Simon Conway Morris, *From Extraterrestrials to Animal Minds: Six Myths of Evolution* (West Conshohocken, Pa.: Templeton Foundation Press, 2022). Cloth. ix + 409pp. £17.99.

Conway Morris, Emeritus Professor of Evolutionary Palaeobiology at Cambridge, is well-known for his trenchant advocacy of certain key positions, especially the importance of convergent evolution, his emphasis on the distinctiveness of human intelligence, and the guess that we might be the only intelligent life-form in the universe. His writing is always stimulating and often provocative.

So I turned with much anticipation to a book that promises to expose a series of misunderstandings about evolution. First he tackles and rejects the idea that evolution explores the whole space of possibilities for life. He notes that a key transition was the evolution of the eucaryotic cell. One sub-myth is that life always moves from the simpler to the more complex – the earliest eucaryotic cells were complex, just as some early enzymes were. Some animals have simplified themselves to become almost like protozoans again. Some of the limits on life-possibilities stem from physical constraints – these limit the minimum size of cells, the minimum detectable light and sound, the maximum likely brain size for a given body.

Conway Morris's second myth is of 'randomness'. Here we get a re-presentation of Conway Morris's familiar notion that certain sorts of evolved forms will continually recur. Biological hyperspace 'will be dotted with inevitable destinations' (52). From there he moves to 'the myth of mass extinctions'. Yes, these great events reduced species numbers, sometimes massively. But the 'winners' that emerged were, the author claims, already predictable. Though the rise of the big reptiles temporarily obscured the development of mammals, the latter were already forging ahead. There were zones of relative safety even in the very dramatic Cretaceous-Tertiary event, and snakes, birds and insects seem to have survived surprisingly well.

He then addresses 'missing links'. The complexity of evolutionary development is emphasised; over and over again innovations are found combined with relatively archaic forms. There is some fascinating information here on the emergence of four-leggedness, and of bird-flight. Conway Morris also tracks recent revisions of hominin evolution, including the paradox of the small-brained *Homo Naledi* with their remarkable interment practices, and the increasing respect for the cognitive and cultural abilities of Neanderthals.

The last two 'myths' may be the least palatable for the reader who has followed the recent semi-popular literature. In Chapter 5, Conway Morris is at great pains to demolish the continuities between human minds and those of other animals. He goes through a range of evidence for animal cognition, empathy and linguistic ability, dismissing it as not remotely in the same league as even that of young human children. The use of tools by other animals he finds 'strangely one-dimensional, strongly stereotyped, devoid of flair and panache, and tellingly are not in any way cumulative' (177). The last chapter emphasises his view that other intelligent civilisations are unlikely in the universe, drawing heavily here on the Fermi Paradox that none has been detected.

I have sketched the basic contours of the book, but I have to admit that I found its general texture disappointing. I found myself wondering exactly who the expected reader is. There are 166 pages of endnotes giving the references to the vast literature Conway Morris has consulted, so the scientist looking for technical information can find it. But much of the argumentation, particularly in Chapters 2-4, seemed to dissolve into technical details based on the complex vocabulary of palaeobiology, and the main lines of the argument got rather lost. (For example, I found the idea of the 'limits' very interesting, but the account of these would have benefitted from more signposting and summarising.) Again, a remarkable amount of information about the palaeobiological world was presented, but it was hard for the non-specialist to evaluate. From time to time the author acknowledges the 'frightening inadequacy of the fossil record' (75), but that didn't seem to inhibit him from making very big claims on its basis.

The style of book becomes more and more trenchant, even dismissive, as it moves into the area of animal and ET intelligence. It ends on a very whimsical note, moving from the unlikelihood of ET life to the potential importance of the paranormal. This underlines what an individual, even quirky book this is. Arguably every author writes for him or herself. But in the middle sections of this book I felt that Conway Morris had become so immersed in the detail of his evidence that he had somewhat lost touch with what a non-specialist reader might need to understand.

So for all its many virtues I give this a somewhat qualified recommendation.

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