

ESRO and ESA. The treatment is not always balanced: for example, there is much about the French national programme and the satellites launched, and nothing about the (smaller) British programme, with no mention of Black Arrow, Prospero or the six Ariel satellites. There are some errors too, but the book can be recommended as generally reliable. □

Desmond King-Hele, 3 Tor Road, Farnham, Surrey GU9 7BX, UK.

Bee warned

Thomas Seeley

Anatomy of a Controversy: The Question of a "Language" Among Bees. By Adrian M. Wenner and Patrick H. Wells. *Columbia University Press: 1990. Pp. 339. \$63.50.*

IN the 1960s a major controversy arose in the field of animal behaviour. At issue was the mechanism by which a honeybee recruits nestmates to a rich source of food. Since the 1940s it had been understood, from the work of Karl von Frisch, that one bee recruits others to rewarding flowers by means of both dances that she performs — which contain information about the direction and distance of the flowers — and floral odours that she bears — which further specify the flowers. Adrian Wenner and his colleagues challenged this view, arguing instead that recruitment occurs solely by odours, with recruits learning to recognize the odours borne by a dancing bee and then searching for the source of these odours. This challenge to the traditional view of bee recruitment, with its implication that bees cannot communicate direction and distance information, triggered intense debate, much of it laced with hostility toward Wenner. Why did this happen? What was the outcome? How should we now view the dances of bees? These are the main questions addressed in this book.

Two individuals from one side of a controversy cannot be expected to provide a reasoned, detached analysis of the controversy, and we certainly do not get such an analysis in this book. Indeed, it contains such a distorted account of the controversy that its primary value is to provide a window on the minds of Wenner and Wells, through which some future historian of science can peer to prepare an accurate account of this debate. The most serious distortion comes in the presentation of the dance-language hypothesis which, according to Wenner and Wells (see pages 63–64), ascribes no importance whatsoever to odours in recruitment. This is crucial to their position because they then argue that if they can demonstrate

that odours play a role in recruitment (which, of course, they can), then they have falsified the dance-language hypothesis. But their version of the dance-language hypothesis is a straw man. In both his 1950 and 1967 books, von Frisch explicitly discusses the importance of odours in enabling recruits to locate the recruitment target once they reach its general vicinity. Hence virtually all the evidence that Wenner and Wells muster to refute the dance-language hypothesis is actually consistent with von Frisch's view of the dance language.

Many other serious errors of scholarship further erode the credibility of this book's analysis of the dance-language controversy. One example that illustrates the depth of these errors occurs on pages 98–99, where the authors greatly misrepresent the classic 1944 experiment of von Frisch which first suggested that bees can communicate distance information. First, they claim that von Frisch did not report the numbers of bees arriving at the feeding station for all five trials, even though he does do so, in the footnotes. More importantly, they claim that the results of this experiment indicate that "all was not well" for the dance-language hypothesis because the recruit counts were lower at the feeding station (the recruitment target) than at the test station (a scented plate 30–100 metres from the feeding station). A careful reader of von Frisch's own account of these experiments will realize that there is no problem here. The recruit counts at the feeding station represent the number of captures of bees there, but the recruit counts at the test station represent the number of approaches by bees to the test station, which certainly exceeds the number of bees visiting the test station because a single bee can make many approaches. Comparing the two sets of numbers is meaningless, something which von Frisch recognized (hence he reported the feeding station counts only in footnotes), but which Wenner and Wells failed to discern.

Specialists in insect behaviour will also be astonished by numerous surprising claims: such as that the dance-language hypothesis is anthropomorphic (page 63), does not mesh well with mechanistic explanations of behaviour (page 74), and was negated by Maurice Maeterlinck's observations (page 53); that in his 1950 book von Frisch failed to distinguish between newcomers and experienced bees at a feeder (page 84); that the acoustical signal in dances is an anomaly for the dance-language hypothesis (page 118); and that Wenner and his colleagues were the first to discover that bees learn to associate odours in the hive with food at a feeder (page 119). Also, specialists are not likely to be convinced by the evidence presented in support of the odour-search hypothesis, virtually all of which (recruit-

ment dependence on odour, inefficiency of recruitment, long recruitment times, and so on) is consistent with the hypothesis that bees use dance information to find the general vicinity of a recruitment target and then use odour information to pinpoint the target.

Today, some 20 years after the start of this controversy, few students of animal behaviour doubt that bees share information about the location of rich food sources by means of their dances. Wenner and Wells attempt to show that this continued acceptance of the dance-language hypothesis reflects sociopolitical forces maintaining a traditional hypothesis, and that the empirical support for this hypothesis is weak. Sociological factors play a role in every scientific debate, and this book sheds light on those involved in this controversy. But this book's presentation of the biological issues and experimental evidence pertaining to the dance-language controversy is inaccurate and misleading. Readers beware. □

Thomas D. Seeley is in the Section of Neurobiology and Behaviour, Cornell University, Ithaca, New York 14853, USA.

Rocky treasure

Jake Hancock

Solnhofen: a Study in Mesozoic Palaeontology. By K. W. Barthel, N. H. M. Swinburne and S. Conway Morris. *Cambridge University Press: 1990. Pp. 236. £36, \$59.50.*

THE Solnhofen Limestone was the first example of a sediment that was recognized to contain exceptionally well preserved fossils and hence an extraordinary range of organisms which are normally not preserved as fossils at all — a *lagerstätte* in current jargon. Thanks to *Archaeopteryx* — still the earliest known bird — the fame of this limestone has spread beyond scientists to educated people world-wide. Anybody outside Germany wanting to find out more about the petrology of the limestone and its general range of fossils would have been in difficulties. Moreover, Barthel's original book pre-dated the vital research by Keupp on the microfossils. Geologists are now indebted to Nicola Swinburne and Simon Conway Morris for an excellent general survey in English, which incorporates the considerable body of research by German sedimentologists and taphonomists during the last 25 years.

Roughly half the book is a systematic survey of the fossils known from the limestone, which includes good photographs of all the major taxa. But one is discouraged from getting much further into the taxonomy. Many of the famous publications on Solnhofen fossils, mentioned in