

## BOOK REVIEWS

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tions and why these are necessary. It is seen that those who oppose the technology-based paradigm often have a background in arts and humanities, and not in sciences or engineering. And there is a paucity of reading material that would explain the technology paradigm in a manner, and restricting itself to a level, that would be understood by those not trained in S&T.

This void will be filled to a large extent by this book with contributions by 11 authors, and edited by U. Aswathnarayana, who is also the majority contributor. The book is an interesting mix of – as the title suggests – technology, economics and policy issues related to water, energy, minerals, biodiversity and even disaster management. After an introductory chapter, there follow over 30 essays in six sections.

Typically, books on water, energy, etc. tend to be devoted either entirely to technology, or entirely to policy with some economics. But the practice of technology per force requires factoring in economics and policy. This book serves an important purpose of bringing discussion on all the aspects in one volume.

Expectedly, over 40% of the discussion (and therefore also 40% of this review) is about water resources. Starting with basic concepts of water balance, it covers conjunctive use of surface and groundwater, pricing of water, policy perspectives, agriculture, degradation of water quality, diseases arising from toxic substances in water, wastewater reuse systems, remote sensing for water resources management, etc.

It would be a mistake to comment, as some might, that none of the topics is treated in adequate depth. For example, Chapter 2.6 'Wastewater reuse systems' is just 13 pages. But this reviewer is of the opinion that enabling the reader to design, say, a bio-pond purification system is perhaps not the intended purpose of this book. A practitioner/professional wanting to do that will have to refer to authoritative texts devoted entirely to wastewater treatment, and there are many such books. In 17 pages, any book can only provide an overview. But the importance of such an overview has perhaps been underestimated so far. During his tenure as Chief Engineer of the Upper Yamuna River Board, the present reviewer has often interacted with NGO activists who feverishly argue that Delhi sewage be treated to CPCB Class C

specifications ( $BOD < 3$ ), without any demonstrable understanding of how this can possibly, if at all, be achieved.

The era when civil engineers could plan and execute a Bhakra project, or atomic scientists could plan and execute a Tarapore atomic reactor, is over. Now, consultations with civil society actors is an integral part of the planning process to make use of natural resources, and it is necessary that an overview of the science of water management, or energy management, or any other topic, is presented to a non-S&T personnel.

Similarly, the book provides an overview of various minerals and their management, energy resources management, bio-resources and disaster management.

The reviewer's perception that the book fills a void that was needed to be filled, can best be explained by an example: Section 3.3, 'Control technologies for minimizing environmental impact of mining'. During the last few years, the mining industry has come under disrepute for causing environmental damage. When such instances come to notice, usually there is an outcry to stop the mining altogether. For example, the Western Ghats Ecology Expert Panel Report recommends a direct or indirect ban on all mining in entire Western Ghats. But, as C. N. R. Rao, Chairman, Science Advisory Council to the Prime Minister notes in his foreword, mining cannot be avoided. Unfortunately, the society seems to have lost sight of the fact that it is possible to do mining while minimizing environmental damage. Section 3.3 should help bring that back on the discussion table.

The book will also be found useful by the experts in a particular domain, for acquiring a working knowledge of other domains. Water resources engineers will find useful the chapters on minerals management, while mining engineers will find useful the chapters on, say, energy management. All technocrats working in water, energy and mining sectors would do well to read Section 5 on 'Bio resources and bio diversity'.

In the introduction to his celebrated book *A Brief History of Time*, Stephen Hawking says his publisher warned him that every equation in his book will reduce the number of readers by half. Hawking said despite his best attempts he could not avoid one equation,  $e = mc^2$ , and hoped this would not scare away half his potential readers. It is conceded that Aswathnarayana could not have written

this book with just one equation. But there are many instances where the mathematics does not add any value. For example (p. 103), 'Land availability constraint. The extent of land used for various crops cannot exceed the total available land. Also, the land allocated to a given crop has to remain unchanged from sowing to harvesting' is clear. The equation that comes next,

$$\sum_{i=1}^n A_i \leq TA$$

does not add any value.

Except for this one comment, or even with it, this book is strongly recommended for all, specialists as well as others.

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Commenting on the release of the first volume of the *Annual Review of Physiology* in 1939, the *Journal of the American Medical Association* mentioned 'Its editors, confronted by the enormous dimensions of investigative work in the field of physiology, have chosen to advise the authors to attempt a critical appraisal of the contemporary field by an analysis and interpretation of the most significant contributions rather than a more comprehensive review'. That task has become even greater today with the blurring of the boundaries of physiology and the exponential increase in the quantum of experimental work. Over the years, the articles in the *Annual Reviews* have changed in character from more descriptive work to mechanistic insights and from more integrative physiology to cellular and molecular perspectives. In an attempt to ensure that the *Annual Reviews* retains its broad perspective, the chapters, as in the past, are cited within

sections devoted to specific organ systems.

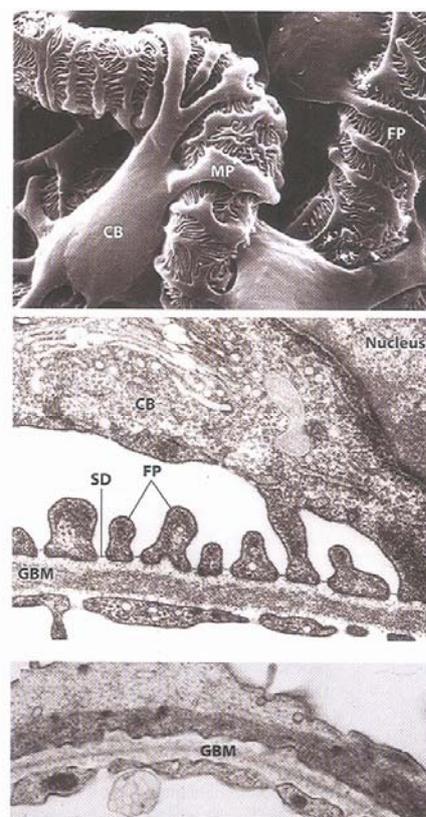
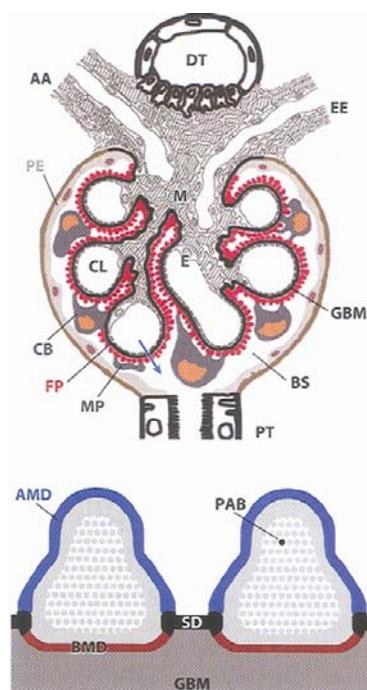
The rapidly expanding field of epigenetics, human biology and disease is explored in three separate articles in this, the 74th edition of the *Annual Review of Physiology*. The foetal origins of adult chronic disease first evolved out of observational studies, such as the follow-up of the Dutch birth cohort of the 'hunger winter' of 1944. In this year, during World War II, rations were severely restricted affecting foetal growth in pregnant women. Subsequent to this, several large epidemiological studies, to a large extent driven by Barker from the University of Southampton, UK demonstrated associations between low birth weight and adult chronic disease morbidity. The article entitled 'Fetal programming and metabolic syndrome' by Rinaudo and Wang, summarizes the epidemiological data linking foetal growth and low birth weight with metabolic syndrome (a combination of hypertension, overweight, dyslipidaemia and dysglycaemia) and discusses physiological mechanisms that could lead to this condition both at tissue/system levels and molecular/cellular levels. Alexander and Owens in a separate article discuss the 'Epigenetic control of smooth muscle cell differentiation and phenotypic switching in vascular development and disease'. Smooth muscle cells are remarkably plastic and undergo profound phenotypic changes both in response to physiological stimuli and in pathological states. This area of research is particularly fascinating because it could lead to the identification of therapeutic targets in a variety of conditions such as enhancing the development of collateral blood vessels following a heart attack, or increasing the rate of wound healing, reducing the spread of tumour cells or stabilizing atherosclerotic plaques. 'The epigenetics of cardiovascular development' is discussed by Chang and Bruneau. About 2% of newborns suffer from some malformations of the heart at birth. While major malformations are sometimes incompatible with life, others often result in significant morbidity and require surgical intervention. This article focuses on factors that control gene expression in relation to cardiovascular development.

A rapidly ageing population across the globe has meant an increase in morbidity and mortality, as well as health costs associated with chronic non-communicable

disease. While diabetes and cardiovascular diseases have been the mainstay of discussions, particularly in India, it is refreshing to see an article devoted to bone health, another organ system that is affected in a major way in the elderly, in a discussion of 'Biology without walls: novel endocrinology of bone' by Karsenty and Oury. The notion of bone as an endocrine target is well established in physiology. What is novel is that bone may in fact function as an endocrine organ affecting other organs. In this lucidly written article, the authors expand on this view illustrating, for instance, the potential role of osteocalcin, secreted by osteoblasts in the bone of pancreatic function, particularly  $\beta$ -cell proliferation and insulin secretion. This fundamental change in construct of the bone as a cause of ageing as against the popular view of bone dysfunction (reduction in bone mass, increased fracture risk, etc.) as a consequence of ageing will fascinate physiologists. In a complementary article 'The calcium-sensing receptor beyond extracellular calcium homeostasis: conception, development, adult physiology and disease' is discussed by Riccardi and

Kemp. The calcium-sensing receptor (CaSR) was only identified in 1993 and its role in calcium homeostasis coupled to events in the bone, gastrointestinal tract (regulating calcium absorption) and kidney (regulating calcium reabsorption and excretion) has been well established. This article extends the discussion of the role of CaSR to other physiological events such as nutrient sensing, hormone and fluid secretion in the gut, and in the regulation of neuronal excitability in the nervous system. This article will particularly appeal to general physiologists since it has an integrative and comprehensive approach to the role of CaSR across body systems.

It is hard to estimate the global burden of end-stage kidney disease (ESKD) because of the absence of national registries. In India, where diabetes is a major cause of ESKD, less than 10% are believed to receive renal replacement therapy in the form of dialysis or kidney replacement. For a considerable time, the glomerulus has been the central anatomical structure of interest in the diabetic kidney, increased glomerular filtration being a risk for later diabetic nephropathy. In their



Scanning electron microscopy view from Bowman's space highlighting the intricate shape of podocytes.

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article, Vallon and Thomson focus on altered tubular function as a cause of glomerular pathology evoking the well-known tubuloglomerular feedback mechanism, linked to glucose reabsorption at the proximal convoluted tubule. This mechanism is important as a therapeutic target and is currently the focus of clinical trials, the long-term results of which are awaited. In a related article, Greka and Mundel discuss the role of podocytes in glomerular function and its implications for a wide range of kidney diseases. The podocytes are part of the filtration barrier and derangements in podocytes are responsible for proteinuria. Traditional textbooks of physiology typically deal with the podocyte as an anatomic entity and this article is a welcome discussion of the biology of the podocyte in terms of the surface receptors, ionic channels and signalling systems.

Electrolyte balance in the body is the result of many mechanisms. For sodium balance, electrolyte transport in the distal nephron has conventionally focused on hormones of the renin-angiotensin-aldosterone system and of antidiuretic hormone. In their article, 'A new look at electrolyte transport in the distal tubule', Eladari *et al.* discuss two new important issues. The first is the role of the intercalated cells in the absorption of sodium chloride and potassium. While the authors discuss the possible role of intercalated cells in blood pressure regulation, the relative contribution of the intercalated cells vis-à-vis traditional mechanisms of electrolyte balance is not clear. The authors also emphasize the role of local paracrine factors such as tissue kallikrein

in sodium and potassium handling in the kidney. This article for me, is an example of how the *Annual Reviews* fulfil their objective – it addresses relatively new concepts and discusses them comprehensively so that a general reader of physiology can be adequately informed about advances in the field.

It was Dale who first proposed the principle of one neuron, one neurotransmitter. Over the last few decades, evidence has mounted of co-location of neurotransmitters in vesicles in the nerve terminal and of neurotransmitter co-release. The functions of colocalization and release thus become important to elucidate. Hnasko and Edwards in their article 'Neurotransmitter corelease: mechanism and physiological role' review the literature and provide evidence for multiple ways in which co-release of neurotransmitters can influence synaptic transmission. Thus there may be independent roles for co-released neurotransmitters, one neurotransmitter may affect the storage of another neurotransmitter, and the co-release of two neurotransmitters may occur from independent vesicle populations in the nerve terminal. Despite this new knowledge there is much to learn about this phenomenon.

Every year the *Annual Review* focuses on the development of important fields in physiology through the eyes of key researchers. This year, the prefatory chapter is an interview with Jensen Elwood, who discovered the estrogen receptor in 1958 and opened the whole field of nuclear receptors. But Jensen's work was not confined to the basic sciences alone. He later developed a method for evaluating estrogen receptors in breast cancer

tissue; this was to become a routine test prior to making therapeutic choices. For his work, Jensen received the Lasker Award. In this volume, the prefatory chapter takes the form of an interview. I found this a refreshingly different approach – more personal, somehow more human.

In every review, the editors devote a section to an area of physiology that merits attention as a Special Topic 'based on recent exciting advances, novelty, broad interest, or all of the above'. This year the Special Topic focuses on 'Germ cells in reproduction' and covers diverse topics such as the control of male fertility by spermatozoan ion channels, sperm-egg interaction and the genetics of mammalian reproduction.

As an integrative human physiologist, there is a part of me which views the reductionism of current experimental work in physiology with some trepidation. However, it is clear that an integrated approach to physiology is not always possible – advances in some areas outstripping those in others. Thus, it was pleasant for me to read an *Annual Review* that still has a considerable number of articles which move beyond isolated cellular/molecular events to more integrated functions across body systems.

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