

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 successful 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 magnifica*) and the vent mussel (*Bathymodiolus thermophilus*) taken as examples. The ploychaete worms, where episybioses 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.

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**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.

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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

the Defence Research and Development Authority of India. In 1961, he took over as the Chairman of the University Grants Commission, a post he held till 1973.

His contributions to higher education in India culminated in the form of the recommendations of the Education Commission – better known as the Kothari Commission – which submitted its report in 1966.

Between 1962 and 1972 (and later once in 1983) Kothari delivered convocation addresses in 42 universities, sometimes as back-to-back presentations. He started with Mysore in 1962 and traversed the whole length and breadth of the country, speaking to university students of Santhiniketan, Agra, Bombay, J&K, Guwahati, Kerala, Madras, Calcutta, Banaras, etc. He covered seven universities in 1965 and seven more in 1968. These convocation addresses are available in a collected form now.

Kothari spoke on many themes of interest to students and teachers alike. There was a familiar ring about his remarks. Often times, he quoted Nehru and made it known that ‘the quality of a university is always in direct proportion to the quality of its teachers’. He did quote from *Taitreya Upanishad* (*Satyam Vadaa*, etc.), Eric Ashby, Christopher Ingold and Roger Reville, to bring home the point why and how it was necessary for us to blend tradition and modernity in our higher education.

Kothari did believe strongly in the state making large investments in university education, research and development. In his addresses, Kothari provided data on expenditure on education and expenditure on S&T as percentage of GNP, university enrolment as related

to population and the educational level of working population. By comparing our poor performances with those of advanced countries and other developing countries, he made a strong plea for higher allocations for education and science. This is continued till date!

He dwelt on the qualities, duties and responsibilities of Vice-Chancellors and towards the latter part of his engagement with the students, enumerated on the main elements of educational reconstruction for our country, as brought out in the report of the Education Commission. He spoke of development panels and freedom within the university confines and the need for student participation in the formulation of policies and programmes for development of university education and upgrading of standards.

All these meant, necessarily perhaps, to his having to repeat himself. He did so, consciously and convincingly and in a characteristically persuasive manner. Therein lay the strength of the man. He was full of passion when it came to matters of higher education. He spoke with unalloyed sincerity, which won him universal admiration. He never changed track and adhered to the few known basic principles, assured of their permanent relevance.

All this did not mean he lacked originality. He made elegant remarks about academic standards being international and the quality of good researchers. (In science, a good researcher is a good teacher.) In his Jadavpur speech he said, ‘The new thing in the modern world is Science’ and ‘Science is the new humanism’. He also touched on, at least on four occasions, the general obsolescence of science, in his own inimitable style.

‘So rapid is the progress of science that a young man receiving a Master’s Degree in a modern subject is nearly obsolescent on the day of his graduation. A degree, like a passport, would need to be revalidated every five or ten years. A research paper, if a good one, is often out of date on the day of its publication. An expensive research tool is out of fashion by the time it is procured’.

The Prof. D. S. Kothari Centre for Science, Ethics and Education and NISCOM (CSIR) deserve congratulations for having brought out this volume for two reasons—(a) the ideas and ideals of one of our brilliant scientist-turned-educationist are truly and well-represented in these convocation addresses, and (b) students and teachers prone to pass over convocation addresses as ceremonial homilies may pause, read and derive inspiration from the utterances of someone who simply but effectively and convincingly put across his views on university education and how it could contribute to character building in the younger generation. His views are valid even today. As he said, ‘One thing is certain; yesterday’s educational system will not meet today’s and even less so the needs of tomorrow’ (p. 335).

A good compilation, worthy of study by those interested in university education. Recommended for acquisition by libraries of universities, research laboratories and higher technological institutions.

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