

Communication for Biomedical Scientists. S. R. Naik and Rakesh Aggarwal (eds). Indian Council of Medical Research, Ansari Road, New Delhi 110 029. 2003. 180 pp. Price not mentioned.

The object of all research is publication. We know that a considerable amount of Indian biomedical research is often sub-standard. However, even for those whose research is of the highest quality, getting the message across to the editors and readers often seems to be a problem. Admittedly, this is not a difficulty unique to Indians, judging from the fact that there are numerous books published by writers abroad, on the topic of how to write research papers.

The Indian Council of Medical Research (ICMR) has published this title so as to redress this problem. The editors are eminently qualified to do so, being amongst those responsible for one of the few success stories of Indian medical journalism, the *Indian Journal of Gastroenterology*. Perhaps because of this bias, as many of seven of the 14 contributors are from the field of gastroenterology. Remarkably though, for a multi-author book, there is little repetition, if any, of ideas and thoughts. This illustrates careful planning on the part of the editors. The style is informal and, at times, tongue-in-cheek.

Communication for Biomedical Scientists is a book that most researchers, and all postgraduates, would greatly benefit from. There are the usual suspects – chapters on IMRAD style and the various parts of a manuscript, writing style and so on. Wisely, however, the editors have also included important topics which are often not addressed – these are the excellent articles on how to select the right journal (with the expected reference to impact factors!) and on conflict of interest (while on this topic, I must state a personal conflict of interest – this essay, along with three others are written by friends of mine). Moreover, the editors have accepted the words ‘biomedical communication’ in the complete sense of the phrase. Thus, there are chapters on writing a thesis, poster and podium presentations, etc. That the selection by the editors, of authors for this book is appropriate is seen from the fact that D. Balasubramanian, among the best science essayists in the nation, has written

on the difficult art of popularizing science to the public.

What changes would I make if I were to edit the next edition of the book? First, 177 pages of a lot of black and white text may be bit forbidding for young investigators, for whom the book is meant. The book can be made more reader-friendly with coloured boxes which highlight key points of the article and make it easy on the eye. Secondly, and this was the only drawback of the book, a good, detailed bibliography at the end of each chapter, with relevant websites and their URLs would have been useful. Finally – and I am most serious when I state this, as I have read many books on this topic – this one stands out there with the very best. If the changes mentioned above were to be made, with additional ones that other reviewers and critics may add, I believe that the ICMR could, with good marketing, sell the book abroad. With globalization being the key word today – and with the ‘feel good’ factor in the nation as I write this, be it in the sporting world, IT or finance, *Communication for Biomedical Scientists* would be the appropriate tool to match and supercede Western writers.

SANJAY A. PAI

*Manipal Hospital,
Bangalore 560 017, India
e-mail: s_pai@vsnl.com*

Comparative Biomechanics – Life’s Physical World. Steven Vogel. Princeton University Press, 41, William Street, Princeton, New Jersey 08540, USA. 2003. 580 pp. Price: US\$ 60.

In about 2,30,000 words printed on 580 pages, *Comparative Biomechanics* explores the structures and functions, the motions and mechanism of living organisms set in a physical world which is determined almost entirely by the forces of gravity, elasticity, viscosity, capillarity, surface tension, and the van der Waals attraction. The material of the book is organized in 25 chapters, grouped in four parts, with a comprehensive index for ease of reference. The bibliography at the end is impressive.

Part One prepares the reader with the basics of physics, mathematics and bio-

logy that would be needed later. It introduces the physical variables and the issues of shapes and sizes – their variability. It also introduces the notion of dimensions and dimensional analysis leading to the powerful ideas of scaling – the allometric scaling that relates relevant physical quantities, e.g. the size and the mass of an organism varying over many powers of ten. Part Two is all about fluids, mostly air and liquid water, their flow patterns and the forces that control them, specially in the Small World. Part Three is about the biological materials, often composites, e.g. bones, and the questions of structure and motility. Part Four is about some general contexts in biomechanics – questions of safety and tolerances, of adaptation (in response to mechanical stresses of wind and gravity). Also, what Nature does not or cannot – its limitations – and what we can learn from it, e.g. biomimetics. In all these, the author has tried, rather successfully, to describe and explain the organism in form and action in terms of the science that there is in everyday life, but going much beyond common sense. The level of description is intermediate between that of the grossly macroscopic and the minutely microscopic. Atoms and molecules do not feature here – in fact, there is no chemistry in the book. Biology is known for the tyranny of the particular. This book shows that much is nevertheless explicable in robust and generally valid terms, accessible to the undergraduate students of science and engineering.

The sense and the flavour of *Comparative Biomechanics* can be had from the questions it poses and tries to answer. How is walking different from running? Why a two-legged creature, a man say, must switch from walking to running beyond a particular speed, but a four-legged creature, a horse say, must change its gait – or the pattern of footfall – from walking to trotting to, finally, galloping. And still why the long-legged camel or giraffe, must pace and rack. In all these patterns of locomotion, where and how is the potential energy stored – gravitationally in the raised centre of gravity or elastically in the strained muscles? And then, what about the six-legged insects, or the no-legged snakes and the worms, or the slithering slugs. How do flies fly, and the samaras spin? How does the water-strider walk the air–water interface? What about adhesion – how does the

gecko adhere to the wall so strongly and yet detach itself with such ease at will? How is a tapered rubber-stopper different from a tapered cork-stopper? Why should the former be given a twist and a push, while the latter simply pressed down? It is all a matter of the Poisson ratio, we are told! Why do tall trees not simply fall over in strong wind? How are tall trees possible any way? Is the sap pushed up from the tree roots, or really pulled up from the tree tops? It seems that it is mostly the latter. And so on. Examples multiply.

A good part of *Comparative Biomechanics* is devoted to considerations of fluid flow, and quite understandably so, because life is wet after all. There is a crash course in fluid mechanics—the Bernoulli principle and the Hagen–Poiseuille flow; laminar-to-turbulent transition; no-slip boundary condition; boundary layers, and so on. It discusses the subtle questions of the drag and the lift, and the forward thrust that can result from the two together that makes the heavier-than-air machines/organisms fly. We are taught how an organism can hide in plane sight in the boundary layer, or how some dirt or a mite perhaps, can stay put on a fast-rotating fan blade – why is it safer there? Or why a swipe with a dishcloth can remove the residue from a plate faster than a dish washer. No-slip boundary condition provides the answer. We learn why ‘no viscosity’ means ‘no lift’ – must have a vortex bound to the wing! There is an interesting discussion of the Bernoulli and Hagen–Poiseuille equations in the context of our blood circulation and aneurysm that deserves serious attention. It is like the blow-suction effect, and points to the possibility of flow-induced-collapse of an artery!

We are introduced to the almighty Reynolds number – the dimensionless number that measures the relative importance of inertia and the viscosity, and ultimately decides the point of transition to turbulence from the slower laminar flow. And then, there is the fascinating Small World of organisms swimming at low Reynolds numbers that demands different strokes altogether. Besides Reynolds

number, there are other dimensionless numbers too. I have actually counted seven of them in the book – the Weber number, the Strouhal number, the Jesus number, the Womersley number, the Froude number, the Péclet number, and the Rayleigh number. Armed with these, one can really go a long way.

There are some interesting and useful tips too. We learn why the valsalva manoeuvre, recommended by several airlines, may be dangerous after all following a heavy exercise. We also learn how two balloons or bubbles connected through a Y-tube cannot be inflated simultaneously – a kind of double-bubble-trouble if you like – and its relevance to our two lungs. They can be inflated simultaneously only because they are in separate compartments in the ribcage!

The book deals with the curious mechanisms that organisms use, including pumps, ciliation, flagellation, peristalsis, etc. We learn of the toroidal feeding vortex of the stalked vorticella! Then there are the curious structural facts. Did you know, for example, why the fish has the tiny bones – the spicules – embedded unattached in the muscles? These ‘islands of compression in the sea of tension’ represent the subtle phenomenon of tensegrity, which is of great advantage to the fish, though not so much to the fish eater, I may add. Counter-intuitive effects abound. Thus, we really have irrotational vortex (not an oxymoron), but the core of the vortex, however, is always rotational. Also, no viscosity means no lift. And, lift can exceed the drag. And so on and so forth.

Other topics addressed in the book include the engines and their energetics – power and efficiency; life’s devices like pumps, motors, levers, muscles, flagella and cilia, and the various kinematic mechanisms. A thoughtful feature of the book is the set of tables giving some typical numbers or parameters of interest for a quick reckoning.

Comparative Biomechanics also tells us what the organism (Nature) does not do. Thus, organisms have not discovered the wheel. There is no true rotation here. The only known exception being the bac-

terial flagellation (driven by a motor inside the cell). Also, organisms do not make ropes – the spider does not spin. Nor does the weaver bird weave. Metal is unknown to the organisms – they use bones (visco-elastic composites) and the muscles. Nor are the Nature’s organisms perfect, despite the evolution by natural selection. There is the case of the exapted panda’s thumb. The book is somewhat critical of naive naturalism – of biomimetics. On the other hand, organisms do display strange capabilities like stress-induced adaptations. There is the phenomenon of thigmomorphogenesis – stress-induced remodeling of the tree trunk, or of the bone.

Biology is, of course, known for its tyranny of the particular. Oddities abound. Clearly, one cannot be exhaustive. Still, I must bemoan one particular omission from the book – the righting of a cat in its free fall from heights so as to land on all fours and thus survive. This involves zero-angular momentum turns (air is too thin to provide the alibi of something pushed against). The case of the ‘self-righteous’ cat is, however, subtle. It actually belongs with the problem of swimming at low Reynolds numbers that the book does touch upon. This and the famous Scallop Theorem would have brought extra grace to the book.

Finally, who should be reading this book? First, the teachers – *Comparative Biomechanics* can enliven almost any course of lectures in science and engineering. Personally, I have found it relaxing to read the book after a day of heavy formalisms. Science students in general, and biologists in particular should enjoy reading it, but some initial effort will be called for. *Comparative Biomechanics* does complement the classic *Growth and Form* by D’Arcy W. Thompson. The book is strongly recommended to university and public libraries, and for individual possession.

N. KUMAR

Raman Research Institute,
Bangalore 560 080, India
e-mail: nkumar@rri.res.in