

BOOK REVIEWS

of mucins abound and form a mat about 10 μm thick, trapping and helping remove unwanted particles. They are major contributors to the viscoelastic properties of the mucus in airways, but also mediate cell–cell signalling, EGF receptor signalling and airway protection as presented in a series of four reviews in the section on respiratory physiology. Aberrant secretion and accumulation are associated with various lung diseases such as cystic fibrosis, asthma, chronic obstructive pulmonary disease, emphysema and lung cancers. The complex regulation of over 20 genes involved in mucin synthesis and secretion is starting to be revealed.

Aquaporins (AQPs), which serve to significantly enhance the permeability of membranes to water, are also associated with epithelia and their malfunction associated with a number of diseases. Rojek *et al.* review the mounting evidence that several aquaporins are not actually involved in water transport, but serve to mediate transport of small, uncharged solutes such as glycerol, urea and perhaps ammonia (but not ammonium ions). The rapidly expanding literature on aquaglyceroporins and unconventional AQPs is fraught with inconsistencies, including contradictory publications from the same group! The review is heavily biased to mammalian AQPs and restricted to the animal kingdom, leading one to wonder about the situation in plants which have to respond to huge changes in water and solute potentials. The regulation of AQPs is critical to drought response, and it is conceivable that aquaglyceroporins and unconventional AQPs play a comparable role in other responses.

Following Muybridge's work in the 1880s, studies of animal movement have relied on high-speed imaging and elaborate set-ups. Following the introduction of megapixel cameras with framing rates of 1–100 kHz, the study of musculo-skeletal function has expanded to the imaging of fluid flow around moving animals and appendages directly in digital format. This has greatly facilitated the calculation of forces in the surrounding fluids and a much more detailed understanding of the mechanics of animal locomotion. The examples presented in the review by Lauder and Madden are drawn from studies on fish, but similar work has been done on the flight of birds, bats and insects. Analysis of vortex wakes generated by swimming and flying animals have provided insight into the mecha-

nism of force generation and give the lie to the oft-quoted claim that 'aerodynamics shows that the bumble bee cannot fly'.

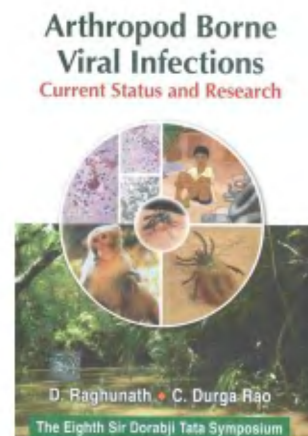
Static imaging also provides spectacular images that illuminate our understanding of the structure of biological objects. The use of X-rays for imaging is as old as X-rays. Westneat, Socha and Lee review the use of synchrotron radiation for X-ray imaging, using phase contrast and tomography to obtain nanometre resolution at a timescale that allows the monitoring of physiological processes. Non-destructive access to the innards of living, behaving insects have allowed the investigation of breathing, grasping and chewing, overturning conventional wisdom in the process. As John Lighton writes in *Current Biology* (2007) 'to see a familiar ant (*Camponotus vicinus*) turned into glass on the video monitor. I could not believe what I saw. That dark opacity I had known for decades, and which always seemed such a guardian of secrets, became a crystal paperweight alive with troubling mystery. It pulsed and wove its threads and beads while I watched lost in the wonder of seeing what few had seen before. Much I could interpret; much more I could not fathom. *This is what it was like to own a telescope during Galileo's time, I thought, but with the vision turned inwards not outwards*'. For instance, it was presumed that gas exchange in small insects like flies was purely diffusive. However, imaging studies revealed cycles of tracheal compression, while monitoring of gas composition showed active expulsion of CO_2 even in flies. In larger insects, convection overcomes diffusive limitations in O_2 delivery. Scaling studies indicate that the space available for trachea to pass through constrictions such as leg joints may impose upper limits on the sizes of insects. Indeed an analysis carried out after this review was written spans several different lineages and confirms this supposition. More, it suggests that in the Carboniferous, when O_2 concentrations reached 35%, size limitations were less severe, consistent with the observation of giant insects. The largest such insects found are at the upper limit predicted at 35% O_2 in the scaling exercise described.

These reviews serve to point out that even the staidest of fields can spring surprises – who would have thought ten years ago that X-rays would reveal the inner workings of insects? At the same

time, 'striving to bring molecular and mechanistic insights to problems concerning the physiology of the whole organism', emphasizes the central role that some of the usual suspects play. While calcium is not the answer to the question 'What is the meaning of life, the universe and everything?' (that would be potassium channels), this volume echoes Heilbrunn's proclamation in the 1940s 'Kalzium macht alles!' (calcium does it all).

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Arthropod Borne Viral Infections: Current Status and Research, The Eighth Sir Dorabji Tata Symposium. D. Raghunath and C. Durga Rao (eds). Tata McGraw-Hill Publishing Company Limited, 7 West Patel Nagar, New Delhi 110 008. 2008. 430 pp. Price not mentioned.

Austin Kerr, the founder-Director of Virus Research Centre, Poona (now, National Institute of Virology; NIV), while initiating the Centre wrote that research on arboviruses (arthropod-borne viruses) is like worshipping the Goddess Saraswati with four arms. According to him the arms represent the study of the virus itself; effects of the virus on its vertebrate host; study of the vector of the virus and study of the ecology of the vector, host and the virus. Now more than half century later, the study of arboviruses can be stated as: (a) the study of the genome of the virus and its gene sequence data; (b) the study of immunology, pathology and molecular events in the vertebrate hosts; (c) multiplication

and transmission of the virus in the insect hosts and (d) ecological studies of the vector, virus and the hosts could be extended to factors like global warming, climate changes, man-made geo-ecological changes, etc. The idea of Kerr has only been extended. Development of vaccines and drugs remains an important end-result for all infectious diseases. The book under review is a fitting tribute to the concept of Kerr.

The term 'arthropod-borne viruses' today denotes a collection of a group of viruses. It is essentially an ecological concept. It does not have taxonomic validity according to the modern system of classification of viruses espoused by the International Committee of Taxonomy of Viruses (ICTV). It is true that the ICTV classification is now the accepted classification of viruses, even though it does not have any evolutionary significance. The lateral transmission of genes and extensive recombination have put questions on the ICTV concept of species of viruses. No doubt, the explosion of knowledge on gene sequencing and cell biology has prompted the virus taxonomists to adopt a methodology which puts the overall lifecycle of a virus at a slightly lower status, but can be surmised that in due course of time the ecological-evolutionary concepts shall gain due respect in the classification of viruses. It is heartening to note that the organizers of the symposium and the editors have employed the eco-evolutionary terminology 'arthropod-borne viruses'.

While going through the volume it is apparent that the symposium was directed to the important pathogenic virus of the 'arthropod-borne group' affecting the Indian population, viz., dengue, Japanese encephalitis (JE), chikungunya, and Kyasanur Forest disease (KFD), though some attention was paid to Chandi-pura and West Nile. The proceedings of the symposium are divided into: two keynote addresses, ten sessions, each consisting of one or two presentations, and (c) two plenary sessions. Though different aspects of the above-mentioned viruses were covered, there was no comprehensive presentation either with new data or new ideas on the control of vectors of these viruses. Was it due to paucity of information in this important field of research? A session of the symposium was devoted to 'control' and dealt with repellents, and a new method has been described for the testing of repellents.

The first keynote address deals with the situation of arboviral infections in India. The second keynote address contains a short but excellent review of the global situation by Gubler (CDC, USA) with regard to the above-mentioned viruses. Some data presented in the first keynote address are confusing. Table 1 showing the seropositivity for JE in Uttar Pradesh (UP), shows 64% of sera positive for JE in affected children by the ELISA test in 2005. Whereas in 2006 seropositivity became 13.4%. The author adds that the number of cases who attended the hospital was still high!! Figure 15 showing the seasonal variations of the occurrence of JE in UP, Assam, West Bengal and Maharashtra, is relatively indistinct and unexplained. It would have been better if the seasonality of the occurrence of JE was shown from Karnataka, Tamil Nadu and Andhra Pradesh as well. The keynote address deals essentially dengue and JE, though a passing mention has been made about KFD.

Session I deals with viruses and vectors. In the presentation entitled 'arthropod-borne viruses general characteristics and classification', the authors have summarized known information on the subject. However, the authors have not stressed that the flaviviruses, viz. JE, WN, YF, SLE, MVE and the different dengue types constitute a belt around the globe roughly 35°N to 35°S. Though they have some degree of geographic overlap, there are areas where they hold their fortress. Though JE virus was present in the Asian region, it did not cross the Wallace line for a long time, but recently JE has crossed over, though MVE has not. Is it only a question of time before MVE crosses over to Asia like WN crossing over to the Americas. Regarding WN virus the authors state: 'West Nile fever is a dengue-like illness that occurs in both epidemic and endemic forms in Africa, Asia and the Mediterranean countries'. Mediterranean countries are in Africa, Asia and Europe. West Nile fever is known to be active in India and Pakistan. The present reviewer has encountered WN encephalitis in India as well. It does produce dengue-like illness in Egypt, Lebanon, Israel and Syria, but sometimes also produces encephalitis. In USA and in the middle and South American countries, where the virus has gained foothold recently, it produces encephalitis and death (vide the plenary lecture on WN in this volume). One of the most important

features of the WN virus is its catholicity of accepting many different species of mosquitoes as its vector. Therefore, WN is likely to maintain itself in varying eco-climatological conditions and 'invent' different ecological niches for itself. It is likely to cause public-health problems of severe magnitude in future.

The two presentations on the vectors of dengue in peninsular India, with particular reference to Kerala, contain a wealth of data. In a sero-survey carried out in 1956, Kerala was relatively free of arbovirus (flavivirus) antibodies. An entomological survey carried out subsequently showed that the prevalence of *Aedes aegypti* in towns and villages of the west coast of peninsular India was much less than in the east coast. Since then the scenario changed gradually and Kerala and other west-coast towns experienced massive epidemics of dengue and chikungunya. This is an indication of water management in the towns and villages of the west coast and failure of the public-health machinery to keep pace with the increase of population, migration and change of habitat. It only underscores the importance of public-health surveillance. The role of *A. albopictus* has been rightly stressed in one of these articles. Intensive research is necessary to understand the interrelationship of *A. aegypti* and *A. albopictus* mosquito populations, not only in Kerala, but also in other dengue-prone areas.

The progress of dengue (and also its vectors) to new areas has been a source of global concern. In the Indian subcontinent, as early as in the first decade of the 20th century, it was noted that troops from the Carnatic area did not contract dengue when posted in Calcutta, while those from Punjab were infected in large numbers, implying thereby that the northwest part of the country did not have dengue at that time. About eighty years later Delhi, Jammu and other cities of Punjab had extensive epidemics of dengue. There have been epidemics of dengue and DHF in Pakistan in recent years. There is good proof that dengue has indeed produced outbreaks in the NWFP of Pakistan. One wonders whether dengue has invaded Kandahar, Kabul and other towns of Afghanistan as well!

The two presentations on KFD adequately cover its history and the present status in Karnataka. However, the status report on KFD does not give much information on the vaccine and its use, though the vaccine was developed at

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NIV and the technology was transferred to the Karnataka State Government authorities many years ago. Perhaps it reflects the lack of interest of the government in the prevention of the disease.

The next three presentations deal with the immunological aspects of dengue and dengue haemorrhagic fever. They summarize the rise and fall of different cytokines and their interactions. Both cellular and humoral components on the immune system and almost all factors in clotting blood are involved in the development of haemorrhage and shock. Of a large number of dengue cases, a fraction develop haemorrhage and shock, which may prove fatal. In the studies summarized in the presentations, it was heartening to note a link between the NS-1 of the virus, complement activation and clinical manifestations of DHF. It is hoped that a user-friendly bedside test can be developed to predict the development of haemorrhagic manifestations and shock in dengue patients.

The presentations on the clinical features and management of dengue and clinical features of JE are excellent. The former gives a thorough and down-to-earth diagnosis and management of dengue and dengue haemorrhagic fever. Perusal of this presentation will help the clinicians evaluate their cases properly. The presentation on JE gives a thorough insight in the differential diagnosis.

Two presentations are related to the development of dengue vaccines and their trials. The development of dengue vaccine is beset with problems of enhanced manifestation of the disease (including haemorrhage) in patients with

pre-existing dengue antibodies. Evidences have also been provided that the specific genotype of dengue may be responsible for DHF. Many different approaches have been tried, viz. killed vaccine, attenuated virus vaccine, DNA vaccine, chimeric vaccine (chimera with 17D strain of Yellow fever with dengue), etc. Now a few biotechnological companies have entered into dengue vaccine manufacture and trial. The problem with the dengue virus is that unlike Yellow fever or KFD or TBE, it does not have a good primate model, except that of humans. It is hoped that this difficulty would be surmounted in future.

The new approach for the development of vaccine against arboviruses was epitomized in a presentation which dealt with Blue tongue virus of sheep. The author with an extensive background on the subject, has presented the analytical aspects of the virus structure, but is also acutely aware of the importance of host-virus interactions during virus trafficking between mammalian and vector cells. Perhaps the author would further add: hosts as themselves.

In conclusion, one would strongly recommend this book to the libraries of individuals or institutions concerned with public health in general and vector-borne diseases in particular. Aspiring research workers would find a wealth of information and ideas in this volume.

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Indian Astronomy – A Primer. S. Balachandra Rao (ed.). Bhavan's Gandhi Centre of Science and Human Values, Bharatiya Vidya Bhavan, #43/1, Race Course Road, Bangalore 560 001. 2008. 90 pp. Price: Rs 75.

Bhavan's Gandhi Centre of Science and Human Values, Bangalore in its attempt to inculcate the spirit of scientific inquiry and human values has brought out a slim book titled *Indian Astronomy – A Primer* by S. Balachandra Rao. This book is mainly intended for students of astronomy and interested readers. This book consists of four chapters which are: Introduction – Historical Survey, Zodiac and Constellation, Yuga System and Eras and Ahargana. It also has a list of various other books by the same author for further study.

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