From the Editor's Desk

Exploring diversity in life forms has been pursued in almost all branches of science with an effort to mimic "Nature". The efforts to arrive at evolutionary pathways in terms of fluid mechanical influences are discussed in a remarkable variety of articles in this issue on "Bio-fluid Mechanics" guest edited by Professor Jaywant Arakeri. I find this issue somewhat special and the articles take us through a wonderful journey involving mechanics associated with air and water with examples associated with flora and fauna. On behalf of the editorial committee, I extend special thanks to Professor Arakeri for his efforts. We now await the issue on Chemical biology and drug discovery edited by Professor G. Mugesh to finish up the publication activities of the current year. We shall begin the year 2012, the year of sustainable technologies, with reviews on "Biomass and energy technologies for sustainable Development".

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Guest Editor's Desk

Bio-fluid Mechanics

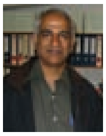
Interest in bio-mechanics, and more generally in biology, can be traced to perhaps three innate impulses of humans, to understand how nature 'works', to copy from nature, what is now fashionably termed bio-mimetics, and to engineer nature for their own well-being and survival, primarily seen in the practice of medicine and agriculture. In this issue on bio-fluid mechanics we feature articles addressing all three issues. Starting from when life first occurred on earth about 3500 million years ago, to the appearance of the first fishes 350 million years ago, and flowering plants 150 million years ago, to the present time when man is a dominant force, evolutionary pressure has produced an incredible diversity in life forms. What is also clear from the articles in this issue is that most of these life forms, even simple uni-cellular animals, have intricate fluid mechanical processes, at multiple scales, many of which are poorly understood.

Bio-fluid mechanics inevitably is concerned with the flow of the two common fluids on which life depends, air and water. The unique and often anomalous properties of water seem to play an important role. Plants, amazing organisms, take in oxygen and carbon-dioxide from the atmosphere, water and only minute amounts of micro-nutrients from the soil, and energy from the sun, all this with hardly any movement. And they essentially sustain all other life forms. Some plants can grow to enormous heights, about 100 m in the case of the Redwoods of California. Driven by evaporation from the leaves, water moves up from the roots to these great heights, equivalent to about ten times the atmospheric pressure, a feat no man-made (suction based) pumping system has achieved so far. How plants have evolved to sustain the necessarily large tensile stresses, overcome the tendency to cavitate, and how repair takes place should cavitation occur is lucidly described in the article by Sane and Singh.

Besides the developments in experimental techniques, the enormous increase in computational power has made possible the recent progress in the study of bio-fluid mechanics. Even though the modeling of biological flows involves many simplifying assumptions, it provides a basis for understanding the processes themselves and for important applications in medicine. Narasimhan reviews recent advances in the modeling of flow and heat and mass transfer in the often porous media found in animals, which find application in such diverse areas as tissue engineering, targeted drug delivery, laser based treatments, and the recently introduced, drug eluting stents. Gundiah et al. discuss matters close to the heart. The formation and build-up of atherosclerotic plaque in arteries, the leading cause of coronary heart disease and death, is intimately related to flow induced shear stress levels and transport across their porous arterial walls.

The next three articles deal with swimming and flying. Ganesh and Nott, in an elaborate and pedagogic review, take us to the fascinating world of propulsion in a micro-world where viscosity dominates; the low Reynolds regime which is equivalent to a human being trying to swim in a fluid which is a million times more viscous than water. These micron-sized organisms swim using nano-metre sized appendages, with apparently bizarre movements, though they are perfectly rational from a fluid mechanics perspective. And when they swim collectively, much like a school of fish, we see beautiful 'bio-convection' patterns. Though tiny in size, micro-organisms are partly responsible for the large-scale mixing in the oceans, so vital to sustenance of life there. The more familiar, but equally fascinating flight of insects and birds, and locomotion of aquatic animals have been discussed by Sreenivas et al. and by Govardhan and Arakeri. Who has not marveled at the sudden and rapid maneuvers of a dragon fly, the hovering flight of a nectar-sucking humming bird, the graceful swimming of a shark and the entirely different mode adopted by eels? The aerodynamics and hydrodynamics associated with the highly unsteady motions in these creatures are not well understood, but seem to offer immense potential in the design of new types of flyers and underwater vehicles, especially autonomous ones. And finally, there is the eternal question of whether natural devices are better or more efficient than man-made ones, for which we have no answer.

Writing good reviews takes time and effort, and I believe we have an excellent set in this issue. I would like to take this opportunity to thank all the contributors.



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