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. ASSALL, 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

below and above the zero line with a plus sign is nonplussing; only reference to the next figure (p. 75) can show which is which, and there the zero error in the pulmonary arterial blood flow appears to be in excess of 20 percent of the mean flow in that vessel. The reader who would like to look these figures up is foiled by the fact that their reference "From Assali *et al.*, 1965" is not numbered.

As a further example, the effects of drugs on the pulmonary circulation are discussed on pages 94–104. The effect of acetylcholine on pulmonary flow and pressures is illustrated by a figure on page 98 which shows a proportionally greater change in pulmonary arterial blood pressure than in flow. Yet its legend states there is no change in resistance.

There is no doubt, however, that Assali has recruited some expert contributors. The chapters "Growth and composition of the fetus and newborn" and "Maternal and fetal blood constituents" are perhaps excessively occupied with facts, but they are sound, and the chapters on the fetal kidney and lung are new and exciting.

One is perhaps inclined to demand more from *Biology of Gestation* than from *Foetal and Neonatal Physiology* because of its greater pretensions in title, number of pages, and price, and then one finds oneself disappointed. Part of the large bulk of *Biology of Gestation* is occupied by material that is so elementary or treated so superfically as to be useless—for examples, the review of Starling's hypothesis of the capillary (p. 164) and the discussion of neurophysiological methods (p. 262). It contains a chapter on modeling of the fetal and neonatal circulation that, like so many similar projects, proves little more than that it can be done. Nevertheless, the book can be useful as a source book, it being the most completely referenced work on the subject since Davies' *Survey of Research in Gestation and the Developmental Sciences* published in 1960. It is unfortunate that the references are given in order of citation in the bibliographies of some chapters and alphabetically in others, all without titles. Perhaps this was done to insure that the user must read the text to make use of the references.

We should have known better, perhaps, but when confronted with these summaries of the last 20 years' worth of work on prenatal physiology we expected to see a glimpse of "the spectacular progress of science." The disappointment is no fault of their authors. Prenatal research is expensive. It is therefore often done on a casual basis by workers whose primary obligations lie elsewhere, and the results are less than brilliant.

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Plant Constituent

Constitution and Biosynthesis of Lignin. K. FREUDENBERG and A. C. NEISH. Springer-Verlag, New York, 1968. x + 132 pp., illus. $7. Molecular Biology, Biochemistry and Biophysics, vol. 2.

The elucidation of the chemistry of lignin has been an intractable problem. Lignin is universally present in the older cell walls of higher plants, and its presence in association with cellulose and the hemicelluloses is indicative of maturity of the tissue, in that the cells are no longer capable of a change in dimension. Although lignin is not unreactive, its removal from plant tissues can be accomplished only by relatively drastic treatments that result in structural change and the formation of derivatives. It has long been recognized as aromatic, in part at least, and its association with polysaccharides suggested some mechanism of synthesis from intermediates of a carbohydrate nature.

This volume is peculiarly interesting inasmuch as it brings together the results of two distinguished investigators who have chosen entirely different approaches to the study of lignin. Karl Freudenberg, in the classic tradition of organic chemistry, has prepared derivatives, degraded these to identifiable products, identified functional groups, and attempted to construct structural formulas consistent with the information thus laboriously assembled. Freudenberg's lignin investigations have extended over a period of more than 40 years.

Arthur Neisch's approach has been to seek biosynthetic pathways by which precursors might be converted to, or incorporated into, lignin. In this he has been aided immeasurably by the use of C^{14}-labeled materials. He was led quite early into the study of the formation of the aromatic amino acids through the shikimic acid pathway and demonstrated that a variety of C_6–C_3 phenylpropanoids could be incorporated into lignin. Much of this work has been done in the past 15 years.

Side by side, then, the reader has presented to him aspects of lignin chemistry from two entirely different vantage points. Yet another approach, referred to only in passing by Freudenberg and Neish, is that followed by F. F. Nord in investigations of the biological decomposition of lignin-containing material by wood-rotting fungi and in the identification of products. The addition to this book of a chapter by Nord would have logically triangulated the topic.

Both Freudenberg and Neish agree that there is a family of lignins derived from phenylpropanoid compounds, such as coniferyl alcohol and homologs. Both agree that some form of polymerization is involved, but Freudenberg goes much further than Neish in attempting to develop empirical and structural formulas, as have other lignin chemists through the years, such as Hibbert, Erdtman, and Brauns, each on the basis of extensive degradative studies. Neish, on the other hand, speculates on the evolution of lignification in vascular plants from a condition in which lignin-like materials are essentially secondary or by-products to one in which the lignins confer certain physical and mechanical properties to the tissue that are advantageous to the structure of the plant.

Each author's contribution is an excellent review of his own beliefs on the nature of the lignin. There is no interplay between them. Nevertheless, the book would be a valuable addition to the not overly long bookshelf on plant cell wall constituents.

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Physical Acoustics

The Acoustical Foundations of Music. JOHN BACKUS. Norton, New York, 1969. xiv + 314 pp., illus. $7.95.

The word "acoustics" is derived from a Greek antecedent meaning "hearing." Thus, to the purist, "the acoustics of music" must imply the hearing of music. The field known as the acoustics of music is, however, a complex, extensive discipline ranging in subject matter from the microscopic, physical