

## Future informative

C. J. S. Clarke

**Mind Tools: The Five Levels of Mathematical Reality.** By Rudy Rucker. Houghton Mifflin: 1987. Pp. 328. \$17.95.

POPULARIZING pure mathematics for the man in the street (or at least the humanities graduate on the campus) is a task which daunts most mathematicians, but one to which Rudy Rucker rises with aplomb. The structure of his latest book comes from a thesis that mathematics is based on five archetypal ideas: number, space, logic, infinity and information, more or less in the sense of Shannon's "information theory". According to Rucker, we are now entering an era dominated by the fifth archetype, and his aim is to give an account of the other four in the light of information.

The result is a highly individual perspective on mathematics. The remaining unclimbed peaks (Riemann hypothesis, Poincaré conjecture, Goldbach conjecture) are passed over in favour of what is thought to be the area of the future: discrete mathematics (including an implicitly constructive approach to the reals) and the description of complexity. In places this gives rise to a rather cavalier attitude to the traditional approach — for example, in identifying the infinite

numbers of non-standard analysis with the infinite ordinals of conventional set theory.

The start is low-key, wandering through the integers in an apparently effortless conversational style. In this area there are no surprises and the book at first comes out second best to others. (For modern pythagoreanism — the use of numbers as an allegory in metaphysical arguments — nothing can touch the originality of Arthur M. Young's *Geometry of Meaning*, and for the personalities of individual numbers *Les Nombres Remarquables* by Le Lionnais and Brette is indispensable). But the pace picks up through tilings and fractals, covering much else *en route*, and reaches a climax on the home straight to computational complexity and Chaitin's theorem.

The reader is left with a picture of the Universe as a vast computer, in which the human brain is a very finite subsystem with abilities strictly limited by a bound that can be calculated. Although I am not convinced that the classical Turing machine provides the right paradigm for a discrete universe (quantum theory still has something to tell us about how to combine fuzziness and discreteness), I still recommend all the bio-computers reading this review to include Rucker's book in their input data. □

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## Social business

Alan Dixon

**Primate Societies.** Edited by Barbara B. Smuts, Dorothy L. Cheney, Robert M. Seyfarth, Richard W. Wrangham and Thomas T. Struhsaker. University of Chicago Press: 1987. Pp. 577. Hbk \$60; pbk \$27.50. To be published in Britain on 30 July, hbk £47.95; pbk £19.95.

BECAUSE of the inherent drawbacks of the genre, most edited volumes on primate biology fail to live up to the promise of their titles. *Primate Societies* is an exception. Although the book has five editors and 46 contributors, it is a superb synthesis of knowledge about the social lives of non-human primates.

The five sections deal with the evolution of social diversity, socioecology, group life, communication and intelligence, and future prospects for research. Detailed descriptions of social organization in prosimians, monkeys and apes are provided in the first 14 chapters, which contain comprehensive tables of data on population densities, group sizes, ranging patterns, and dietary and reproductive habits. Field studies continue to show how

variable primate social structures are, even within a single species. Bearder describes the complexity of social communication in nocturnal prosimians. The extraordinary tarsier, usually regarded as a non-gregarious species, is now known to live in pairs under some circumstances. Anne Wilson Goldizen presents surprising evidence for polyandrous social organization in some callitrichids — primatologists have long assumed that marmosets and tamarins live in monogamous family groups. These new findings could explain unusual features of callitrichid reproduction, such as large relative testis size in some species.

Marina Cords surveys the social organization of forest-living guenons (*Cercopithecus* spp.) and of the terrestrial patas monkey. The traditional view that these monkeys live in one-male units must now take into account the observation that additional males sometimes enter groups and mate with the resident females. Among the colobine monkeys an influx of new males or "group takeover" may be associated with infanticide of some, or all, of the existing offspring. When this phenomenon was first reported in langurs, many primatologists interpreted it as aberrant behaviour in overcrowded populations. However, Struhsaker and Leland

review the evidence and present a strong case for infanticide as a reproductive strategy in male colobines.

Rodman and Mitani describe alternative reproductive strategies employed by male orang-utans. Adult males are typically solitary and possess marked secondary sexual characteristics (cheek flanges and a laryngeal sac). There is, however, a second class of smaller males which do not have these features; these males are reproductively active, but they avoid aggressive contact with the bigger, territorial males.

The socioecology section makes it clear that relationships between ecology and social organization in primates are much less simple than was believed 20 years ago. Indeed it is very hard to obtain measurements of variables, such as predation pressures, which may have influenced the evolution of social organization. More progress has been made in understanding the dynamics of group life and how competitive or cooperative interactions affect the reproductive success of group members. The third part of the book contains 11 chapters on this theme, and I particularly enjoyed the reviews on patterns of sexual activity, sexual competition and mate choice by Hrdy, Whitten and Smuts.

The final two sections are much shorter and deal with communicatory biology and prospects for research on primate social organization. There is a very good contribution by Seyfarth on vocal communication, but only one short chapter is devoted to olfaction and vision. Additional coverage of these areas would have been valuable.

Field workers have made many contributions to conserving primates as well as studying their behaviour and ecology. The penultimate chapter by Mittermeier and Cheney is a sad reminder that more than 30 of the 51 extant primate genera contain endangered species and that human overpopulation results in the destruction of 10–20 million hectares of rain forest each year. Apart from the great importance of protecting these animals for their own sake, without habitat conservation and captive breeding programmes most biomedical research involving non-human primates has no future. □

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• Newly published by Springer-Verlag is *Primates: The Road to Self-Sustaining Populations*. The book (a large one, of 1,044 pages) is the proceedings of the conference of the same name held in San Diego in June 1985. It contains 74 contributions on various aspects of the main topic, principally case-histories of conservation in the wild, captive breeding and primate health. The collection is edited by Kurt Benirschke and costs DM 198.