiser to revert to the original pattern of the early volumes of *Advances of Enzymology,* in which reviews were only 20, instead of 42, pages in length. This would have the added advantage that the nonspecialist would not be plagued by the reading of so much unimportant detail.

IRWIN W. SIZER
Massachusetts Institute of Technology

Heat Transfer and Fluid Mechanics Institute, 1957. Preprints of papers. Held at California Institute of Technology, Pasadena, California, June 19–21, 1957. Stanford University Press, Stanford, Calif., 1957. vii + 439 pp. Illus. $8.50.

This publication contains 21 papers, in the areas of heat transfer and fluid mechanics, presented at the tenth meeting of the Heat Transfer and Fluid Mechanics Institute at California Institute of