

arise if light is available' (p. 45). Whilst acknowledging that such structures as eyes have indeed evolved independently (and indeed many times), they point out that so far as biospheres are concerned n equals one. My own view is that biological convergence still provides a very strong indication of what we will find 'out there', but the great virtue of this book is a detailed exploration of the alternatives.

Yet the conclusions of Schulze-Makuch & Irwin still make for sobering reading. Thus, in reviewing a litany of potential extraterrestrial examples, invoking energy sources as diverse as magnetism, gravity, pressure and radioactivity, the repeated refrain is one of doubt and scepticism. Even the possibility of heat engines, whereby an organism hitches itself to the Carnot cycle, looks energetically feasible, yet so far as we know has never been exploited on this planet. Odd, given the rampant opportunism of evolution? Maybe the problem is quite basic, as any power station engineer will tell you, and that is the very low efficiency of the thermal system, although Schulze-Makuch & Irwin suggest some ingenious ways to resolve the dilemma.

Even though many exotic systems appear to be no more likely in extraterrestrial biospheres, by no means is all lost. Thus the perennial fascination in a silicon biochemistry, which in any event on this planet is touched upon by such groups as the diatoms, is well rehearsed. So too, on much colder planets an ammonia based system may be truly viable. Here too, however, to us weird solvents such as hydrofluoric acid, hydrazines and silicones may all suffer literally fatal defects. These discussions circle, of course, around the perennial debate about the suitability of water as the universal biological solvent, and the cross-comparisons presented here are extremely valuable.

This is an open-minded and engaging book. Although demanding a reasonable knowledge of chemistry, it is written in an engaging style. It is properly speculative, and emphasizes that what we know is far outstripped by what we do not know, let alone dream of. Astrobiology is a growing field, but any enthusiast will want this sensibly priced volume to hand.

Simon Conway Morris

WEBBY, B. D., MÁNGANO, M. G. & BUATOIS, L. A. (eds) 2004. *Trace Fossils in Evolutionary Palaeoecology. Proceedings of Session 18 (Trace Fossils) of the First International Palaeontological Congress Sydney, Australia, July 2002*. Fossils and Strata no. 51. v + 153 pp. Oslo: Taylor & Francis. Price US \$50.00 (paperback). ISSN 0300-9491.
doi:10.1017/S0016756806002846

The study of trace fossils, known as ichnology, is a sub-discipline of palaeontology and concerns organism–substrate interactions of all kinds. Ichnology has been somewhat of a late starter, but has in recent years come into its own as an important branch of both palaeontology and sedimentology.

In recent years there have been a number of important books, short course notes, and compilations of papers that encompass: palaeobiology (Donovan, 1994; Bromley, 1996); applied ichnology (Pemberton *et al.* 2001) and stratigraphic and palaeoenvironmental analysis (McIlroy, 2004). When I was offered the opportunity to review a thematic set on the evolutionary palaeoecological aspects of ichnology I was delighted. Upon receiving the volume I was surprised to see that it was published by Fossils and Strata, as thematic sets are not their normal fare.

The volume itself is made up of ten papers that are, according to the editors, 'an eclectic sampling of current

work'. I certainly found that to be the case. I read and greatly enjoyed a number of the papers as a specialist in ichnology. Particularly stimulating were papers on the Proterozoic–Cambrian transition (Buatois and Mángano) and the early Palaeozoic colonization of the inter-tidal realm (Mángano and Buatois), which should give sedimentologists pause for thought when constructing facies models of ancient deposits. The work of Adami-Rodrigues *et al.* on trace fossils such as leaf mines and galls from the Triassic of Brazil is stunning in its detail. The paper that was the most relevant to the title of the book was that of Carmona *et al.*, which studied the fossil record of crustacean burrows such as *Thalassinoides* through time and makes some highly relevant statements about evolutionary palaeoecology of the burrowing crustacea. Other papers with an evolutionary/stratigraphic bias are little more than extended abstracts and appear to have been lightly edited. There are also some good papers that do not seem to address the title of the book at all. Their inclusion in the thematic set is presumably because the authors were involved in the IPC session rather than their relevance to the topic of evolutionary palaeoecology.

If I had bought the book as someone interested in evolutionary palaeoecology, I think I would have been disappointed with the lack of focus of the thematic set. There is – I am sure – enormous scope for applying ichnology to evolutionary palaeoecological issues, but this volume only scratches at the surface. However, I hasten to add that, as an ichnologist and sedimentologist, there were some stimulating papers in the compilation that are of relevance to my normal work as a palaeontologist/sedimentologist. This is one for the shelf if you are a specialist; if you are a generalist/non-expert, you might like to get it from the library first.

D. McIlroy

References

- BROMLEY, R. G. 1996. *Trace Fossils: Biology, Taphonomy and Applications*. London: Chapman & Hall, 361p.
DONOVAN, S. K. (ed.) 1994. *The Palaeobiology of Trace Fossils*. Chichester: John Wiley & Sons, 308p.
MCILOY, D. (ed.) 2004. *The Application of Ichnology to Palaeoenvironmental and Stratigraphic Analysis*. Geological Society of London, Special Publication no. 228, 490p.
PEMBERTON, G. S., SPILA, M., PULHAM, A. J., SAUNDERS, T., ROBBINS, D. & SINCLAIR, I. K. 2001. *Ichnology and Sedimentology of Shallow to Marginal Marine Systems*. Geological Association of Canada Short Course Volume 15, 343p.
BEAUDOIN, A. B. & HEAD, M. J. (eds) 2004. *The Palynology and Micropalaeontology of Boundaries*. Geological Society Special Publication no. 230. vi + 355 pp. London, Bath: Geological Society of London. Price £85.00, US \$153.00; GSL members' price £42.50, US \$77.00; AAPG/SEPM/GSA/RAS/EFG/PESGB members' price £51.00, US \$92.00 (hard covers). ISBN 1 86239 160 2.
doi:10.1017/S001675680600286X

The papers in this book derive in part from a special session of the joint annual meeting of the Geological and Mineralogical Associations of Canada held in Saskatoon in 2002. Given that the session, which was sponsored by the Canadian Association of Palynologists, consisted of seven papers and a poster, and that there are 16 papers in the volume not including the introduction written by the editors, other contributions solicited subsequently make up at least half of the collection. Stratigraphic coverage is in some respects broad, the paper by MacLeod covering the