



**The Mandovi and Zuari Estuaries.** S. R. Shetye, M. D. Kumar and D. Shankar (eds). National Institute of Oceanography, Dona Paula 403 004, Goa. 2007. 145 pp. Price not mentioned.

An estuary is a semi-enclosed water body where freshwater from one or more rivers mixes with salty sea water. The natural estuarine environment, which is influenced by tides and yet sheltered from waves, is highly productive and serves as an abode to several species of plants and animals by way of supporting a variety of ecosystems. As a result of human settlements along the banks, estuaries have been used for transportation, fishing and dumping of waste. Each estuary in the world is unique in terms of its exposure to the sea (geometry), seasonality, and run-off character. However, it appears that the environmental pressures which the estuaries are exposed to are similar; they are subjected to contamination by toxic chemicals, over-enrichment of nutrients, and alterations of run-off into the estuaries. Therefore, knowledge of the estuarine environment – their physical, chemical and biological characteristics – and an understanding of their dynamics is essential, particularly when the developments along banks of an estuary are taking place at a rapid pace. Considering these factors, Shetye *et al.* have put together and edited the volume under review, in order to disseminate knowledge that they have gained through several years of observation, data analysis and modelling.

Chapter 1 presents the geographical setting of the Mandovi and Zuari estuaries. This chapter provides a detailed description of the geometry of the estuaries and variability of rainfall, winds and run-off. The Mandovi and Zuari estuaries are nestled in the coastal plane between the Sahyadris and the Arabian Sea. The monsoon months of June–September

constitute the wet season and the rest of the year is termed as dry. Both estuaries have a bay near the mouth and converging channels upstream. The need for one- and two-dimensional models for the bay and channel respectively is indicated in this introductory chapter. The converging channel width and run-off determine the water level at the upstream part and tides determine the same at the downstream end. Consequently, the oceanographic processes are remarkably different during the dry and wet months. This demands that there be a new class of estuaries called the ‘monsoonal’, into which almost all the estuaries along the Indian coast might fall. Based on the channel geometry and season, each part of the Mandovi and Zuari estuaries falls into one of four categories, namely wet channel, wet bay, dry channel and dry bay. On the whole this chapter provides all the essential basics that need to be known to take up detailed investigation of the estuary.

At their mouth the estuaries are forced by tides. Chapter 2 documents the tides and the associated variability in the Mandovi and Zuari estuaries. Harmonic analysis of the tide gauge data shows that at Murmagao, the principal lunar (M2) tide has the highest amplitude. Interestingly, the amplitude of the diurnal and semi-diurnal constituents increases from the mouth of the estuary to its head. The upstream end of estuarine channels is located at the foothills of the mountains and the larger mean elevation at these locations causes a drastic drop in tidal amplitude. During the summer monsoon, when run-off into estuaries is high, the water level is determined primarily by variation of the run-off.

The complete set of equations governing tidal circulation and tracer concentration in an estuary do not have analytical solutions and needs to be solved numerically. Such models can either be one- or two-dimensional; the latter would capture the cross-sectional variation, in addition to the along-channel variations. Both types of models for the Mandovi and Zuari estuaries are presented in Chapter 3, which reproduces the surface elevation seen in observations. As the authors conclude, since these estuaries are fully mixed only for a part of the year, the vertical variations could be significant for a major part of the year.

Classification of estuaries has been considered to be the first step in the understanding of the working of an estuary.

Through well-supported observations, the authors have successfully classified the Mandovi and Zuari estuaries. Geologically they are coastal plains, macrotidal in terms of tides, positive with respect to rainfall and partially mixed in stratification. This is probably the most significant achievement of this effort and the authors have lucidly described the foundation for this classification in Chapter 4.

Chapters 5–11 concern the chemistry and biology of the estuaries and thus are directly related to their health. Several processes affect the seasonal as well as along-channel variability of nutrients and other chemicals. These are discussed in detail in Chapter 5, for nitrates and phosphates. There are three grounds that serve as a source of high nitrogen for the Mandovi and Zuari estuaries. First, the iron and manganese ore mining regions; second, the rice paddies where fertilizers are used and third, the mangroves whose litter is rich in ammonia and dissolved organic nitrogen. The nitrate concentration is high during the wet period and this is attributed to the run-off which carries nutrient-rich water. The drop in nitrate level during the dry period is caused by two important processes. One is the mixing with sea water having lower nitrate concentration and the other is the biogeochemical cycling in which the mangroves play a crucial role. Most of this knowledge is derived from observations in the Mandovi and the authors suggest that these can be extrapolated to the Zuari. However, the later chapters indicate that this extrapolation may not hold very well.

The estuaries are flushed out several times over during the summer monsoon. This process has a crucial control on the physics, chemistry and biology of these estuaries. The two estuaries present dramatic changes in phytoplankton species composition (Chapter 6). It is interesting to note that the chlorophyll concentration is higher upstream in the Zuari whereas in the Mandovi, highest values are observed in the middle of the estuary. The reasons for these differences seem to have gone unattended. The flushing of the estuary also leads to low abundance of biomass and zooplankton (Chapter 7) during the monsoon months. The flushing affects the estuarine benthic fauna too (Chapter 8). However, it appears that the mining activity – iron and manganese mining in the land and mining of sand from the estuaries – plays a more impor-

tant role in determining the benthic fauna. Chapter 9 is devoted to the importance of iron and manganese. However, the measurements have not revealed any clear pattern, except that they tend to be slightly larger in the middle of the estuaries. It is left to the reader to examine whether these distributions are consistent with the arguments made in the previous chapters and to check how the reported levels compare with other estuaries.

Chapters 10 and 11 examine the pollution levels in Mandovi and Zuari estuaries. The tributyltin levels appear to be high owing to the operation and maintenance of ships and barges. The reported concentration levels are damaging and there needs to be a legislation that stops the release of tributyltin into these estuaries. Sewage pollution levels as indicated by coliform bacteria are also high in these estuaries, making the water unsuitable for human use unless treated appropriately. Both these chapters call for measures, primarily legislative, to be taken to check pollution levels and to protect these estuaries. Chapter 12, which is somewhat different from the rest of the book, but nevertheless interesting, deals with the 'khaznam' (low-lying lands along the banks of rivers protected from inundation by bundhs used traditionally for agriculture and fishing). The author of this chapter is irate about the fact that the khaznams are not being used primarily for what they were intended. It is rather curious to note that a well-balanced agriculture-fishery system could exist in this environment.

The book is intended to be a compilation of the existing information and knowledge about the Mandovi and Zuari estuaries, and this has been done excellently. The information available, particularly with respect to the chemistry and biology are meagre and much remains to be done. However, a consistency analysis across chapters would have made it easier for the readers to understand the distributions with respect to the processes. Nevertheless, the book offers an excellent guideline on what could be planned for the many estuaries that string both coastlines of India.

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**Molecular Biotechnology: Principles and Practices.** Channarayappa. Universities Press (India) Private Ltd, 3-5-819, Hyderguda, Hyderabad 500 029, India. 2006. 1217 pp. Price: Rs 735.

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Biotechnology is an upcoming area and many universities have started undergraduate and Master's programmes, attracting young graduates in large numbers. A basic understanding of this interdisciplinary area is thus much desired and the authors have tried to fill this void. The present book balances both the founding principles and the practices followed in biotechnology. Concise and simplified presentation of facts, coupled with a generous dose of illustrations makes the book reader-friendly.

The book is divided into nine sections covering important tools and techniques essential for a student of biotechnology. Individual chapters dwell into further detail. The introductory part has a chapter on 'Good laboratory practices', giving the readers some insight into biosafety aspects. Techniques are divided into three parts: one on advanced techniques in molecular biology, another on working with nucleic acids, and yet another on recombinant DNA and genetic engineering. However, it would have been better to deal with the advanced techniques (Part II) after the basic techniques (described in Parts III and IV). Nonetheless, in the text, lucid illustrations are followed by a rather comprehensive detail of the subject, without confusing the reader. The chapter on bioinformatics in biotechnology is well dealt with. The section on working with nucleic acids has a good amalgamation of theory and practical details, and thus should keep the reader engrossed. The chapter on working with proteins is also well conceived and deals in detail with various protein purification, detection, estimation, fractionation and immuno-techniques, and their modifications. Part VII is on bacterial and mammalian cell cultures, while Part VIII deals with *in vitro* plant cell culture and crop improvement.

While techniques have been given emphasis, the application aspects presented in Part V are somewhat outdated. Whereas there is extensive coverage of *in vitro* plant cell culture techniques in nine chapters (Part VIII), only one chapter (22) is devoted to plant biotechnology (i.e. genetic engineering). Looking care-

fully into the chapters and contents of Part V, it is surprising that it precedes Parts VI-VIII. The last chapter deals with environmental biotechnology and how biotechnological intervention can help in genetic conservation and pollution control. More appropriately, it also touches upon the regulatory aspects, intellectual property rights and discusses ethical issues.

Despite some shortcomings, the book is a good and concise collation of information on practical and theoretical aspects of biotechnology. It is reasonably priced for undergraduate and postgraduate students from diverse backgrounds, who are in a hurry to gain information on the tools and techniques employed in this emerging area of life sciences.

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**Quantum Computing Back Action 2006, AIP Conference Proceedings Vol. 864.** Debabrata Goswami (ed.). American Institute of Physics, AIP Office of Rights and Permission, Suite INO1, 2 Auntington Quadrangle, Melville, NY 11747-4502, USA. 2006. 332 pp. Price not mentioned.

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The possibility of using quantum mechanical systems to provide a new paradigm for computation has opened up new areas of research in quantum information theory in the last decade. Logical operations in quantum computation are implemented on qubits, the basic units of quantum information. A qubit can be visualized as the state of a two-level quantum system, with the two eigenstates being mapped onto logical 0 and 1. The fact that a qubit can exist in a general coherent superposition of the eigenstates leads to new possibilities for computation. Furthermore, it has been postulated that quantum computation can exploit inherently quantum features such as entanglement and quantum superposition, to solve problems hitherto deemed intractable on any classical computer. Shor's quantum algorithm for factoring is one such example. This fusion of ideas from