A Course on Borel Sets. S. M. Srivastava. Springer-Verlag. Indian Liaison Office, 906-907, Akash Deep Building, Barakhamba Road, New Delhi 110 001. 2000. 261 pp. Price: Rs. 400.

Descriptive set theory has its origin in the works of Cantor, Poincaré, Baire, Borel and Lebesgue and with the discovery of operation A and analytic sets by Souslin, the theory was carried forward by Lusin, Sierpieñski, Kuratowski and others. The methods of the theory emerged out of attempts to answer the foundational questions such as continuum hypothesis, measurability of higher projective classes, etc. and are intimately connected with mathematical logic. The classical books on topology by Sierpieñski and Kuratowski and the book by Hahn on real variables contain a good account of this theory. However, many popular books on measure theory published after the Second World War, concentrated on an abstract point of view at the expense of the more concrete descriptive set theory, although for applications and for proper understanding of notions such as conditional probability, disintegration of measures, orbit spaces of group actions, etc. some knowledge of descriptive set theory is essential. G. W. Mackey, D. Blackwell, G. Choquet and J. Dixmier had shown the usefulness of descriptive set theory for representation theory, probability, functional analysis and von Neumann algebras. The second volume of V. S. Varadarajan's book, *Geometry of Quantum Mechanics* and the book by K. R. Parthasarathy, *Probability Measure in Metric Spaces*, made these ideas available more widely. Indeed, the latter book contains a very well-written digest of these ideas, very much in the form needed by working analysts and it is even today a standard reference book.

In the meantime, some work of J. W. Addison (1959) connecting recursive function theory with descriptive set theory led to the creation of a more powerful, but also more technical theory, called effective descriptive set theory, which not only gave a sharpened version of classical results, but also led to the discovery of new results. The book by Y. N. Moschovokis, *Descriptive Set Theory*, gives a good account of this theory. However, methods of this theory have remained confined to the workers in the field and not spread to the users of classical descriptive set theory, which continued to develop with impetus coming from problems in other areas of analysis such as group actions, von Neumann algebras, etc. Many new selection theorems and uniformization theorems, stronger than the theorems of Lusin, were proved in the classical setting. A good exposition of the classical descriptive set theory, taking into account the development during the last fifty years, is contained in the book by A. Kechris, *Classical Descriptive Set Theory*.

The first impulse of a beginner in measure theory is to skip the section on operation A and analytic sets, as it appears to be an unnecessary complication in a subject where countable unions and countable intersections seem to suffice. Only subsequent experience shows how mistaken this instinct was, since some of the most useful properties of Borel sets and Borel functions depend on mathematics stemming from this operation. To correct this mistaken notion, a beginner is advised to read the relevant portions on analytic sets from Kuratowski's book, *Topology* (vol. 2) or K. R. Parthasarathy's book mentioned earlier. He can then read the book under review. It gives a thorough and modern account of Borel and analytic sets, selection and uniformization theorems of descriptive set theory and some of the important applications to group actions and probability theory. Basic methods of classical descriptive theory are well exposed, at the same time detailed discussion of higher projective classes and game theoretic method, an advanced topic of interest to research workers in the field, is avoided. On the other hand, Vaught Conjecture, a kind of continuum hypothesis for group actions, which can be of interest to non-experts as well, is discussed. The book is also a good source of reference and reading for pure and applied analysts, theoretical statisticians as also other mathematicians who need results from descriptive set theory in their work. New and elementary proofs are provided for some of the important results such as the Borel isomorphism theorem.

The book is claimed to be written in an easy-going style, but in reality the style is rather formal with a good sprinkling of well-formed formulas, and so rather less beginner-friendly. It is for this reason that the reviewer has suggested a prior initiation for a beginner from older sources before coming to this book, which takes into account some of the developments during the last fifty years.

M. G. NADKARNI

Department of Mathematics,
University of Mumbai,
Kalina,
Mumbai 400 098, India
e-mail: nadkarni@math.mu.ac.in

The Ecology of Deep-Sea Hydrothermal Vents. Cindy Lee Van Dover. Princeton University Press, 41 William Street, Princeton, New Jersey 08540, USA. 2000. 424 pp. Price: US $ 39.50.

The deep-sea hydrothermal vents and their interesting and unique biota were discovered in 1977. It is amazing to note the amount of information gathered on this ecosystem since then – there are now over several hundreds of publications and some conference proceedings. Two decades of research has helped us to experience a quantum jump in understanding the biology of the deep: > 500 new species; > 12 new families; > 90% species known only from vents. Nonetheless, the absence of a good textbook covering all aspects of the basics of the ecology of these vents and their possible economic value, has always been felt by students and researchers alike. The book under review, with detailed coverage of geophysical, chemical and biological aspects of the hydrothermal vents, amply fills up this void.

The author, Cindy Lee Van Dover, is an experienced technician and pilot of the deep-diving submersible *Alvin* and has made about 100 dives to depths greater than 2000 m during 1989 and 1991. She has dived in almost all the vent fields in the Atlantic and Pacific. This vast experience, coupled with her natural curiosity, is well-reflected in the organization of the various chapters, beginning from the genesis of the vents up to their cognate communities and ending with a

speculation on the possible role of these vents in the origin of life. The author's rich experience has also contributed a lot in selecting appropriate photographs and illustrations for the various chapters.

After a brief introduction, Chapter 2 describes the characteristics of major hydrothermal sites and explains how 'black smokers' are formed. Chapter 3 deals with the physical and chemical properties of vent fluids and the importance of hydrothermal circulation in controlling the chemistry of sea water. Chapter 4 discusses, with sufficient explanations, the processes by which the high-temperature (~ 350°C) vent fluid, coming into contact with the cold sea water surrounding the chimneys, forms hydrothermal plumes, altering the chemistry of the sea water in the immediate vicinity and leading to the production of particles. The most interesting aspect of the vent ecosystem is its biota, especially the microbial communities that are responsible for the chemosynthetic production of organic matter and the microbe–animal interactions. Chapter 5 on microbial ecology, gives a good account of various microbial communities, including hyperthermophiles and superthermophiles, with select examples on the use of molecular techniques in understanding their composition. What is striking in these extreme environments is the very low species diversity, as exemplified by the dominance of a single phylotype (snake pit site) compared to about 4000 bacterial phylotypes in a single gram of forest soil. Nonetheless, the chemoautotrophs maintain a sucessful symbiosis with their macro-invertebrate hosts. These unique and interesting relationships drive the ecosystem so well that the mouth-less and gutless giant tube worms, for example, can grow up to 2 m in length, something unknown from other marine ecosystems. The compilation of information on symbiosis in Chapter 6, illustrated with many photographs and line drawings, is neatly done. The analysis by the author of the dual symbioses in mussels – do methanotrophic and thioautotrophic symbioses have a common ancestry? – is quite thoughtful and underscores the need to understand better, the symbiont acquisition mechanisms by animal communities in the vents.

Chapter 7 covers the many unique features of the physiology of host–symbiont interactions, with the giant tube worm (*Riftia pachyptila*), the giant clam (*Calyptogena magnefica*) and the vent mussel (*Bathymodiolus thermophilus*) taken as examples. The ploychaete worms, where episymbioses replace endosymbioses, and the vent shrimp populations, with their novel photoreceptors and chemoreceptors, are the other two major groups of animals that the author has chosen to deal with in detail. Chapter 8 deals with the food web, giving examples from the Rose Garden vent area. Chapter 9 treats at length gametogenesis, larval development, dispersal, settlement and colonization, all of which are vital in controlling the distribution pattern on the vent species. Of extreme interest here are the *in situ* observations of the spawning of the giant tube worm and the fertilization process that follows.

The next three chapters are devoted to community ecology: species succession and community dynamics in Chapter 10, bio-geography in Chapter 11 and cognate communities in Chapter 12. The book concludes with a discussion on the origin of hydrothermal systems and life therein, with even speculations on extraterrestrial hydrothermal systems that could orient our search for life in outer space.

In every respect, the vent ecosystem and the animals that live there are unique and the author has consistently brought this out, with appropriate examples and suitable illustrations. More than that, the author has made great efforts to kindle the scientific curiosity in the reader like – How have the animals spread to discrete vent sites in the mid-ocean ridge? Do they still retain their phylogenetic similarities? How do they manage to recolonize vent areas after intensive eruptions? Can the cognate communities help us in our search for energy resources from the deep sea (like the 'ice worm', *Hesiocaea methanicola*, that lives in gas hydrate area)? and so on. Every single answer throws up several new questions!

The book is remarkably thorough and comprehensive and keeps the reader captivated right up to the end. I would like to congratulate the author for the fine book. I recommend this book to all libraries and individuals alike, even if they are not oceanographers, because it is a unique source of information on knowledge of an ecosystem that few of us will ever get a chance to see first-hand. Even though the book is up-to-date now in its coverage, I guess the author will have to update it continually. The recent (April 2001) finding of vent sites in the Indian Ocean is one reason and the ever-increasing knowledge on deep-sea biology is another. Judging from the outcome of this book, I can only say that every further reprint could only enhance its usefulness and value.

D. CHANDRAMOHAN

Biological Oceanography Division,
National Institute of Oceanography,
Dona Paula,
Goa 403 004, India
e-mail: mohan@csnio.ren.nic.in

Education and Character Building — Collection of Convocation Addresses (1926–1983) delivered by Prof. D. S. Kothari. National Institute of Science Communication, Dr K.S. Krishnan Marg, Pusa, New Delhi 110 012. 2000. 459 pp. Price not mentioned.

The growth in the number of universities in India during the recent past has been phenomenal. Until the end of 1968, there were 70 of them; today the number is anywhere around 350. Imagine a majority of them deciding to have convocations and invite eminent scientists, technologists, educationists, politicians and civil servants to address the students on graduation days. The number of convocation addresses delivered annually will then be huge indeed. And pray what happens to these 'addresses'? As a fresh graduate put it – listen to these speeches, applaud them whenever necessary and forget them.

Not so, if someone as respected as the late D. S. Kothari spoke. During the sixties and seventies, Kothari was counted among the tall figures in the field of science, technology and university education in India. Having worked with Rutherford, Kapitza and the like, this physicist of no mean repute laid the foundations of a strong department in Delhi University, with which he continued his association till his last days. He was the first Scientific Adviser to the Ministry of Defence and Chairman of