

heaven-sent dream you will be a far happier and richer man than the millionest millionaire.'

But the most effective person was Heaviside because, in addition to his vitriolic polemical style, he actually showed in his work on electromagnetic theory how effective vector analysis could be in the solution of physical problems. Crowe says that Heaviside's style can be placed somewhere between brilliant and obnoxious depending on one's point of view; while G. M. Minchin referred to him as the 'Walt Whitman of English Physics'. Certainly he is never dull. Read 'But supposing, as is generally supposed, vector algebra is something "awfully difficult", involving metaphysical considerations of an abstruse nature, only to be thoroughly understood by consummately profound metaphysico-mathematicians, such as Prof. Tait, for example. Well, if so, there would not be the slightest chance for vector algebra and analysis to ever become generally useful.' Or 'And it is a noteworthy fact that ignorant men have long been in advance of the learned about vectors. Ignorant people, like Faraday, naturally think in terms of vectors. They may know nothing of their formal manipulation, but if they think about vectors, they think of them as vectors, that is, directed magnitudes. No ignorant man could or would think about the three components of a vector separately, and disconnected from one another. That is a device of learned mathematicians, to enable them to evade vectors. The device is often useful, especially for calculating purposes, but for general purposes of reasoning the manipulation of the scalar components instead of the vector itself is entirely wrong.' And finally '... I ought to also add that the invention of quaternions must be regarded as a most remarkable feat of human ingenuity. Vector analysis, without quaternions, could have been found by any mathematician by carefully examining the mechanics of the Cartesian mathematics; but to find out quaternions required genius.' This was, of course, tongue in cheek.

Many readers may be surprised to learn that the leading British physicist of the time, Lord Kelvin, and the leading mathematician, Arthur Cayley, were both opposed to the development and use of vector analysis. The fact, however, is that science, or rather the scientific establishment, is conservative and usually opposed to any serious change. When Planck was once asked when the new physics would be accepted

by the older generation of physicists, he is said to have replied that they would never be able to accept it; they would just have die off and the younger generation, brought up with the new ideas, would absorb them without any difficulty.

Crowe's book is not without flaws, but they are too minor to warrant listing here. Whether you wish to learn some history, or you wish to learn how science develops or if you just want to have a few good laughs, the book is an excellent read. The charm lies in the fact that science is an intensely human activity, with all the attendant drama, humour and pathos. I strongly recommend this book.

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Photosynthesis in Algae. Anthony Larkum, Susan E. Douglas, John A. Raven, eds. Kluwer Academic Publishers, Dordrecht, The Netherlands. **Advances in Photosynthesis and Respiration.** Govindjee Series Editor. University of Illinois, Urbana-Champaign, USA. Vol. 14. 500 pp. 2004. Hardbound. ISBN 0-7923-6333-7. November, 2003. Price: 255 US Dollars/232.00 Euros/160.00 British Pounds.

In most Indian universities, the undergraduate (BSc) and postgraduate (MSc) courses in botany and plant sciences include algae as a subject. Nowadays, the programmes in life sciences, biotechnology and microbiology also include algae as a major subject. Further, in many universities, phycology is taught as a specialization. However, the course structures on algae in these programmes are mostly limited to discussion on a bit of morphology, systematics and life cycles of some selected algae. The algal physiology, biochemistry, the economic resource aspects and ecology of this important group of plants are rarely discussed. This is largely because of lack of good textbooks on algal biology and biotechnology. If one searches for the new books – both text and reference types, *Photosynthesis in Algae* is a forceful book on this exciting topic.

The first introductory chapter written by the three editors tells about origin and discovery of algae, their diverse photo-

synthetic mechanisms. It discusses various groups of algae like green, red, brown chromophytes, euglenas and chloroachinophytes, and the algal genomes. It also points to rich algal bioresources and one can understand the importance of algae in biotechnological industries. The phylogenetic tree of major plant taxa is instructive. The nature of endosymbiotic origin of algal plastids, fine structure of algal plastids, the route of chlorophyll (Chl) *a/b* binding protein and pigments, chlorophyll *c* as well as appearance of thylakoids in different groups make interesting reading in next chapter.

Prochloron, prochlorothrix and prochlorococcus represent unique type of Chl *a/b* protein-containing oxyphoto prokaryotes. Like cyanobacteria (blue bacteria), these oxyphotobacteria are photosynthetic prokaryotes, but contain Chl *b*. These organisms have unique nature of light harvesting pigment organization and photosynthetic apparatus. They exhibit unusual dynamics of short-term state shifts mechanism as well as long-term acclimation. Molecular phylogeny of chl *b* containing oxyphotobacteria is presented in the third chapter. We owe to algae our current understanding of photosynthesis, the discovery of the prochloron type green oxyphotobacteria. Unicellular algae like *Chlorella*, *Scenedesmus* and *Porphyridium* and cyanobacterium *Anacystis* (*Synechocystis*) have been extensively used for photosynthesis research – both in the investigations of light reactions and of carbon assimilation reactions. These algae were and still are uniquely suitable for biochemical and biophysical studies, and data generated by using these algae led to the foundation of our current knowledge on photosynthesis. Of course, the use of isolated chloroplasts and thylakoids proved valuable for exploring the intricacies of photosynthetic electron flow and related redox reactions. I recall that, in the late 1960s, hand-drawn pictures of damsels by Fred Cho who did his Ph D with Govindjee, were pasted on the walls near Eugene Rabinowitch's office. These pictures were that of *Anacystis*, *Chlorella* and *Porphyridium*. Such was the influence of algae on photosynthesis research in the bygone era (!!!). Thus the book under review is an important book in current AIPH series.

The book contains 19 chapters, contributed by 25 experts besides the three editors. These chapters deal with the following five major aspects: general structure, molecular genetics, biochemistry–physio-

logy, light harvesting systems and adaptive features of photosynthetic algae. The unique evolutionary origin of oxyphotobacteria is a valuable chapter for students. The next three chapters of section II deal with regulation and genetics – the regulation of biosynthesis, both light dependent and light independent biosynthesis of chlorophylls. The use of reverse genetic analysis for analysing functional algal genes is a new approach and this aspect would be of interest to workers working on algal genetics.

The subsequent four chapters in section II, address various algal electron transport, oxygen consumption in photo and chlororespiration, the well-known 'water-water cycle', the carbohydrate metabolism and respiration as well as the carbon dioxide-concentrating mechanism in algae. The next four chapters are on algal light harvesting systems (LHS). Chapter 12 introduces to the readers the biophysical aspects of excitation energy transfer in thylakoid membranes. Course instructors and students shall find this chapter a good starting material for further studies on how algal plants capture light by their antenna and harvest light energy for conversion into chemical energy.

The panoramic overviews on the algal light harvesting systems for optimizing light capture, the structural components and types of phycobiliproteins in red algae,

cryptomonads and glaucocystophytes as well as the functioning of carotenoids in the LHS in general and particularly the energy transfer from fucoxanthin and pteridinin to chlorophyll have been elegantly presented and these chapters add to the attractive features of the book.

The last four chapters of the book deal with the subjects that are of interest to many researchers in India and abroad. These include photosynthesis in algae, marine macroalgal photosynthesis, UV-B effects and photoinhibition and algal photosynthesis. The chapter on adaptation, acclimation and regulation in algal photosynthesis brings out the recent advances made on cyanobacterial genomics that has helped in our understanding of adaptive strategies for optimizing light harvesting and concentrating CO₂. It also shows that modelling of photosynthesis is useful in predicting the efforts of environmental variations.

Recalling the number of books that were available earlier to students, the book *Photosynthesis* by G. E. Fogg and *Algal Physiology and Biochemistry* by W. D. P. Stewart remained attractive for long years with the students. Personally, I do not know of any other book that has focused on 'Algal Photosynthesis'. Many books on photosynthesis have appeared but these did not give enough importance to algal photosynthesis. The book under review makes a

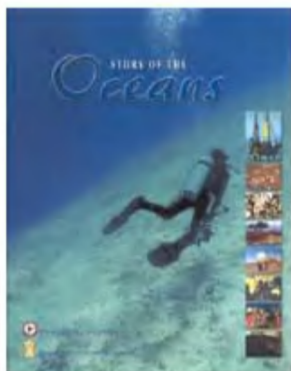
powerful entry both as a text and reference book.

All the 19 chapters have innovative approaches – they are critical in the analysis of facts and data; the chapters are rich in excellent figures, and diagrams of phylogenetic trees and contain a large body of references. This book is thus not just a book on algal photosynthesis, but a book that provides a unique and excellent picture of photosynthesis in algae. In my opinion, this volume is of enormous contemporary relevance. It not only addresses the intricacies of algal photosynthesis, but also all aspects of algal physiology and genetics. It also points to the usage of algal natural products in phycobiliprotein industries. It deals with nearly on all aspects of algal biology; the presentations by all the contributors are comprehensive and complete and these add to the nature of the book. The volume is impressive in all aspects and more so, because of current global interest in algal biodiversity and biotechnology.

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Story of the Oceans. Geological Society of India, Bangalore 560 017. 2003. 36 pp.



The Geological Society of India, Bangalore at the instance of the Department of

Ocean Development, New Delhi, has brought out a slim, illustrated booklet titled *The Story of the Oceans* to be given free of cost to schoolgoing children to kindle their interest in ocean exploration and ocean resources. The booklet, useful for the general public as well, describes briefly and in an easy-to-understand manner how important the oceans are to us, with the underlying message being, Save the Oceans! It also answers intriguing questions like do the oceans move? Can we know the climates of the past? Are our oceans polluted? Does the benevolent ocean get furious? Economic potential and mineral wealth, owners and users of resources, oceans as a source of food, medicines and sea vegetables, energy from the oceans, life in the oceans and its heritage are all explained vividly with



accompanying beautiful pictures. Satellite oceanography, career opportunities, amazing facts about the oceans, marine sediments, ocean floor and drifting continents are some of the other chapters in this fascinating booklet.