

Prototheria

The Biology of the Monotremes. MERVYN GRIFFITHS. Academic Press, New York, 1978. x, 368 pp., illus. \$31.

Although the unusual nature of the monotremes was recognized well before they were known to be oviparous, real knowledge of their biology languished until the last decade, largely because of the dismissive assumption that they were aberrant and primitive. The renewed interest in monotremes was largely stimu-

lated by Mervyn Griffiths's book *Echidnas*, published in 1968, and much of the work he reviews in *The Biology of the Monotremes* has resulted from that stimulus. Indeed, almost half the 500 references cited in the book have been published in the last ten years.

This is still a field of zoology where one person with the mind to do it can command the whole subject, and Griffiths is such a person. He has written a book that considers everything of importance that has been written on monotremes from their discovery in 1782 until late last year, and an appendix includes notes on still more recent studies. The review of published work is informed by the author's own wide knowledge of and research on echidnas, platypuses, and zaglossids in many parts of Australia and New Guinea and is enlivened by his direct, uncomplicated style of writing.

All students of comparative zoology are aware of the extraordinary mixture of mammalian and sauropsidan features possessed by the monotremes, and in this book we learn that the *mélange*, as Griffiths calls it, extends from gross anatomy to the microscopic and molecular levels of organization. Thus the sclera of the monotreme eye consists in part of a

cartilaginous cup unknown in any marsupial or eutherian; the partially coiled cochlea is intermediate between those of Jurassic and living mammals but contains an expanded lagena and macula acustica unknown in mammals and similar to that of birds and reptiles; the sperm are sauropsidan but the mammary glands wholly mammalian; and the keratin of hair and the crural spur is composed wholly of the α species, as is the keratin in all other mammals.

In their thermoregulatory adaptations, however, both echidna and platypus fall

well within the ranges of comparable eutherian and marsupial species. Griffiths challenges the notion that the standard metabolic rates of monotremes are more primitive than those of other orders of mammals. He refers to unpublished work by Grant that shows that the platypus has a capacity to withstand low water temperature unequalled by diving mammals such as muskrat, beaver, and polar bear. Similarly, the echidna can cope very effectively with low ambient temperature and when fasted can hibernate and become hypothermic in association with adrenocortical responses. In both species these adaptations are reflected in enzyme kinetics and isolated tissue metabolism similar to those of eutherian mammals rather than to those of poikilothermic animals.

Griffiths compares monotreme and marsupial modes of reproduction in detail and emphasizes the important facts, which have escaped some recent reviewers, that although monotremes lay eggs these are very much smaller and less yolk than sauropsidan eggs and that intrauterine development in monotremes depends, as it does in marsupials, to a considerable extent on uterine secretions, probably controlled by an active

corpus luteum. The hatchling monotreme and neonatal marsupial are remarkably similar. The post-hatching development of echidna and platypus and the mode of milk synthesis and secretion are described. The milk changes markedly in composition during the course of lactation in a way similar to that of marsupials, and the changes in both are related to the changing requirements of the dependent young.

In the final chapter the relationships of monotremes to other mammals, living and extinct, are discussed. The most important feature of the chapter is Griffiths's reexamination of the homologies of the monotreme braincase, especially the identity of the alisphenoid, a matter long disputed and crucial to understanding the relationship of monotremes to fossil mammals. With a fine series of specially prepared skulls Griffiths provides the best evidence yet for the structural homologies of the side wall of the skull in echidna and platypus. This evidence and that from dental anlage in the platypus dentary strengthens considerably the old view of Cope that the monotremes are living descendants of the multituberculates. With the new finds of multituberculates in Mongolia and elsewhere Griffiths's studies are timely.

This is undoubtedly the most important book that has been written on the monotremes. It will be necessary reading for anyone interested in the evolution of mammals and their mode of reproduction, and for others it will be a source of enlightenment about these very fine beasts.

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Quantum Chemistry

Excited States in Quantum Chemistry. Theoretical and Experimental Aspects of the Electronic Structure and Properties of the Excited States in Atoms, Molecules and Solids. Proceedings of a NATO Advanced Study Institute, Kos, Greece, June 1978. CLEANTHES A. NICOLAIDES and DONALD R. BECK, Eds. Reidel, Boston, 1979 (distributor, Kluwer Boston, Hingham, Mass.). x, 572 pp., illus. \$59. NATO Advanced Study Institutes series C, vol. 46.

The contributors to this book of symposium proceedings include several scientists such as Peyerimhoff and Buenker who have contributed much to developing variational techniques for studying excited states as well as scientists such

as Linderberg, Öhrn, Cederbaum, Von Niessen, and Altick who have helped develop Green's function and other many-body techniques. Although most of the contributions deal with excited electronic states of isolated small molecules, Michl gives a nice overview of the role of excited states in organic photochemistry and several authors (Collins, Economou, Kunz, Ladik, and Koutecký) describe how modern theory contributes to understanding excited states of extended systems (polymers and solids).

I especially liked the chapter by Von Niessen, Cederbaum, and Domcke because of its clear and comprehensive treatment of how Green's function methods have been used to study ionization processes and their accompanying vibrational structure. The series of chapters by Peyerimhoff *et al.* on the application of modern multiconfigurational configuration-interaction techniques to molecular excited states is also a high point of the book. These authors show clearly how modern theory has been able to aid in the understanding of ambiguous experimental data. The chapters by Siegbahn, Öhrn, Von Niessen, Cederbaum and Domcke, Beck and Nicolaides, and Altick add up to a nice overview of the photoionization process from both experimental and theoretical perspectives.

On the whole, the chapters included in the book are interesting state-of-the-art descriptions of quantum chemical research on the electronic structure of excited atoms, molecules, polymers, and solids. The quality and excitement of the book could have been improved if the editors had included several chapters dealing with the nuclear-motion dynamics on excited-state potential energy surfaces. Future meetings of this kind should include a better balance between electronic structure and dynamics.

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Chemical Carcinogens

Polycyclic Hydrocarbons and Cancer. HARRY V. GELBOIN and PAUL O. P. TS'O, Eds. In two volumes. Vol. 1, Environment, Chemistry, and Metabolism. xxiv, 408 pp., illus. \$37.50. Vol. 2, Molecular and Cell Biology. xxii, 452 pp., illus. \$42. Academic Press, New York, 1978.

Polycyclic aromatic hydrocarbons are released into the atmosphere during the incomplete combustion of organic matter, and that includes all the fossil fuels.

They are therefore ubiquitous environmental contaminants. As chemical carcinogens, the hydrocarbons possess a certain class distinction, since compounds of this type were the first pure chemicals to be shown, by Sir Ernest Kennaway and his colleagues in the 1930's, to induce cancer in experimental animals. The current concern over the environmental impact of the polycyclic aromatic hydrocarbons can be more readily appreciated if it is borne in mind that, while the amounts of just one of these compounds, benzo[a]pyrene, that are released into the atmosphere over the United States are measured in hundreds of tons per annum, the quantities of this substance that have to be applied to initiate the process of tumor formation in mouse skin are commonly considered in millionths of a gram.

The two volumes under review provide what is probably the most compact coverage available of the problems posed to scientists and to society by the carcinogenic polycyclic hydrocarbons in terms of their environmental distribution, chemistry and metabolism, and biological and biomedical effects. The book, which is well organized and includes contributions from most of the prominent research teams, is divided into 15 sections that are arranged in a logical sequence; in each section, a group of research reports is preceded by a more general paper that is intended to serve as an introduction for the uninitiated. Many of these review papers are excellent, and those dealing with synthesis, with metabolism, with microsomal monooxygenases, with DNA repair, and with mammalian cell mutagenesis can be especially recommended. The literature cited often extends to work that was published during 1977. The text contains much about benzo[a]pyrene and comparatively little about the rest of the potpourri of polycyclics that are made freely available to so many. There are sound reasons for this bias, however, since benzo[a]pyrene has been very much more intensively investigated than any other hydrocarbon. Much of the recent progress has followed from the discovery, in 1974, of the diol epoxides and of the crucial role that this type of metabolite seems to play in, for example, hydrocarbon-induced mutagenesis and carcinogenesis. Prior to 1974, dihydrodiols were generally regarded as true detoxication products that could, because they were more polar than the parent hydrocarbons, be more readily excreted by many species. It then became apparent that some dihydrodiols can be convert-

ed, by a Machiavellian quirk of metabolism, into diol epoxides, a novel type of reactive metabolite that is formed when one atom of oxygen is added enzymically across the isolated olefinic double bond adjacent to a non-K-region dihydrodiol grouping. The synthesis, properties, and formation of such diol epoxides are fully covered in the book. Indeed, so much recent work has been concerned with these vicinal diol epoxides rather than with the once-fashionable free radicals and simple epoxides that the symposium from which these volumes originated is referred to in a summary as "the diol epoxide meeting." The book also contains a useful section devoted to the bay-region hypothesis, which is a refinement of the general diol epoxide mechanism of activation and which does provide a rational basis for the activity of some carcinogenic polycyclic hydrocarbons even if it fails to explain why others are inactive.

On the minus side, the volumes lack an in-depth appraisal of the roles played by enzymes such as epoxide hydratase and the glutathione transferases in the activation and detoxication of the hydrocarbons that would have balanced the detailed treatment accorded to the microsomal monooxygenases. Presumably the editors failed to persuade their contributors to adopt a standard nomenclature for the different stereoisomeric forms of the benzo[a]pyrene diol epoxides; the average reader of the book will have to be forgiven if he or she does not immediately realize that the substance that is called diol epoxide I in one laboratory is the same compound that is known as diol epoxide 2 in another, and this quite unnecessary confusion brings no credit to anyone involved with its propagation. One obvious gap in the coverage concerns tumor promotion, which may play an important part in the etiology of hydrocarbon-initiated cancers of several sites in humans and which is only dealt with here in a commendable chapter on tobacco carcinogenesis. Tumor promotion has recently been considered in detail, however, in other books. One or two contributions could have benefited from closer scrutiny at the proofreading stage or from additional editorial attention, but these are really only minor criticisms of what forms an otherwise excellent addition to the literature on carcinogenesis in general and the polycyclic hydrocarbons in particular.

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