

## Light-emitting diodes

*Light-Emitting Diodes.* (Monographs in Electrical and Electronic Engineering.) By A. A. Bergh and P. J. Dean. Pp. viii+591. (Clarendon: Oxford; Oxford University: London, 1976.) £22.

THE general public first became aware of light-emitting diodes (LEDs) when pocket calculators made their dramatic entry on to the market. The miniature calculator was in fact made possible by LEDs, although the more recent development of reliable passive displays, such as liquid crystal devices, would eventually have filled the gap. For many years preceding this sudden appearance, LEDs were the subject of intense research in solid-state laboratories in many parts of the world.

The history of this period is an exciting one, with its full share of disappointments and surprises, and the authors of this book have played an important part in promoting the theory and the technology of the subject. It is disappointing that, contrary to early expectations, conversion efficiencies from electrical energy to visible light remain low in spite of the massive effort put into improving them, so the rapid technical advance of the 1960s and early 70s has now slowed down. The fact that LEDs have now found wide commercial applications, makes this a period of stability and therefore a most appropriate time for the appearance of this comprehensive work on the subject.

Nearly half of the book is devoted to a deep and detailed account of the theoretical aspects of carrier injection and the factors affecting the efficiency of light generation, most particularly in the III-V compounds. There follows a good account of the interesting field of up-converters (infrared to visible)—phosphors which seem to defy the basic rules of phosphor physics. Even though this technique has not found commercial application, it may prove of great importance if solid-state lasers are developed with output wavelengths more closely matched to the excitation band of the few available phosphors.

The remainder of the book is devoted to the technology, design and application of LEDs and associated devices, and here again the treatment is detailed and comprehensive. A minor disappointment (perhaps inevitable if the book is to be constrained to a reasonable length) is the treatment of photometry. Although a whole chapter is devoted to this subject, and many aspects are enlarged on in the chapter on LED design, the results are put in the form of generalised equations. Photometry is such a jungle of defini-

tions, concepts and units that it is a permanent headache to the engineers trying to compare the merits of different light-emitters. An appendix containing some worked examples would have been very helpful.

The work is naturally devoted to the most theoretically tractable light-emitting devices, especially the III-V semiconductors, although there are brief discussions on SiC and ZnS. It is impressive in its deep treatment of the subject, and the enormous range of study is indicated by the collection of more than a thousand references. This makes it a valuable source-book and a necessary addition to the library of any physicist or engineer working in this field.

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## Reptilian physiology

*Biology of the Reptilia.* Vol. 5: Physiology. Edited by C. C. Gans and T. S. Dawson. Pp. xv+556. (Academic: London and New York, October 1976.) £16.80.

THE preceding volumes of this encyclopaedic survey, which appeared between 1969 and 1973, were devoted to morphology; and herpetologists interested in physiology have had to await patiently the turn of their own speciality. The first of the physiological series, however, should not disappoint them. The literature on the subject is remarkably scattered because reptiles have been studied, not only in their own right but also as subjects for physiological and pharmacological assay. In the book under review, an attempt has been made to provide an overall summary orientated towards reptiles as a taxon rather than towards single topics such as metabolism, thermoregulation, or water balance. In this endeavour, the editors have enlisted authors who, in each case, have contributed signally towards elucidating the particular topics they summarise. The cast is all-American, but at least the book was printed and bound in Great Britain.

In their opening chapter, entitled 'Reptilian physiology: an overview', the editors emphasise the ecological aspects of environmental physiology. This is followed by a detailed discussion of 'Methods for the physiological study of reptiles' by Harry S. McDonald. Subsequent chapters are as follows: 'Metabolism' by Albert F. Bennett and William R. Dawson; 'Respiration: mechanics, control and gas exchange' by Stephen C. Wood and Claude J. M.

Lenfant; 'Circulation' by Fred N. White; 'Regulation of acid-base balance in reptiles' by Barbara J. Howell and Hermann Rahn; 'Osmo-regulation' by P. J. Bentley; 'Salt glands in reptiles' by William A. Dunson; and 'Renal function (with special emphasis on nitrogen excretion)' by William H. Dantzler. The volume concludes with a comprehensive index, but this does not seem to have been checked with quite the thoroughness usually characteristic of Academic Press.

Throughout, the reader will be struck by the heterogeneity of the Reptilia, which is reflected in their physiology. For instance, in many reptiles the salt gland is the major route for excretion of electrolytes; yet these glands have evolved independently, over and over again, in the process of adjustment to dry or saline environments. Great variation exists in the regulation of nitrogenous excretion, and this too may be related to habitat as well as to the end products of metabolism, the ability of the cloaca or bladder to regulate the volume and composition of the urine, and the ability to excrete ions by extra-renal routes. Similarly, metabolic rates are extremely variable, but little attention has yet been directed towards their functional correlates. The vast diversity of respiratory mechanics, lung morphology and gas transport mechanisms, is matched by comparable diversity in habitats, habits and levels of activity. The heterogeneity referred to above is thus clearly related not only to phylogenetic divergence but also to adaptive radiation within the various orders and suborders.

The search among living reptiles for intermediate evolutionary linkages with mammals and birds has diverted attention from the adaptive features and control mechanisms of the reptilian cardiovascular system. Yet, such features and mechanisms form an important part of the integrative physiology of the class. Reptiles have, potentially, a large contribution to make both to cellular biology and to ecology, and the future of reptilian comparative physiology should be linked closely with these areas.

Relatively few of the physiological processes discussed in this important volume have yet been investigated intensively, and any such studies comprise only a few species. Much work remains to be carried out before reptilian physiology can be understood really adequately. This book plays an important rôle in emphasising both what is, and what is not, now known.

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