

Cosmic travelogue

Beyond the Moon. By P. Maffei. Pp. 376. (MIT Press: Cambridge, Massachusetts, and London, 1978.) \$12.50; £8.75.

Beyond the Moon is a cosmic travelogue that takes us at ever-increasing velocities from the inner Solar System to the depths of the Universe. The purpose of adopting this unusual approach is to heighten the reader's awareness of the vastness of space. Some feel for the immensity of the heavens is conveyed by occasionally looking back at the Solar System until the Earth and Sun disappear from view. To adopt such a style of writing is a bold stroke: on the one hand it may captivate the curious reader, but there are points at which the description of the journey becomes altogether too precious and perhaps out of place in a scientific book.

Thus, on p167 we plunge into the cliché of holiday guide "Having witnessed the phantasmagorical spectacles of double stars and the cataclysms of novae and supernovae, we now set our sights on other goals . . .". Just round the corner to the Orion nebula: ". . . we tend at first to hold our breath, as if for fear that these tenuous veils will come undone . . . but the nebula remains . . . changeless in its very evanescence". The metaphor looks over-worked even in the local stellar neighbourhood, where super-drive would be needed to dive through worm-holes of space in order to complete the itinerary.

For those willing to admit that suspension of disbelief necessary for enjoying science fiction, *Beyond the Moon* is a good read. It describes the Solar System, the nearest stars, and our Galaxy. Among the many commendable features is a surprisingly thorough survey of variable stars, a topic often skimped in popular writing. About one-third of the descriptive prose is a ramble through the extragalactic universe. Five appendices round off the journey, and there is also an outstanding index for those wishing to retrace their steps.

In no sense is *Beyond the Moon* a complete course in astronomy (neither author nor publisher claim that it is); rather it is like a series of extended essays in which the author is at his best when drawing out the themes that appeal to him particularly. His style and approach compares favourably with Asimov but lacks the incisiveness of Hoyle's writing at this same level.

Already *Beyond the Moon* has run through six editions in Italian, and it deserves to sell well in the English language. The translation and up-dating

by D. J. K. O'Connell, S.J., of the Vatican, reads smoothly. Occasional lapses grate a little to anglophones (" . . . the Protestant minister David Fabricius") and some analogy requires a good knowledge of Italian geography, such as knowing the distance by road from Rome to Genoa. This, however, is nit-picking, for O'Connell has done a fine job to this best-seller.

To whom is the book addressed? In the English language it must stand up

to far more competitors than in its mother tongue. However, it seems admirably suited to that legendary and industrious hero of publishers' blurbs: the intelligent layman. It is a good account for the inquisitive but un-informed.

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Structure of food webs

Food Webs and Niche Space. By J. E. Cohen. Pp.189. (Princeton University Press: Princeton, New Jersey, 1978.) Hardback £9.40; paperback £4.65.

ECOLOGISTS have been surprisingly myopic about food webs. They have described them; complained about how complicated they are (the "tangled knitting hypothesis"); noticed that the number of trophic levels is never very many; perhaps commented on the fact that some seem to be compartmentalised; and then got on with the serious business of studying single-species populations, interspecific competition, species-frequency distributions and what have you. Questions about the shape of entire food webs within which the ecological play actually takes place, have hardly ever been asked.

In this book Cohen assembles data on thirty-one food webs, accumulated over four decades of field work by other biologists. He claims no first-hand knowledge of the natural history of the plants and beasts involved, but seems to have been meticulously careful in reading what others have written about them. He then analyses the structure of these food webs, focusing on patterns of food sharing. Specifically, he asks whether the overlap in food utilisation among various kinds of organisms can be represented in one dimension, or more formally as an interval graph. Cohen's central conclusion is that community food webs are interval far more often than chance alone would provide.

A great deal of the book is taken up with deciding what chance will provide if she is allowed to design random food webs—to generate the hypothetical tangled knitting as it were. Thus, after setting the scene and gently introducing his reader to the jargon of graph theory and combinatorics in chapters one and two (it sounds more difficult than it is) Cohen moves to a description of his real food-webs in chapter three.

Chapter four contains a major statistical analysis of the properties of these

webs, and reveals a number of hitherto unexpected properties over and above the surprising fact that most, perhaps all real webs are interval. For example, the number of kinds of prey is roughly three-quarters the number of kinds of predators in all the community webs; the number of links between the bottom of a food chain and the top is highly constrained but has different distributions in different webs; and as a multiple of the number of predators in the food web, the distribution of dietary overlaps is roughly uniform. There is much food for thought in these, and the other empirical patterns revealed in this part of chapter four.

The remainder of chapter four and part of chapter five discuss a series of model worlds; seven random webs constructed under a variety of assumptions and constraints. (A large part of chapter five is also devoted to the clinical diagnosis of a sick, or at best perverse random number generator, and says much about Cohen's meticulous care in the analysis of both data and models.) The main conclusion from this, the core of the book, is very clear. The high frequency of interval webs in the real world is extremely unlikely to have arisen by chance.

The remainder of the book is devoted (in chapter six) to asking why food webs should be interval. Cohen runs through three minor, and three major possibilities. I must confess that of the three interesting hypotheses, I found one so vague, and one so esoteric mathematically that I did not understand them. The third, focusing on the notion that there are dynamic constraints on the design of food webs, is to my mind the most interesting. Cohen's use of qualitative stability analysis merely scratches the surface, and indeed may be misleading as a large number of webs that are qualitatively stable turn out not to be locally stable when parameters are assigned and the models analysed properly. There is much scope for further work here. Finally, chapter seven flies away into some fairly esoteric air—the higher corners of Euclidean space and intersection graph theory—which may keep the pure theorists happy but is unlikely to lead to many empirically testable