

hensive taxon sampling to comprehend the root and the structure of the eukaryotic tree of life.

Readers interested in bacterial physiology will find reviews on bacterial persistence and toxin–antitoxin loci, evolution of two-component signal transduction systems, structure and regulation of type VI secretion system and twitching motility in *Pseudomonas aeruginosa* insightful with excellent figure illustrations and comprehensive bibliographies. Esther Angert's discourse on maintenance of cytoarchitecture and DNA dynamics in large-sized (>200 µm diameter) bacteria, via massive polyploidy and predominant distribution of nucleoids toward the plasma membrane, makes an engaging read and invokes questions on existence and evolutionary implications of eccentric life styles and deviant cell types in microbial community.

Additionally, Ma *et al.* in their chapter on vaginal microbiota focus on the mutualistic relationship between human vagina and the resident vaginal bacterial community and development and use of cultivation-independent approaches to

identify vaginal microflora. They accentuate the need to define vaginal health on the basis of composition as well as function of the vaginal ecosystem and dissociate it from the mere presence of *Lactobacillus* species.

Reviews on Herpesvirus transport to nervous system, Polyomaviruses large T antigens and Recognition of viral pathogens by host innate immune system will appeal to those interested in the study of host–virus interactions.

My personal favourite is Derek Levey's review on electromicrobiology, an emerging exciting discipline of science, which studies unique electrical properties of microbes and their interactions with external electronic devices. Several microorganisms are capable of donating to and accepting electrons from electrodes without any external aid. For example, two metal-reducing bacteria, *Shewanella oneidensis* and *Geobacter sulfurreducens*, predominantly interact with electrodes via release of soluble electron-shuttling molecules, flavins, and outer-surface, redox-active *c*-type cytochromes, respectively. Furthermore, *G. sulfurreducens* biofilms, owing to the presence of pili, capable of long-range electron transport along their length, display conductivity similar to that of synthetic conducting polymers. This microbe-electrode electron exchange holds great promise for the areas of bioenergy, sensing and bioremediation, anaerobic microbial ecology and microbial electrosynthesis. Fittingly enough, while providing a timely overview of this field, Derek Levey cautions to tread carefully and avers that delineation of basic mechanisms of electromicrobiology is imperative for practical advancements.

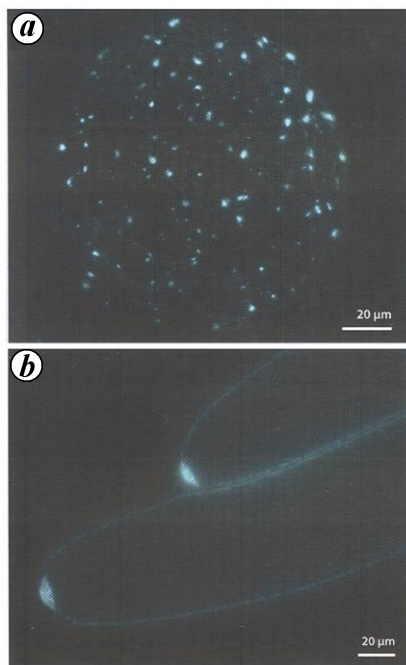
The book culminates with a review on the use of a soil bacterium, *Corynebacterium glutamicum*, as a biocatalyst in the postgenomic era. Although *C. glutamicum*, an industrial work horse, has historically been used for the production of amino acids, nucleotides and vitamins, sequencing and analysis of its complete genome has paved way for new applications including commercial production of fuels and chemical building blocks for use in transport and polymer industries. The current chapter not only summarizes the information available on corynebacterial systems biology but also brings unique, economically beneficial features of *C. glutamicum* physiology (ability of growth-arrested cells to produce several

metabolites under oxygen-deprived conditions and concurrent metabolization of diverse carbon sources) to the forefront. Vertès *et al.* discuss how rationale-based design and inverse metabolic engineering may be used to improve the industrial robustness, homeostasis and biosynthetic power of *C. glutamicum* strains in order to fully exploit the economic potential of this microbe.

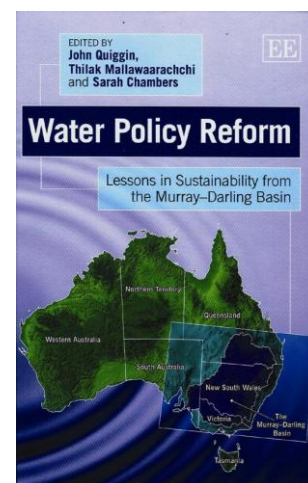
Overall, reviews in this book are superbly written, highly informative and provide ample fodder to inspire budding young microbiologists.

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Large bacteria, stained with DAPI, display a similar arrangement of their cellular DNA. **a**, Numerous nucleoids found in the peripheral, active cytoplasm of a spherical *Thiomargarita namibiensis* cell are associated with the plasma membrane. A surface layer focal plane of a small *T. namibiensis* cell is shown. **b**, Half of a large *Epulopiscium* sp. type B mother cell.



Water Policy Reform: Lessons in Sustainability from the Murray–Darling Basin. John Quiggin, Thilak Mallawaarachchi and Sarah Chambers (eds). Edward Elgar Publishing Limited, The Lypiatts, 15 Lansdown Road, Cheltenham, Glos, GL50 2JA, UK. 2012. xix + 238 pp. Price not mentioned.

The book under review is an edited volume that is the outcome of a workshop held by the Risk and Sustainable Management Group of the University of Queensland, Australia to discuss the guide to the Murray–Darling Basin Plan and to input into the water policy process. The guide to the plan released in October 2010 was opposed by farmers of

the basin, and its copies were burnt in meetings. Much of the anger was directed at the perception that the guide envisioned the curtailing of water entitlements of farmers in the basin.

The cutbacks in water entitlements were indeed proposed by the guide, with the overall goal of restoring the environmental balance of the Murray–Darling river basin. But these cutbacks were mandated to be facilitated by buying water entitlements from willing sellers by the Commonwealth Government. This was clearly a case of lack of proper communication between the Government (actually the Murray–Darling Basin Authority, an Australian Commonwealth Government institution) and the farmers.

At the heart of this controversy are concerns and issues such as environmental sustainability of river basins, the ways in which this issue of sustainability and interests of rural communities (based on agriculture) can be mediated, and the best ways of mediating this. The essays contained in the volume under discussion provide some deep, well-argued templates about thinking about these issues. Given the increasing scarcity of water in India, persistence of conflicts (both inter-sectoral and inter-state) surrounding water, and the alarming environmental health of a large number of its rivers, these issues are of increasing relevance in our country.

There are some similarities between water resources situation in Australia and India. First, in both the countries river systems show high variability of flows. Second, and equally important, both inherit strong federal constitutional and institutional architectures. In the first paper in the volume authored by Cummins and Watson, titled ‘A hundred-year policy experiment: the Murray–Darling Basin in Australia’, we come across a summary of literature that classifies the history of water resources development in Australia into four phases. These are exploration, expansion, phase of mature water economy, and the present state, that of contraction. These scholars use these phases to characterize the whole water economy of Australia. This schema may be borrowed for understanding the Indian context, albeit with some modifications. Different regions and river basins of India have had different histories and a pan-Indian schema might not be productive to use. But it is increasingly clear that the limits of expansion of

development of surface water resources are being reached in India. In a large number of river basins in India we are reaching limits of sustainable extraction. In this context how Australia manages to address the issue of environmental sustainability of river basins might have important lessons for policy planners and practitioners in India.

Nguyen *et al.* in their paper titled ‘Assessing the regional impacts of the Basin Plan and the Water for the Future program in the Murray–Darling Basin’ argue that impact on agricultural production and employment will be minimal (at the basin level) with the proposed withdrawals from agriculture for restoring environmental balance. In fact, they argue that any such impact will not be much more than the ‘natural’ fluctuations that already exist due to variations in water availability.

This might be true for many environmentally fragile river basins in India as well where some withdrawal of water from irrigation to support the river basin as an ecosystem can be carried out without much serious socio-economic disruption. But these policy interventions will need to be carried out after careful studies and proper consultations with all relevant stakeholders, especially farmers. In this context, the use of real options theory and state-contingent analysis might be important policy tools to achieve the goals optimally. As discussed by Mallawarachchi *et al.* in their paper titled ‘Investment as an adaptation response to water scarcity’, in a state-contingent approach we can deal with production and decision-maker uncertainty separately. Also, all possible outcomes can be talked about within a state of nature. There is perhaps a need to apply such analysis in the Indian context.

But even if diversion of water from irrigation to support the ecosystem of rivers is desirable and possible, how is such a policy objective to be realized? Most of the papers in the volume dealing with this issue advocate a market-based approach. They, of course, do not propose the use of market-based approaches in a blanket, ahistorical fashion. This advocacy is based in the specific history of water management in the Murray–Darling Basin. During the expansion phase of water resources development in the basin, the Government was the sole player in water delivery. Over a period of time clear water entitlements and some

water trade emerged in parts of the basin. Therefore, many scholars in this edited volume argue that a clearly specified market-based approach will work the best; water entitlements are envisaged to be bought from willing sellers by the Government, which then is supposed to put them into environmental uses.

Following the analysis of the papers, the introduction by the editors summarizes the points of agreements amongst scholars who have contributed to this volume: (a) ‘water should be purchased from willing sellers, that is, there should be no cuts in water entitlements’ (p. 2) and (b) ‘irrigation infrastructure projects to recover additional water should only be financed publicly when the cost is consistent with the market price of the water saved’ (p. 2), and ‘funding allocated to infrastructure investment under the National Plan for Water Security should be used to finance investment in social infrastructure wherever the benefits are greater than those of investment in irrigation infrastructure’ (p. 2).

Even if there is this scholarly consensus about how to deal with diversions of water from agricultural to environmental use, the question of measuring the value of the environmental goods still remains. Jeff Connor *et al.* in their chapter ‘Maximising benefits from Murray–Darling Basin water resource management’ deal with this issue. They summarize three methods – stated preference, revealed preference, and cost-based approaches (pp. 141–142) that can help us measure the non-market values of services provided by ecosystems. They further argue that these can be used in benefit-cost analysis in any water resources-related projects and analyses productively.

Given the context of the present water usage patterns and institutional architecture in the Murray–Darling Basin, these constitute sage advice indeed. But this reviewer wonders whether these can be usefully extended into the Indian context. For example, most Indian surface-based irrigation systems are run by old water bureaucracies of hoary colonial origins, and the water sector does not have any clear system of entitlements. How does one trade-off the competing claims of irrigation and environment in the Indian context then? The situation in India is, therefore, far more complex. Additionally the political economy of water in India is embedded within a wider cul-

tural politics of caste and community. The Australian case then is not easily extendable to the Indian context, although some tools and techniques such as state-contingent analysis might be productively employed in the Indian context as well.

I have two reservations about this volume. First, it is economic in its orientation. This is in line with increasingly influential economic scholarship in the water sector that is slowly challenging the dominant hydrological scholarship;

but more often than not this emergent scholarship replaces narrow engineering models with perhaps equally narrow economic orthodoxies¹. Secondly, it does not deal with important sociological/anthropological critiques of frameworks that see policy as design that gets implemented, and not as something that is co-emergent with practice². Despite these observations, the book is a major addition to the literature on water policy and river basin management, and should be widely circulated, read and discussed.

1. Routray, S., *Indian J. Soc. Work*, 2006, **67**, 423–429.
2. Mosse, D., *Cultivating Development: An Ethnography of Aid Policy and Practice*, Vistaar Publications, New Delhi, 2005.

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