cellular processes, like growth factor signaling, protein translocation, host cell invasion and mitochondrial function. As a result, rhomboids show a widespread presence from bacteria to human and are involved in diseases like cancer and diabetes.

At the organismal level, Serbus *et al.* (pp. 683–707) provide an in-depth account of Wolbachia–host interactions. How Wolbachia modulates multiple genetic and physiological pathways to facilitate its spread has been discussed. Gibson *et al.* (pp. 413–414) discuss the symbiotic interplay between host legume plants and rhizobial bacteria. Genetic basis for how bacteria impinge upon the host by suppressing the pathogen-defence response, and how legumes exude over-infection is explicitly presented. Wolf and Goff (pp. 143–163) review how hosts have evolved restriction factors that interfere with replication and the life cycle of retroviruses.

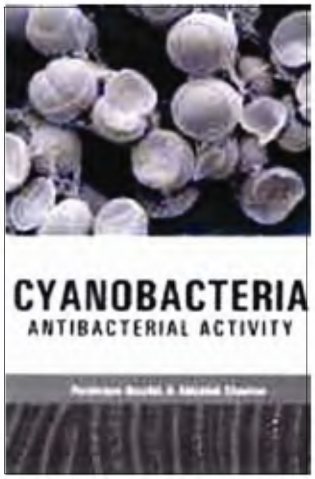
An interesting review of bio-nano-engineering is presented by Kroger and Poulsen (pp. 83–107). They summarize how diatoms form biosilica through biomineralization. The biochemistry, cell biology and genetics of silica formation in the membrane-bound compartments of diatoms have been discussed in detail. Diatoms can serve as a model to study and dissect the mechanisms for chemical cross-linking and chemical displacement reaction in a biological system and even for understanding how nanomaterials self-assemble. The article also gives a new perspective on how diatom genetics can be exploited to make silica based sieve for biomolecules separation; micro-electromechanical systems and masks for micro-fabrication.

Surprisingly, a single article is attributed to the genetic basis for complex behaviour. Andretic *et al.* (pp. 361–388) discuss the multiple loci that could be involved in complex behaviour like sleep. It has been elucidated how in-depth genetic analyses in model organisms like worms, *drosophila* and mice are helping in overall understanding of sleep requirements, timing and the adverse effects of its deficit in learning and memory, etc.

As expected from a book of 'The Annual Review' stature, this book delivers many exciting topics and reviews which could serve as an invaluable resource for both students and principal investigators working in the field of genetics and also for those who are planning a career in genetics.

UPENDRA NONGTHOMBA

*Department of Molecular Reproduction, Development and Genetics, Indian Institute of Science, Bangalore 560 012, India*
*e-mail: upendra@mrdg.iisc.ernet.in*




**Cyanobacteria: Antibacterial Activity.** Purshotam Kaushik and Abhishek Chauhan. New India Publishing Agency, 101 Vikas Surya Plaza, CV Block, L.S.C. Mkt, Pitam Pura, New Delhi 110 088. 2009. xii + 198 pp. Price: Rs 990.

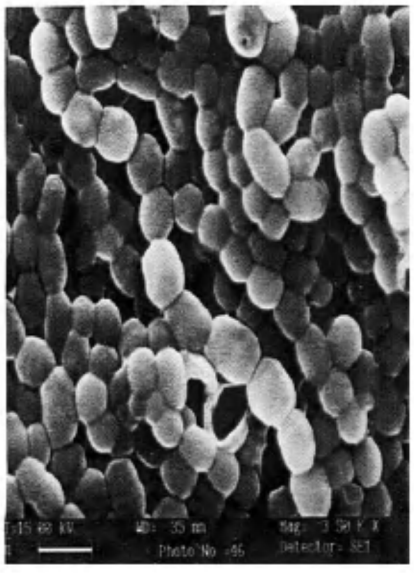
The discovery of many classes of antibiotics represents a medical miracle, but at the same time, the problem of treating infectious diseases is always there. Resistance to antibiotics in bacterial populations has increased dramatically with time and usage of antimicrobial drugs. Consequently, there arises a need to explore and develop new and more effective antimicrobials. In this context, cyanobacteria offer a great opportunity as these are considered to be one of the potential organisms useful to mankind in many ways. Worldwide attention is drawn towards cyanobacteria for their possible use in mariculture, food, feed, fuel, fertilizer, natural colours, production of diverse secondary metabolites including vitamins, toxins, enzymes, pharmaceuticals, etc.

Cyanobacteria are photosynthetic prokaryotes that are known to produce a diverse array of toxic or otherwise bioactive metabolites. Though the functional role of the vast majority of compounds from these organisms, particularly in terms of the physiology and ecology of cyanobacteria that produce them, remain largely unknown, their role as anti-viral, anti-tumour, anti-bacterial, anti-HIV, etc. has been well established. Studies have also suggested that some of the compounds may have ecological roles as allelochemicals, specifically including compounds that may inhibit competing sympatric macrophytes, algae and microbes. This potential is being realized as more and more research information in the areas of physiology and biochemistry of these organisms is gathered and the knowledge of cyanobacterial genetics and genetic recombination increased.

The impact of bioactive compounds from cyanobacteria is promising. These provide novel and useful pharmaceuticals that are difficult to produce synthetically because of their structural complexity. The medicinal qualities of cyanobacteria were first appreciated as early as 1500 BC, when *Nostoc* species were used to treat gout, fistula and several forms of cancer. Yet, not much attention was paid till the turn of the century when during 1990, workers at the University of Hawaii, Oregon State had begun to screen extracts of cyanobacteria mostly strains of *Microcystis* and *Anabaena* spp., for various biological activities. It was reported that nearly 4000 strains of freshwater and marine cyanobacteria were screened inferring that cyanobacteria are a rich source of potentially useful natural products (6% having anti-cancer, anti-proliferative activity).

Later, several screening processes were initiated over important targets such as anti-bacterial, anti-fungal, anti-AIDS, anti-cancer and others. Lipophilic and hydrophilic extracts of over 900 strains of cultured cyanobacteria *in vitro* were examined for their ability to inhibit the enzyme reverse transcriptase of Avian Myeloblastosis Virus (AMV) and Human Immunodeficiency Virus type 1 (HIV-1). This was further taken up on large scale and more than 1500 strains representing nearly 400 species of blue green algae were cultured, and lipophilic and hydrophilic extracts prepared from these cultures were evaluated. Screening for a wide variety of potentially useful bioactives including cytotoxic, multidrug resistance reversal, anti-fungal and anti-viral effects has led to the discovery of numerous novel bioactive metabolites

including peptides, macrolides and glycosides. The anti-HIV activity of marine cyanobacterial compounds from *Lyngbya lagerhemii* and *Phormidium tenue* have been reported. Cyanobacteria namely *Spirulina platensis* and *Arthrospira* sp. have been widely accepted to be relatively rich in medically important gamma linolenic acid (GLA) which is easily converted into arachidonic acid in the human body and arachidonic acid into prostaglandin E2. Prostaglandin E2 has lowering action on blood pressure and the contracting function of smooth muscle and thus plays an important role in lipid metabolism. Chemical investigations have indicated that cyclic peptides and depsipeptides are common constituents of cyanobacteria. The most familiar ones are microcystins, cyclic heptapeptides, etc. Many of these cyclic peptides or depsipeptides may only be useful as biochemical research tools but no doubt, a few, however have the potential for being exploited into useful commercial products of human welfare. For example Cryptophycin-1, a novel inhibitor of micro tubular assembly from *Nostoc* sp. GSV 224, has shown impressive activity against a broad spectrum of solid tumour implanted in mice, including multidrug resistance ones and Majusculamide C, a microfilament-depolymerizing agent from *Lyngbya majuscola* has shown potent fungicidal activity and may find its application in the treatment of resistant fungal-induced diseases of plants and agricultural crops. These and more products of microbial origin will be more acceptable in days to come because of the constraints on the use of chemical pesticides due to high costs, environment concerns and ever-increasing government restriction and regulations nationally and at the global level.



Different features of *Anabaena variabilis*. Scanning electron micrographs at different magnifications.

Because there are difficulties in culturing all kinds of cyanobacteria by current techniques leading to lack of knowledge concerning their basic biology, many more biological and ecological investigations are needed as a prerequisite for the complete exploration of the biochemical potential of these organisms. Although current molecular biology techniques allow sufficient flexibility to study diverse members of cyanobacterial community, the mass cultivation of these organisms to generate sufficient biomass still poses a great challenge to researchers to fully exploit and successfully investigate for secondary metabolites of unlimited structural diversity. The progress will also depend substantially on methods and techniques that accelerate validation of new target genes potentially related to natural drugs.

The book under review is good and represents a valuable contribution to the applied aspects of cyanobacteria as a source of bioactive compounds. Since the last quarter of the century micro algae, especially cyanobacteria as a source of antibiotics and pharmacologically active compounds, have received ever increasing interest. A large number of antibiotic compounds, many with novel structures, have been isolated and characterized.

This book which is primarily a research monograph has two important aspects. The first is the bacteriology of test organisms which covers the finest details of the micro-organisms under study including their systematic morphology and cultural behaviour enabling a thorough knowledge of the selected cyanobacterial species. The second is the potentiality of cyanobacteria as antibacterial agents as shown by the results of the study. The antibacterial activity of solvent fractionated extracts prepared from the biomass is an effective method for identifying organisms that produce potentially useful compounds.

The book also has several other attributes which make it a handy treatise on cyanobacteria especially for students as the 'Introduction' chapter also dwells upon different aspects of cyanobacteria viz. history, evolution, contribution, etc. The 'Review of Literature' is specific, subjective and comprehensive which gives up-to-date information on the subject of the book. The chapter on 'Materials and Methods' gives full details about culture media and other methods for antibacterial assay. The methods included are standard and explained in a simple language.

Another good attribute of the book is that it is both well written and correctly written. Wherever necessary the text is supported by illustrations and photographs are original and of good quality. It is based on the extensive research done by the authors. The senior author, who has a research and teaching experience of more than three decades, is known for his contribution in the field of microbiology, especially the antibacterial potential of cyanobacteria.

The chapter on Glossary of technical terms and References will be quite useful to students and researchers of the subject.

Although well-written, one can find plenty to do in filling up the details as there has been lot of work and many cyanobacteria have been shown to produce anti-bacterial, anti-viral and anti-neoplastic compounds. Several reviews (Borowitzka, *J. Appl. Phycol.*, 1994, **7**, 3–15; In *Chemicals from Microalgae*, ed. Cohen, Z.; Singh *et al.*, *Critical Rev. Biotechnol.*, 2005, **25**, 73–95, etc.) are available on the subject but the book will serve either as a text for the graduate students or as a reference for researchers in the subject. But in the latter case something more will be required as supplement. Naturally, one cannot cover such a vast subject considering the framework of the book. Nevertheless, it appears that the book accomplishes what authors asserted in the preface.

The errors or misprints are remarkably few and overall, it is a good supplementation to the subject considering the fact that the efforts in the drug discovery are focusing on cyanobacteria and other marine organisms, the forecast for the future looks bright.

SUNIL PABBI

*Centre for Conservation and Utilisation of Blue Green Algae,*
*Division of Microbiology,*
*Indian Agricultural Research Institute,*
*New Delhi 110 012, India*
*e-mail: sunil.pabbi@gmail.com*