ability, statistics, stochastic variables, ergodic ensembles, and so forth, are developed as needed. In my opinion, the book would gain much by including a more complete and precise treatment of these concepts, so important, for example, in problems involving noise. It would also seem desirable to include more in the way of application to problems of system design in which the methods of information theory are advantageous. The student who finishes the book may wonder to some extent what the fuss is all about. Error-detecting codes, theory of radar information, and telephone traffic problems, to name but three possibilities, could provide such examples and balance the almost unrelieved mathematical and theoretical flavor of the treatment.

In spite of this, the textbook succeeds fairly well in bridging the gap between beginning graduate level on the one hand, and the work of Wiener, Shannon, and current research on the other.

JEROME ROTHSTEIN
*Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey*

***The Energetics of Development.*** A study of metabolism in the frog egg. Lester G. Barth and Lucena J. Barth. Columbia Univ. Press, New York, 1954. xviii + 117 pp. Illus. $3.

In the preface to this book, the authors frankly admit that, in spite of the wealth of experimental results in the physiological embryology of the frog, we still lack certain unifying concepts that are necessary for an understanding of the direct coupling between energetics and differentiation. They then proceed with a review of recent studies (mostly those appearing after 1949) of the mechanisms by which the energy of the frog's egg is stored, released, and transferred during early development.

In the introductory chapter, the authors discuss some of the problems of tracing the chain of reactions from the stored energy-rich compounds to the final acceptors of energy within the differentiating cells. They recognize the possibility that some developmental processes, such as the determination (differentiation) of various cell types, may or may not depend upon energy-producing reactions, and that the whole problem of the energetics of development might have to be shifted back to the developing oöcyte in which protein synthesis is occurring. However, there is a possibility (which the Barths no doubt realize but do not discuss) that, even if we are able to pinpoint the detailed pathway by which the energy required for a particular differentiation process is derived, we may still be a long way from understanding the mechanism of the differentiation process itself. It seems unlikely, at least in my opinion, that the energetics of development could be importantly different from the energetics of cells in general. Whether identification of the final coupling reactions between the energy-furnishing machinery of the cell and one of its developmental processes would bring us closer to an understanding of the significant causal features of the process also seems doubtful. It would appear that the energetics of a developing organism is best thought of as an adjunct to, rather than as an integral part of, the various developmental processes. Perhaps in time we shall know whether such a point of view was justified or was merely flippant.

The second, third, and fourth chapters deal, respectively, with the storage of energy in the frog oöcyte, the release of energy during development, and the metabolism of gastrula parts. The evaluation of studies in these areas is rather critical, and the frankness with which the many problems are faced is commendable. For example, in their discussion of the respiratory metabolism of different gastrula parts, the authors come to the tentative conclusion that the modes of energy release in these developmentally very different regions of the egg are identical, and that it is in the utilization of energy that a possible mechanism for correlating metabolism with development (for example, cellular differentiation) is to be sought. They recognize (p. 64) ". . . that fundamental differences [other than respiratory] pre-exist in different cells; otherwise we cannot obtain differentiation from an equipotential system."

In the fifth and final chapter, the Barths discuss recent studies on the protein metabolism of the frog's egg, based largely on their own unpublished researches. About one-third of the book is devoted to a detailed presentation of evidence for the relationship of various extractable yolk proteins to phosphate metabolism. The authors tentatively conclude that (p. 105)

> . . . ATP may not act as a direct intermediary in the transfer of phosphate from phosphoprotein [yolk] donor to acceptor, but rather that its function may reside in a control of the amount and locus of phosphoprotein breakdown.

NELSON T. SPRATT, JR.
*Zoology Department, University of Minnesota*

***New Fibres from Proteins.*** Robert Louis Wormell. Academic Press, New York; Butterworths, London, 1954. xx + 208 pp. Illus. $5.80.

Robert Louis Wormell has spent many years in the study and development of protein fibers in the Courtaulds organization, and one of the principal objectives of his book is to present many of the facts gathered during this experience. A second objective is to clarify existing data and to correlate it with related fields. A third purpose is to advance a new concept of protein fiber structure ("the corpuscular theory"), which pictures a protein molecule as composed of a number of polypeptide chains converging at the center of a corpuscle, rather like a dandelion flower. The book is quite broad in its coverage, including, for example, raw materials, protein denaturation and structure, general principles of protein fiber production, swelling and other physical properties of

protein fibers, dyeing and finishing of regenerated protein fibers, identification of fibers from proteins, uses of fibers from proteins, and so forth.

This book should be most useful for its presentation of accumulated data, taken by Wormell from his own works and the general literature. The material on spin dopes, extrusion of fibers, cross-linking treatments, and physical and chemical properties should be very helpful to scientists and technologists interested in protein fibers, as well as many students of man-made fibers in general.

I found the "corpuscular theory" far from convincing, especially when applied to a fiber such as silk. The emphasis on this theory may actually be confusing to a person unfamiliar with protein fibers, but on the whole the book is a useful compilation that will be helpful to workers in the field.

ARNOLD M. SOOKNE

*Harris Research Laboratories*

***Sex in Microorganisms.*** A symposium presented 30 Dec. 1951 at the Philadelphia meeting of the AAAS. D. H. Wenrich, Ivey F. Lewis, and John R. Raper, Eds. AAAS, Washington 5, 1954. 362 pp. Illus. $5.75 (Members, $5).

*Sex in Microorganisms* is broadly conceived to include anything related to the reproductive cycles of protozoa, algae, fungi, bacteria, and viruses. The subtitle to the volume is unnecessarily restrictive, since many topics are not only presented in greater detail than was possible at the Philadelphia meeting, but they are also more up-to-date than is implied. There is at least one 1953 reference in each article. As is to be expected in a symposium, there is considerable variation in the manner in which the different subjects are treated by the different authors. The papers themselves range in length from 11 pages (bacteriophages) to 132 pages (protozoa).

The volume opens with a brief and clear outline by N. Visconti of the life history, methods of crossing, and genetic observations of the virulent T-phages of *Escherichia coli,* with emphasis on important dissimilarities to equivalent genetic phenomena as known in higher organisms. The sexual behavior of bacteria, as inferred from genetic recombination in strain K-12 of *E. coli,* is discussed by J. Lederberg and E. L. Tatum in a somewhat reminiscent mood. Here the principal emphasis is on similarities to genetic events in higher organisms. Possible relationships to bacterial transformation and transduction are mentioned, but in a manner that seems to imply that little is known of transformations, and that only since 1951. W. G. Hutchinson and H. Stempen discuss the evidence for sexuality in bacteria from studies of morphology, especially from reported examples of conjugation, and they remark on the unsatisfactory present state of bacterial cytology. The diverse life cycles and sexual mechanisms found in the fungi are reviewed by J. R. Raper, and classified according to (i) the occurrence and extent of haploid, dicaryotic, and diploid, phases, (ii) the type and degree of heterothallism, and (iii) the type of cell, or organ, taking part in conjugation. The types of reproduction occurring among the diatoms are reviewed by Ruth Patrick. The topic of sex in unicellular algae, by R. A. Lewin, relates chiefly to *Chlamydomonas,* includes discussions of physiological aspects of reproductive processes, and emphasizes the differences in experimental results obtained by Moewus and all other investigators. In the longest paper, and the only one extensively illustrated, D. H. Wenrich presents a comparative review of the reproduction cycles occurring among the natural groups of protozoa. Mating-type determination in *Paramecium aurelia* is discussed by D. L. Nanney in relation to the parts played by macronucleus, micro-nuclei, and cytoplasm. There is a rather extensive review by C. B. Metz of the physiology of fertilization in *Paramecium* and of the mating substances involved, with references to studies on other ciliates and a comparison with metazoan fertilization. The volume ends with comments by D. H. Wenrich on the origin and evolution of "sex," in which he discusses several postulated reasons why sexual reproduction is beneficial to organisms, omitting that which seems most important to geneticists, namely, that it constitutes the basis for the recombination of genetic traits possessed by individuals.

The audience for which this book is intended is not immediately apparent. While it gives a general survey of the diverse sexual mechanisms occurring among the microorganisms, the coverage is, in some respects, less thorough than in earlier compendiums on the same subject. New and exciting discoveries, not reviewed in older works, are limited principally to the implications of sexuality in viruses and bacteria and to details of the mating reactions in the ciliates.

STERLING EMERSON

*Division of Biology,*
*California Institute of Technology, Pasadena*

***The Human Masticatory Apparatus.*** An introduction to dental anthropology. Meyer Klatsky and Robert L. Fisher. Dental Items of Interest Publ., Brooklyn; Henry Kimpton, London, 1953. xxi + 246 pp. Illus. $6.

Increasingly, dentistry is refuting bygone appellations such as "dental mechanic," "tooth carpenter," and the like. On the contrary, it is emergent as a science and as a healing art, closely integrated with related sciences (such as paleontology, both comparative and human, descriptive morphology, physical anthropology, and genetics) and with the sister healing art of medicine. Time-honored scientific and clinical fences have given way to common grazing grounds.

This volume is a record of the changing perspectives in dentistry, that is, that teeth are more than mere structure and that they have a functional aspect related to other bodily systems. This integrative perspective carries with it a time element, namely, that the