There are a large number of books with similar objectives mainly by foreign authors. Rao's monograph, however, appears to excel all these in conveying the feeling of enthusiasm for the subject, which may be but a reflection of the inimitable personal enthusiasm and extraordinary clarity of conceptions of the author. The publisher has utilized the back-cover of the book in enumerating only a few of the highest international honours and unique recognitions (may be unmatched by any other chemist), but all these are not able to reflect the depth of passion which the author has been depicting for creation as well as dissemination of knowledge for more than four decades.

Rao has in the last section presented fascinating biographical sketches of two most innovative chemists like Faraday who contributed to both chemistry and physics so richly as to be worthy of five Nobel Prizes (if these were indeed in existence during Faraday's times) and Pauling (who actually won two Nobel Prizes), these should be sources of the deepest inspiration to readers of all levels and age groups. While going through these accounts, one is reminded of the equally excellent publication, *Chemical History of a Candle* by Faraday and a brief biography of Pauling by David E. Newton published by the Universities Press in 1994.

The book *Understanding Chemistry* is printed neatly and beautifully with hundreds of illustrations (both in colour as well as black and white), which add to a clearer understanding of the subject matter. In order to avoid the impression of being too laudatory, the reviewer attempted to locate some mistakes, but he could come across only three minor typographical errors: (i) the spelling of Ramsay (p. 108), (ii) the pictorial representation of the shape of BF_3 molecule (p. 162), and (iii) the page caption, 'Two chemists' (p. 291).

In conclusion, the book is a masterly creation – capable of not only infecting the beginner with the unfathomable enthusiasm of the author, but providing some novel insights even to mature chemists with narrow specializations. It would certainly go a long way in inculcating the enthusiasm of learners for this fascinating branch of ever-lasting and universally useful branch of science. I hope the small monograph would be translated in Hindi as well as other Indian languages, even before it is grabbed by foreign publishers for translated versions in their chosen languages.

R. C. MEHROTRA

Department of Chemistry,
University of Rajasthan,
Jaipur 302 004, India

Advances in Photosynthesis – The Photochemistry of Carotenoids. Govindjee (AIPh Series ed.), H. A. Frank, A. J. Young, G. Britton and R J. Cogdell (eds). Kluwer Academic Publishers, Dordrecht. 1999. vol. 8. ISBN 0-7923-5942-9, 420 pp. Hardbound US Dollars 223.00/Dutch Guilders 420.00/ GB Pounds 139.00.

The carrot-coloured pigments, the carotenoids, are ubiquitous – they are found in insects, birds, mammals, higher plants, algae, cyanobacteria, fungi and bacteria. The carotenoids are the second most abundant pigments on earth; the annual production of carotenoids approaches 2×10^8 tons, yet these red, orange and yellow-coloured pretty pigments are usually ignored in the plant science texts. In most plant physiology textbooks, the carotenoids are discussed as auxiliary or at best accessory pigments being accessory to the light-harvesting chlorophylls in photosynthetic organisms. On the contrary, the carotenoids carry out a variety of regulatory functions (besides the commercial importance of secondary carotenoids as vitamin additives and fish-feeds). In recent years, the importance of the carotenoids in photosynthesis, in regulating the biosynthesis of plant hormone, abscisic acid, in controlling the light harvesting by the photosynthetic apparatus, and in protecting the photosynthetic apparatus from excessive light-induced photodamage and from other stress injury, has been recognized. The carotenoids may well be involved in regulating membrane assembly, integrity and fluidity of membranes, and possibly temperature homeostasis. Because of the recent developments in the chemistry, biochemistry and molecular biology of carotenoids, including the bioengineering of provitamin A biosyntehsis pathway in rice endosperm[1], many attractive reviews and books are currently available[2]. While the chemistry, biochemistry and metabolism of carotenoids are discussed in these reviews, the photochemistry of carotenoids is usually overlooked, which creates a void in our understanding of the physiological functions of these pigments. The research efforts in plant biology are becoming more interrelated and interdisciplinary, and thus a book like the one under review dealing with all the aspects of carotenoids in photosynthesis and related areas fills this void. The book containing twenty chapters contributed by leading experts, has been organized into five distinct sections; (i) Biosynthetic pathways and distribution of carotenoids (3 chapters); (ii) Structure of carotenoid–chlorophyll protein complex (4 chapters); (iii) Electronic structure, stereochemistry, spectroscopy, dynamics and radicals (6 chapters); (iv) Ecophysiology and the xanthophyll cycle (4 chapters); and (v) Model systems (3 chapters). The book contains a comprehensive overview on the history of carotenoid research in photosynthesis, chemistry, biochemistry and structural organization of carotenoids and xanthophylls. Further, it includes the structural details and assembly of carotenoid-containing light-harvesting chlorophyll protein complexes (LHC) in higher plants and algae, as well as the three-dimensional structural details of the reaction centres (RC) of purple bacteria. The topics in spectroscopy, electronic structure, stereochemistry, and the interaction dynamics of carotenoids, including their reactions make this volume a very valuable addition to photosynthesis research. Further, the nature, regulation and molecular biology of violaxanthin (V), zeaxanthin (Z), antherazanthin (A) inter-conversion–dependent dissipation of excessive radiation have been fully documented in this book. Also, it deals with environmental factors regulating Z + A levels for providing thermal protection to plants. The molecular biological aspects of this crucial 'Xanthophyll cycle' that protects the photosynthetic apparatus from photodamage would fill the needs of stress biologists. Finally, biomimetic functions of carotenoids and their possible use in developing artificial photosynthetic and photovoltaic systems, discussed in the last three chapters of

the book would be welcomed by researchers who love to copy photosynthesis. The very first chapter of the book provides attractive discussions on past as well as current discoveries of the various roles of carotenoids in energy harvesting, trapping, structural stability and on the mechanism of protection by xanthophyll cycle against photoinhibition of photosynthesis. This chapter also serves as a good introductory overview of the entire content of the book.

The chapters in the first section give in-depth description of the carotenoids as integral constituents of the photosynthetic apparatus, deal with the details of the biochemistry of carotenoids such as beta carotene, leutin, Z, A and V, the carotogenesis in anoxygenic photosynthetic bacteria, and chart out the pathways of biosynthetic of spirilloxanthin and spheroidene. Except for some secondary carotenoids and carotenoid-specific herbicide and inhibitors, the first section deals fully with the biochemistry and metabolism of carotenoids and xanthophylls in photosynthetic organisms.

The second section of this book has been organized to document the association and structural organizational details of bound carotenoids, at atomic level, in LHC of *Rodopseudomonas* (Rh) acidophila, to give the association of carotenoids in LHC in eukaryotic algae, and the three-dimensional crystal structure of RC of *Rhodobacter spheroides* and *Rh viridis*. The structural requirement of carotenoids in light-harvesting chlorophyll complex-assembly becomes evident from the studies involving mutants deficient in carotenoids and also from the reconstitution of chlorophyll *a*/*b* complex of LHC. This section of the book not only provides detailed overviews about the structural and functional roles of carotenoids, but also develops appreciation for the structural and organizational details of photosynthetic apparatus in higher plants, algae and photosynthetic bacteria. This section also exemplifies the interactions of structural–functional correlation in photosynthesis and the crucial roles the carotenoids play in regulating the structure and function.

The third section deals with the spectroscopy, photochemistry, stereochemistry and dynamic states of carotenoids. Discussions on the excited states of polyenes and carotenoids, both singlet and triplet electronic states, the electronic spectroscopy of both short and long carotenoids, and the cross-over among the various energy levels, and the origin of emission of light (fluorescence) in carotenoids and polyenes are quite fascinating. The time-resolved spectroscopy and the functional dynamics of carotenoids in higher plants and bacteria have been extensively discussed, both from the point of view of basic theory and their applications *in vivo*. Discussion on the functional role of *cis–trans* carotenoids and on the universal presence of 15 *cis*-carotenoids in RC of photosynthetic organisms and their roles in photoprotection as well as on the details of methodology and application of proton NMR and resonance Raman of carotenoid molecules *in vivo* would not only prove to be valuable for researchers working on energy transfer process in photosynthesis, but also for stress biologists keen on enlarging the probing methods they use currently. Although this section would be appreciated by the readers having training and interests in physical chemistry and plant biophysics, plant biologists in general can derive a lot of insight by reading, perhaps more than one time, into the intrinsic structure and spectroscopic details and functional dynamics of carotenoids which function as a vital component of photosynthetic membranes of bacteria and higher plants. Simultaneously, discussion relating to the electron magnetic resonance spectroscopy of carotenoids contained in LHC and RC of photosynthetic organisms, provides important information on the mechanisms by which injurious chlorophyll triplets are eliminated from the system; this gives new directions to our understanding of the protective roles of carotenoids. Thus, in this section of the book, the photochemistry and photophysics of carotenoids are comprehensively treated. Simultaneously, chapters in this section give the basics of the application of a wide range of optical methods in carotenoid research and thus this section adds to the novelty of the book.

The fourth section deals with recent trends in physiological research involving carotenoids via the so-called 'xanthophyll cycle', that is the conversion of Z and A V, and the maintenance of high levels of Z + A for better thermal dissipation by plants, as well as on the nature of protection against photoinhibition which limits crop productivity. Interesting descriptions of the mechanism of controlling non-photochemical quenching of chlorophyll-*a* fluorescence, a method now widely used in agricultural and environmental research, and on the molecular biology of xanthophyll cycle and the possible genetic engineering of the xanthophyll cycle via violaxanthin deepoxidase and zeaxanthin deepoxidase for developing transgenics may provide attractive promises to researchers in this field. This section also contains a favourite theme of stress biology involving interrelationship between xanthophyll cycle and antioxidants.

The last section (section 5) of the book gives details of carotenoids as an integral part of membrane lipid bilayers, the physical properties of carotenoids in thin films and as a constituent for biomimetic model systems for energy transfer and proton transfer processes. Since there has been a long-standing interest in studying model photosynthetic systems for the benefit of humans, these chapters would add serious thoughts to these goals.

In summary, all the chapters in the book are very informative; they not only provide current state-of-the-art but also provide insights into the future direction of development. The chapters give enough experimental details in terms of tables, charts, graphs and cartoons. The three-dimensional structures are very illustrative. The editors have taken pains to make the chapters uniform in their presentations and style. Many of the chapters are short and concise and therefore can be easily read by the non-initiated readers. The chapters are not only authoritative, but also innovative. Thus the book may serve as a road map for research efforts involving molecular biology, ecophysiology, biochemistry and photochemistry of primary carotenoids. One would expect the use of *in vivo* carotenoid spectroscopy similar to that of chlorophyll-*a* fluorescence in stress biology and in transgenics. The yellow, orange and red pigments may become gold mines for research in plant biology. Well, who do we recommend this book to? Obviously this book shall be required by all those working on any aspect of carotenoids and also on any aspect of photosynthesis, and also by those who intend to get into this area of research. Plant biologists of all descrip-

tions would like to read this book to widen their research perspectives. The teachers of plant physiology, plant biophysics, biochemistry, molecular biology, ecology and microbiology would find this book helpful in upgrading the text materials. This book will also serve as a valuable reference text. Like previous volumes in the series, volume 8 has many current research references, and a classic bibliography. The publishers deserve our greetings for excellent production but, alas, like the previous volumes of the AlPh series, this superb publication would remain out of reach of many. However, I would recommend this book for libraries and would also like to greet the editors for the commendable addition to the series. I urge the publishers to bring out all volumes in this series as paper-back and inexpensive editions, so that the available knowledge would reach all, and not just a few.

1. Ye Xudong, A Babill S., Kloli Azhang, J., Lucca, P., Boyer, P. and Potrykus, I., *Science*, 1999, **287**, 230–308.
2. Britton, G., Liaaen-Jensen, S. and Pfander, H. P. (eds) *Carotenoids*, 1995, Birkhäuser Verlag, Basel, 1995, vols. I and II.

PRASANNA MOHANTY

Regional Plant Resource Centre,
Nayapalli,
Bhubaneswar 751 015, India

Gymnophiona (Amphibia) of India: A Taxonomic Study. R. S. Pillai and M. S. Ravichandran. Records of Zoological Survey of India, Occ. Paper No. 172. 1999. 115 pp. Price: Rs 300.

The book under review is a taxonomic study of limbless amphibians (also known as caecilians, Class: Amphibia, Order: Gymnophiona).

It is the first major publication on Indian Gymnophiona (formerly wrongly called Apoda) and also the first All-India basis fauna of a group of amphibians. The previous work is the celebrated *Fauna of British India* on reptiles and amphibians by G. A. Boulenger, published by Taylor and Francis, London, in 1890. There have been, of course, some publications on Indian amphibia, on a regional basis such as the *Anuran (Amphibia) Fauna of North-East India* by S. K. Chanda, (Memoirs of the Zoological Survey of India, 1994, no. 18). There have been a couple of checklists but no detailed species descriptions and keys. A good attempt to give brief description and morphometry of salient characters of the various species of caecilians (known till then) was made by G. Bhatt (*J. Biosci.*, 1998, **23**, 73–85), however keys and diagrams (the exception being diagrams for generic diagnoses) were once again not provided.

This volume on Indian Gymnophiona describes twenty-one species in detail, four of which are new and one constitutes a new record for India. As is customary for such taxonomic treatise, the volume contains a brief introduction to the group, review of important literature, overview of external morphology and also explanation of the terms used in systematics of this group. This is followed by comments on the known distribution of the species, general habits and habitat, as well as whatever little is known about the life history of these cryptic creatures. The authors have adopted the latest revised classification of Gymnophiona and classified Indian species accordingly. For each species there is a brief diagnosis, detailed description, morphometry of available good specimens, clear camera lucida drawings of the salient features, range of distribution known, as well as additional remarks wherever there was a previous taxonomic confusion. For example, now it is conclusively demonstrated that *Icthyophis glutinosus* is present in India; *I. beddomei* and *I. tricolor* are distinct species. Authors have also adopted some information from published literature, especially about the type specimens deposited in museums abroad. Location of the type specimens and full synonymy for each species is provided. Some photographs and distribution maps make this volume a tidy 115-page treatise.

Indian caecilians are poorly known and a publication dealing with detailed descriptions along with identification keys is certainly the most welcome and significant addition to our literature on amphibians. It is of interest to note that only 5 species were known at the time of Boulenger's book and only 3 species were added till 1960, taking the total to 8. Taylor (writer of the world famous first monograph on caecilians), who made a major contribution, described 7 species in a short period of about 8 years. After that the only addition came from Pillai himself when he described a single species from Silent Valley. This volume describes 4 new species; thus in 110 years, since the *Fauna of British India* only 15 species have been described. This is, of course, largely due to burrowing habits of these animals and difficulty in obtaining a specimen after strenuous digging efforts, about which the authors have also commented. This treatise by Pillai and Ravichandran is based on an examination of only about 100 specimens that are scattered in different institutions. Although biochemical and other studies have been carried out in some laboratories, detailed biological studies are wanting and much remains to be discovered about Indian caecilians. The name *Ichthyophis* often brings before our eyes a very popular drawing depicting a female coiled around her eggs; but again, apart from pioneering works of our early zoologists like L. S. Ramaswami and B. R. Seshachar, very little is known about the biology of our caecilians.

It is worth noting here that there are only 6 families, 34 genera and 154 species of caecilians in the world and we have, in India, representation from 3 families and 4 genera. Regarding percentage, we have 21 out of 154 species, that is about 14%. Besides, of the 4 genera, 3 (namely *Ureotyphlus, Indotyphlus* and *Gegeneophis*) are endemic with distribution mostly restricted to the Western Ghats. It is well known now that these Ghats are biodiversity hotspots and are a home to an enormous number of plant and animal species. The same area is being exploited to a great extent and the habitat destruction caused in the wake of development is alarming. Already species like *Indotyphlus battersbyi* are known but from a few examples and their extinction may simply pass unnoticed as there are very few naturalists looking for them.

I am reminded of yet another group of herptiles, namely snakes of the family Uropeltidae. These snakes (many genera and species being endemic) are also inhabitants of the Ghats, are burrowing animals that feed on earthworms and are rarely seen above the ground – much remains to be done about these snakes as well.