

ence that deals with what is known as artificial intelligence a fascination with learning. For instance, the first question that is likely to be asked about a chess program, no matter how good, is "Does it learn?" This feeling that learning is somehow the touchstone of intelligence is held not just by novices in the field but by many seasoned workers as well. (It may have something to do with the fact that if a machine learns, then it will not have been the case that it was instructed by someone, as appears to be true of a programmed digital computer, and thus is not open to the charge that it will do only what its programmer has told it to do.) The history of the perceptron itself provides an example of the effects of such a view, where through ten years of intensive investigation (several hundred published papers, at least) almost nothing was learned about performance and almost all attention was devoted to learning. The present book carries the strong message that one must understand the performance characteristics of a class of systems before the learning issues can take on meaning. For learning is always the selection of a particular performance program within a space of possible performance programs. Understanding learning requires, first and foremost, understanding the structure of this space. Again, the book carries this message, not so much by saying it (though it does that, too, here and there) as by attending to the theory of the performance of perceptions and showing how fruitful that theory can be.

A final consideration is the style of the book. It is essentially mathematical, the mathematics in it is not superficial, and the book has the standard backbone of a small set of definitions and a large series of theorems and proofs. But beyond this point it parts company with most mathematical treatises. For the authors are much concerned with the heuristics that guided them, with the clues in the environment that led them on, with the barriers that held them up, with the nature of the reasoning that has been transformed into proof method, and with possible conjectures and concerns about the future shape of the theory. The book continuously deals with these matters, and one comes away with a feeling of having taken a guided tour. It is a fine book for individual study.

Perhaps, now, the grounds for my assessment are clear. It would do no

good to repeat them. All that I have said is favorable. The book of course has its quota of minor flaws, but I have no urge to temper my judgment on the larger issues surrounding the book with a few niggles in an attempt at judiciousness.

I should remark, perhaps, that I am not an unbiased witness, although I trust I have kept my wits about me in examining the book. For I share with Minsky and Papert a common view of the appropriate shaping of computer science into a disciplined field of inquiry. And I see no need to give other than my true assessment of the potential role of this book in that shaping.

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A Genus of Small Mammals

Biology of Peromyscus (Rodentia). JOHN A. KING, Ed. American Society of Mammalogists, Stillwater, Okla., 1968 (available from Bryan P. Glass, Department of Zoology, Oklahoma State University, Stillwater). xiv + 594 pp., illus. \$15. American Society of Mammalogists Special Publication No. 2.

An introduction by W. Frank Blair sets forth clearly the rationale for this fine work. "The diversity of life is so great that we can never hope to answer all of the questions we might pose for all of the kinds of organisms, so we look to detailed studies of representative taxa for elucidation of the principles governing diversification and maintenance of diversity. . . . Ideally, the taxon should have a good fossil record . . . should have a considerable amount . . . of diversification in living forms so that various stages of the evolutionary process are adequately represented," and should be "one that is actively evolving so that the mechanisms of evolution may be investigated as dynamic processes. Ideally the organisms should be obtainable with relative ease and in adequate numbers, and they should be amenable to laboratory culture. The North American genus of cricetine rodents, the white-footed mice or deer mice of the genus *Peromyscus*, about which this book is written, come as near to fulfilling these requirements as one might hope for in a taxon of small mammals."

Many attributes of white-footed mice contribute to their usefulness in

investigating the dynamics and behavior of natural populations. They are of fitting size; most of them are easily trapped alive; some live readily in nest boxes; and they are ubiquitous in North America, probably being the most widely distributed native small mammal and oftentimes by far the most common one. Several species thrive in captivity, and it is thus possible to investigate modes of inheritance of genetic traits, physiological attributes, and behavioral characteristics.

The paleontology of *Peromyscus* is treated in this book by Hibbard and the classification by Hooper. Of the impressive volume of information on the genus, the largest share concerns *P. maniculatus* and *P. leucopus*. We may know more about *P. maniculatus* than about any other wild mammal. Dice, one of the fathers of peromyscology, contributes the chapter on speciation, considering exclusively the splitting of a species into daughter species. "Habitable areas for mice are rarely mouseless for long," relates Baker in his section on habits and distribution. White-footed mice are among the first mammals to invade disturbed habitats, even having been found living in the shelter of year-old Volcan Parícutin lava. Klingener tells us that understanding of the anatomy of white-footed mice, though poor and fragmentary in comparison with knowledge of the dog and laboratory rat, is rich and extensive in comparison with that of many other genera of rodents. Perhaps the greatest flaw in our understanding is the inability to correlate most of the observed structural differences in the genus with differences in function and behavior. In an encyclopedic chapter of 106 pages, Layne reviews morphological and behavioral development and growth, including unpublished work of his own. Knowledge of embryology is limited to a single species, *P. polionotus*, whereas data on at least some aspects of postnatal development and growth are available for 12 species.

Whitaker summarizes information on large parasites and points out subjects for further research. White-footed mice "are not to be considered as major sources of human diseases; indeed, they appear to be very clean little animals." Endocrinology is reviewed by Eleftheriou, whose work with *P. bairdi*, together with that of others, represents the first systematic attempt to clarify the role of the amygdala in secretory

activity regulation. If the results of this work are supported by further studies, the amygdala (in addition to the hypothalamus and other brain areas) will have to be considered as a regulatory complex in the secretion of certain hormones. In his review of genetics, Rasmussen calls attention to the unique rewards offered by white-footed mice in the investigation of certain problems. Home range and travels are documented by Stickel and population dynamics by Terman. The demonstration of factors involved in population control in nature is extremely difficult, and almost nonexistent for white-footed mice. Specifics of reproduction, mortality, and movements within individual populations are woefully lacking. Information is needed on life history, survival, movement, spatial dynamics, eventual home range, and reproduction at maturity. Most of the techniques needed to gather such data remain to be developed. Available information suggests the existence of sensitive population-controlling mechanisms that are by no means understood.

Eisenberg compares the behavior patterns of several species and discusses the evolution of behavior in the light of several current theories. In the penultimate chapter, on psychology, the editor reviews quantitative findings and evaluates them from the standpoint of their contribution to our knowledge of comparative behavior. White-footed mice are particularly valuable for comparative studies because of their wide ecological and geographical distribution and the divergence in external morphology of the eyes and ears. Unfortunately, the aims of the comparative technique rarely have been achieved. King also points out that our knowledge of the behavior of these mice will remain largely superficial until their perceptual world is understood more thoroughly. The work is concluded by Falls's chapter on activity, which deals primarily with locomotion. Light, temperature, and humidity all influence the activity of white-footed mice, although there is a dearth of accurate information from field studies. The mice have a precise circadian rhythm with a free-running period of less than 24 hours in darkness and longer in continuous light. Light appears to be the principal *Zeitgeber*, adjusting the onset and cessation of activity to seasonal changes.

The contributors to this work are recognized authorities. The book is well planned, edited, and produced; I noted but few typographical errors. In addition to subject and author indexes, there is a very useful seven-page index to technical names that also covers topics. Supplemental references provide coverage through 1967. A possible improvement for a future edition would be a chapter comparing the biology of *Peromyscus* with that of its murid counterpart, the Old World *Apodemus*. This volume fills a long-felt need and will be welcomed enthusiastically by ethologists and students of small mammals.

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Life before and at Birth

Foetal and Neonatal Physiology. A Comparative Study of the Changes at Birth. GEOFFREY S. DAWES. Year Book Medical Publishers, Chicago, 1968. 248 pp., illus. \$11.

Biology of Gestation. N. S. ASSALI, Ed. Vol. 2, The Fetus and Neonate. Academic Press, New York, 1968. xvi + 408 pp., illus. \$23.

Perinatal physiology originated in England in the 1930's. Barcroft summarized the early work in the field in 1946 in *Researches on Prenatal Life*. *Foetal and Neonatal Physiology* follows the tradition of this book. Like its predecessor, it is written by a single author.

Nobody could have been better qualified than Dawes to do the job. The book has the qualities of a textbook, a source book, and a scientific autobiography, the last accounting for its somewhat restricted scope. It emphasizes cardiovascular, respiratory, and regulatory aspects of fetal physiology, Dawes's major interests since he became director of the Nuffield Institute for Medical Research. The omissions that result are justifiable where traditional boundaries are in the way, as in the case of immunological tolerance, but not in the case of the kidney, which is entirely neglected. The autobiographical quality of the book is expressed advantageously in the excellent organization of the subject matter and the forcefully argued opinions. When Dawes refutes the conclusions of other investigators, he makes every effort to be

fair, and the discussions of controversial findings provide models of learned criticism.

As a case in point, Dawes discusses the contradictory findings concerning the effects of acetylcholine and catecholamines on the fetal pulmonary circulation (p. 102): Assali and his coauthors (*Biology of Gestation*, volume 2) believe that catecholamines and acetylcholine have little effect, whereas Dawes and others argue for a vasodilatory effect of acetylcholine and a vasoconstrictor effect by catecholamines. Although the reader is referred to another chapter for Dawes's evidence, there follows a concise alternative interpretation of the conflicting observations. The views of Assali *et al.* are given in *Biology of Gestation*, volume 2 (p. 95), as dogma, with no apparent recognition that controversy exists here.

Foetal and Neonatal Physiology will have a great influence during the next decade, for many will turn to it for information and ideas and find it a helpful companion. It is free of factual errors, and the experimental approach to the subject is entirely practical. It was high time that someone took a look at the consequences of birth trauma, if only to be able to compare different methods of resuscitation. There is much sound and sometimes inspiring experimentation reported in this book. Dawes's recording of the first breaths of a lamb (p. 130) is a classic.

Biology of Gestation, volume 2, *The Foetus and the Neonate*, is a collection of papers of mixed quality. (A few topics discussed in Dawes's book, such as the morphology and physiology of the placenta, are dealt with in volume 1, reviewed in *Science* by E. M. Ramsey, 25 Oct. 1968.)

Biology of Gestation is a much more complete book than *Foetal and Neonatal Physiology*, but comparison of the books in the areas where the two can be compared is to the disadvantage of *Biology of Gestation*, in many cases purely because of sloppy workmanship. For instance, there is an arresting non sequitur on page 73: "All these considerations indicate that in the fetal lamb, as in the adult animal, inertial effects rather than pressure gradients play the major role in the flow of blood from the heart into the great vessels," when none of the considerations listed "(a)" to "(d)" justify that conclusion. The labeling of the differential pressure on the next page both