Book Reviews

Population Genetics

Computer Models in Genetics. ALEX FRASER and DONALD BURNELL. McGraw-Hill, New York, 1970. vi, 206 pp., illus. $9.95.

There have been two main trends in mathematical population genetics since the pioneering work of Wright, Haldane, and Fisher. The first has been to the more complex analytic models of the type developed by Kimura and Karlin and the second has been to the computer simulations of genetics models as carried out by Fraser, Lewontin, and many others. This book is the first on the latter approach to population genetics and as such has a special obligation to provide an introduction to the subject for the nonspecialist. Unfortunately the book falls short of this goal and is unlikely to be understandable to someone not already familiar with both population genetics and the rudiments of computer function. Nonetheless, the authors have gathered a number of interesting computer models of single and multiple locus systems and have presented them in sufficient detail that the examples are useful without further references. There is a large variety in the models discussed, and whenever possible the results are compared with specific biological experiments.

From the examples in this book, it appears that there is a direct correlation between the simplicity of a computer model and its utility. In light of the fact that there are no limits on the complexity of a computer model except those imposed by storage space and operating funds, it would seem appropriate for the authors to discuss the purpose of such models. A discussion of this issue would help put the subject matter in the proper perspective. In many cases, for example the models of inversion polymorphisms in *Drosophila* and of the *t* allele in *Mus*, the models were developed in response to particular biological problems. In other cases, simulations have been performed to examine the effect of well-known genetic mechanisms. However, there is the lingering feeling that some computer studies are carried out without any hope of relating the results to any problems of biological interest. There seems to be a danger that the study of computer models in genetics will become unrelated to the subject from which it arose.

The book is well balanced in its choice of examples, and the authors have resisted the temptation to let their own work dominate the contents. However, one has the impression that the book was written in a great hurry; several important terms are never defined and some others, such as "random walk" and "disruptive selection," are used imprecisely. These minor problems, coupled with a somewhat cramped format for tables and figures, make it difficult to follow some of the explanations. Still, much of the material is unavailable in any but the original sources, and for anyone with an interest in the subject this book will make a useful supplement to any of the several recent texts in population genetics.

MONTGOMERY SLATKIN
Department of Biology,
University of Chicago,
Chicago, Illinois

The Sense of Hearing

Foundations of Modern Auditory Theory. Vol. 1. JERRY V. TOBIAS, Ed. Academic Press, New York, 1970. xviii, 466 pp., illus. $22.50.

The science of the sense of hearing, not unlike the science of the other sense modalities, is characterized by an uncomfortable proliferation of data and ad hoc hypotheses on one side and by a dearth of broad, synthesizing theories on the other. The inscrutable jungle of articles on hearing, which are scattered over many psychological, physiological, medical, engineering, and other journals, makes it often impractical to look for the solution of a problem in the literature. It may be less time-consuming to find it directly, through a laboratory experiment. This, of course, exacerbates the situation, since every experiment, even if not new, tends to lead to an additional article.

The need for introducing some clarity into the state of our knowledge of auditory functions and processes seems to have prompted J. V. Tobias to edit *Foundations of Modern Auditory Theory*. His intent has to be applauded, since no reasonably exhaustive text on the psychology and physiology of hearing has been published for many years. The lack of such a text is felt particularly strongly in the teaching of graduate courses.

Unfortunately, the quality of execution lags considerably behind the worthiness of the goal for at least two reasons. First of all, auditory science is currently quite fluid, and even partial synthesis is extremely difficult. Experimental outcomes often lead to conflicting conclusions, many old concepts have fallen or are in the process of doing so, and new focal points have just begun to emerge. Second, the editor has apparently had some difficulties in gathering a sufficient number of contributors who could cover the field in sufficient breadth and depth. The result is a sketchy book with an uneven level of contributions. According to the editor's preface, no effort was made to cover all subjects, but only to fill gaps in the reference literature. For this reason, no chapter on loudness sensation was included. Frankly, I am not aware of any extensive review in English of the recent publications on loudness. The number of such publications is substantial, since loudness has been one of the principal subjects of auditory research during the last 20 years. The editor also states that his "book is not designed to fill gaps that don't exist." However, we find a chapter by G. v. Békésy the material of which has appeared in at least three other books.

More important, the title of the book is misleading and presumptuous. Much of its text is written as a routine review of the literature, of the kind found in annual reviews. Only a few attempts have been made at organizing the material around unifying, empirically well-founded concepts. Perhaps the most outstanding in this respect is the chapter "Critical bands," although the chapter "Periodicity pitch" also develops its central theme in a systematic and convincing manner. Another chapter, "Cochlear mechanics and hydro-dynamics," deals with the important subject of traveling waves in the cochlea of the inner ear. These waves have to be taken into consideration in any analysis of signal processing in the auditory system, and the author draws interesting conclusions with respect to some puzzling effects in pitch perception.

If the book has any broad, unifying theme, it is the pitch perception—a classical problem that concerned philosophers and scientists through many centuries and is still with us. Two schools of thought exist with respect to pitch perception: one attributes it to temporal coding in the nervous system, the other to a spatial frequency analysis. Whereas the first two chapters go to great pains in demonstrating the necessity of temporal coding in order to account for some perceptual phenomena, the remaining chapters assume more or less explicitly the frequency analysis. This lack of coherence is disturbing, and perhaps a chapter devoted more explicitly to spatial mechanisms of frequency analysis should have been added. An included chapter under the title "Time and frequency analysis" seems to have run out of steam before reaching the frequency part.

Although the book is not what it promises to be and, in addition, is outdated in some of its parts, it should be worth having for those who are interested in the sense of hearing. It does contain some useful information and presents a few interesting points of view. The literature references are helpful also, but in several instances historically misleading.

J. J. ZWISLOCKI
Laboratory of Sensory Communication, Syracuse University, Syracuse, New York

A Mathematical Idea

Lebesgue's Theory of Integration. Its Origins and Development. THOMAS HAWKINS. University of Wisconsin Press, Madison, 1970. xvi, 228 pp., illus. $12.50.

Classical and Modern Integration Theories. IVAN N. PESIN. Translated from the Russian edition (Moscow, 1966) and edited by Samuel Kotz. Academic Press, New York, 1970. xx, 196 pp., $12.50. Probability and Mathematical Statistics.

Mathematicians have often been the most curious of scholarly creatures in that they have seldom been curious about the history of their own subject. Normally they have been content with a few gossipy tidbits of folk history: a blend of garbled inaccuracies and apocryphal tales only occasionally stiffened by solid facts. Now there appears to be a rising interest in the history of mathematics, particularly of modern mathematics, as is borne out by recent publication of these two books on the development of integration theory, representing quite different approaches to mathematical history.

In *Lebesgue's Theory of Integration*, Thomas Hawkins has set out "to place Lebesgue's early work on integration theory (1901–10) within its proper historical context by relating it, on the one hand, to the developments during the nineteenth century that motivated it and gave it significance and, on the other hand, to the contributions made in the field by his contemporaries." He has succeeded brilliantly on both counts.

Hawkins begins by examining Cauchy's proto-theory of integration, which treated only continuous functions. He then goes on to Riemann's integral, which is the first true integration theory, and which also contains the germ of a measure theory. As background for Lebesgue's discoveries of the turn of the century, there is a discussion of the various controversies revolving around the nature of infinite sets and what should be meant by a function.

The book is especially interesting because Hawkins has been able to convey the excitement of discovery and groping that must attend the birth of any fundamental theory. The mathematical problems of the 19th century, arising primarily from Riemann's integrals and Fourier series, are placed before us as they then existed, complete with the confusion of concepts that followed after them. Hawkins shows how the differences between ordinary and uniform continuity, or pointwise and uniform convergence, were not fully understood until after Cauchy; ideas about infinite point sets were naive, and many fundamental questions were not settled until after Cantor. The notion that a function was an "analytical expression" was firmly embedded; the concept of a function as an assignment did not take hold until the turn of the century. Perhaps there is a lesson here for us: Should we expect more of our freshmen than of the best professional minds of less than a century ago?

Hawkins centers his treatment around what he calls the three fundamental theorems: I, the inverse derivative problem; II, the evaluation problem for the definite integral; and III, the problem whether, if the (perhaps generalized) derivative of a function vanishes on set, the function itself is a constant there. He shows that as functions grew more complicated in the latter half of the 19th century the problems posed by the fundamental theorems could not be solved by use of the Riemann integral. The author also sheds light on the arc length controversy and the question of general continuity versus differentiability.

There is also an interesting treatment of the interim period immediately preceding Lebesgue. It was at this time that attention began to be focused on measure theory, and there was a realization, even then, that it was strongly linked to integration. Hawkins treats this well, sorting out the various trends into coherent sequences of ideas.

The climax of Hawkins's book is the study of the works of Lebesgue. He shows how Lebesgue started from Borel's earlier ideas of what should constitute a correct set of axioms for a measure and built these ideas up to a complete theory, combining integration and measure. In addition to Lebesgue's well-known limit theorems he was able to show that theorems I, II, and III are in general (almost everywhere, one is tempted to say) solvable and have the expected solutions.

Hawkins as an author is kinder to his readers than most who write on mathematics. Definitions are clearly stated. The notation has been carefully selected for clarity, and there is a well-chosen glossary. His style is easy and comfortable. Perhaps best of all, when a definition or notation has not been used in some time its meaning is recalled. Altogether, Thomas Hawkins has written a book that is the epitome of what a mathematical history should be.

Pesin (or Kotz, since he is listed as editor as well as translator) has given us a different kind of book. Rather than a history, it is presented as "a detailed historical survey of the development of classical integration theory." Only the outlines of the theories, together with some of the proofs, are here. It is truly regrettable that "in view of limitations in space [the author] was unable to present adequately the interrelation between integration and other branches of mathematics, for example, the theory of trigonometric series, a subject in which problems