life's work is that it can be seen as the Rosetta stone for matching up mind and brain. The two routes by which he then uses memory to approach mind are those of computer emulation and disruption caused by disease. We take another whistle-stop tour exploring the enduring obsession with modelling the brain using artificial intelligence, and subsequently arrive up against the objections of John Searle (on operational grounds), Gerald Edelman (claiming that the system is ceaselessly dynamic) and Roger Penrose (arguing for a quantum-mechanical and thus unpredictable process). Rose cites the right arguments, but partly for the wrong reasons: no one would claim nowadays that the requisite of dynamism would preclude computers from being like the brain or that they could easily be complex enough to be unpredictable. The really awkward and probing questions raised by quantum mechanics are whether brains function algorithmically and whether the concept of delocalization is applicable to our ultimate understanding of neuronal processes. In view of the distributed properties Rose has discovered about memory, it is surprising that he does not even touch on these concepts. Moreover, he fails even to describe yet another strong indication for distributed memory when considering dysfunction: in W. Penfield's experiments, different memories could be generated by stimulation of the same locus in conscious patients, whereas stimulation at different sites could evoke the same memory.

We have three topics then: the practicalities, results and significance of research, topics that are presented to the reader as parallel rather than complementary themes. Each of the topics throws up a welter of questions that are not followed through because their respective chapters are in the main interspersed, so that attention is switched back and forth without any convincing attempt to draw the threads together, or actually use the Rosetta stone. Rose's gospel of a restless, holistic brain is attractive yet vague, albeit with aspects strongly redolent of Daniel Dennett's "multiple drafts" and Edelman's concept of "re-entry". But the erratic shuttling between the personal, scientific and philosophic conspires against giving the author the breathing space to develop truly new insights. On the other hand, the pace and readability of the text offer a unique smorgasbord in starter-neuroscience, but one that would whet the appetite rather than gratify the palate of those with a taste for M-words and the brain. □

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Making sense

Michael F. Land

Sensory Ecology: How Organisms Acquire and Respond to Information. By David B. Dusenbery. *W. H. Freeman: 1992. Pp. 558. £27.95, $34.95.*

THE study of the senses has always occupied a shifting zone of overlap between physics, physiology and the behavioural sciences of psychology and ethology. Until recently, most of what we knew about the senses of animals came under the general heading of sensory physiology, and was brought together in, for example, the monumental Springer series *Handbook of Sensory Physiology* completed in the early 1980s. The first book I know of called "Sensory Ecology" emerged from a NATO workshop held in 1977 (*Sensory Ecology*, ed. M. A. Ali, Plenum, 1978) and established the agenda for the 'new' subject. The emphasis now is less on the physiology of the sense organs themselves than on the scope and nature of the information 'out there' in the world, and on how animals use this information in the generation and guidance of their behaviour: sense organs are no longer seen as primary, determining what information an animal can take in, but secondary, having developed and been modified by evolution to effect a match between an animal's informational environment and its lifestyle. Dusenbery takes this general approach, dealing hardly at all with sensory physiology. There are numerous other books called "Animal Senses" and the like that also do this to various degrees, but what makes this book special, and extremely valuable, is the way that the author has brought together the physical underpinnings of the subject, while managing not to be at all dull. There is no other compilation to rival this book, and one would need to work hard to find this information elsewhere.

The book has four parts. An introductory section deals with information and signal processing in general terms; the second discusses stimulus properties in the classical sensory modalities; another deals with stimulus production for the detection of objects via 'active' senses such as echolocation, and also for communication; and a final section is concerned with spatial behaviours such as search and navigation. The first parts tend to be more textbookish, with plenty of equations, tables and generally lucid explanations of physical principles, whereas the later sections are more entertaining for the biologist, with a wealth of intriguing examples of impressive feats of behaviour, ranging from the way shearwaters hitch around the Pacific on the prevailing winds, to the strategy used by desert ants to locate their nests after foraging trips. The author has certainly hit on a formula that allows both breadth and depth of coverage.

There are some minor faults. A careful reading of Section 3–2 on measuring information reveals an author's name spelt incorrectly, some wrongly printed exponents in Table 3–2, and, amazingly, no mention of C. E. Shannon and W. Weaver's seminal book *The Mathematical Theory of Communication* (1949). But in the section on light, which is my field, I found little to object to. And in a book of this scope the coverage is inevitably uneven. Diffusion and flow, and search strategies associated with them, perhaps get more than their fair share of treatment, but this is the author's subject and some indulgence is proper. No major topic seems to be skimped, however. Another problem lies in knowing where the boundaries of the subject are. In the section on light, for example, the author starts to stray into questions raised by visual illusions and by *Gestalt* psychology. Although the information an animal seeks does indeed depend on the meanings that the animal can attach to it, the psychology of the senses is such a vast topic in its own right that it might be as well for the fledgling science of sensory ecology not to claim too much of it — for a while anyway!

This is a work of real stature. By bringing so much otherwise difficult material together in a user-friendly way, the book may itself give research in the area a boost. Researchers, students and teachers of every discipline that deals with the senses will want a copy, and every university library should have at least one. I think it is a little too tough as a text for biology undergraduates, who have a traditional terror of equations, but it is certainly an important work of reference for both advanced undergraduate and postgraduate courses. □

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New editions

■ *A Genetic Switch* by Mark Ptashne (2nd edn). Refines what is known about gene regulation in phage lambda and includes two new chapters that extend the treatment to higher organisms. Blackwell Scientific/Cell Press, £17.50 (pbk). For a review by Sydney Brenner of the first edition, see *Nature* **324**, 179 (1986).

■ *Animal Cell Culture: A Practical Approach* edited by R. I. Freshney (2nd edn). IRL (Oxford University Press), £19.50 (pbk).