

complicated: for example, the "red-sensitive" cones are maximally sensitive in the yellow-green and what is maximal at longer wavelengths is the *ratio* of absorptions in the long- and middle-wavelength cones. Second, given his theory and his actual results, Maxwell had empirical reasons for supposing that there existed three real wavelengths each of which produced a nearly pure sensation; for his results, when plotted in his chromaticity space, suggested that the spectrum locus consisted simply of two straight lines that intersected in the green and thus he was led by his data to suppose that a light placed at any apex of the resulting triangle would come close to stimulating only one sensation.

Maxwell's treatment of colour deserves a more careful assessment than is possible here; but much of the problem has escaped Dr Sherman. The one single error that most held back the development of the trichromatic theory was the belief — still to be heard today — that the peak sensitivities of the photoreceptors must correspond to "primaries", either phenomenologically pure "primary hues" or those primaries in a colour-matching experiment that, by direct mixing, allow the matching of the largest gamut of other colours. Only after

Maxwell was it realized that the latter primaries should be lights that produce the highest ratio of absorptions in different classes of receptor. Dr Sherman's useful book would have been so much the more valuable if it had identified the essential ambiguity of the term "primary colour" in the literature of the mid-nineteenth century. More generally, his readers would have gained if he had much more clearly set out, in an early chapter, the modern distinction between a chromaticity space (representing physical mixtures that produce matches) and spaces in which colours are so placed as to be uniformly spaced phenomenologically. The mapping of one to the other is now known to be very complex.

The historian of science has a peculiarly difficult trade: he must be master of his period and of at least four languages, and he must be also master of the science. If he is to show us the limits of his subjects' thoughts, he must have a conceptual advantage over them and must share this advantage with his reader. He must be Whig without being presentist: the two are not the same. □

John Mollon is a Lecturer in Experimental Psychology at the University of Cambridge.

too polished and urbane to harangue us at any time. It is a very scientific book which embodies more neatly than I have seen expressed elsewhere the conviction of most scientists that

... there are many possible worlds; but the interesting one is the world that exists and has already shown itself to be at work for a long time. Science attempts to confront the possible with the actual. It is the means devised to build a representation of the world that comes ever closer to what we call reality. □

Sir Peter Medawar is Head of the Transplantation Biology Section at the Medical Research Council's Clinical Research Centre, Harrow, Middlesex.

Marine microfossils

B. M. Funnell

Microfossils from Recent and Fossil Shelf Seas. Edited by J. W. Neale and M. D. Brasier. Pp. 380 UK ISBN 0-85312-338-1; US ISBN 0-470-27220-1. (Ellis Horwood/Halsted: 1981.) £35, \$76.65.

A PRINCIPAL merit of this book is the variety of topics it contains. In 28 chapters it covers every geological period from the Silurian to the Recent; a geographical range embracing Spitsbergen and the Barents Sea, East Africa, the equatorial Pacific, the western North Atlantic, Israel, Iran, Pakistan, North-West Europe and the British Isles; and microfossil groups as varied as conodonts, algae, acritarchs, dinoflagellates, ostracods, benthonic and planktonic foraminifers and radiolaria. The organizers of the symposium at Hull University in July 1980, from which this volume derives, were indeed fortunate in having such a wide diversity of contributions on which to draw.

Another successful feature of the book is the high degree of uniformity of contributions, none of which are either too long or too ambitious, and only one of which is reduced to extended abstract dimensions.

The volume as a whole is arranged in stratigraphical order. Approximately 15% is devoted to the Palaeozoic, 35% to the Mesozoic, 20% to the Tertiary, and 30% to the Quaternary and Recent. Most articles apply themselves to stratigraphical or palaeoenvironmental interpretation. No fundamentally new approaches are introduced, and the methodologies used are essentially those developed in the 1960s and early 1970s. A particularly disappointing aspect is the poor understanding of physical and chemical oceanography exhibited by some authors. A few contributions begin to break through this deficiency, for example that dealing with anoxic events in the late Cretaceous and the salutary study of microfossil transport in a modern estuary;

Francois Jacob on possible worlds

P. B. Medawar

The Possible and the Actual. By François Jacob. Pp. 70. Hbk ISBN 0-295-95888-X; pbk ISBN 0-394-70671-4. (University of Washington Press/Pantheon: 1982.) Hbk \$8.95; pbk \$3.95.

THE antithesis embodied in the title of Jacob's short, brilliant and beautifully written little essay can be taken in two ways. In *The Nature of the Physical World*, Sir Arthur Eddington wrote:

I need scarcely add that the contemplation in natural science of a wider domain than the actual leads to a far better understanding of the actual.

An important fraction of Jacob's essay is indeed an exercise of just this kind. It is an exercise more easily possible in the biological than in the physical sciences because in the latter, as Jacob remarks in a Kantian aside, the right-seemingness and naturalness of the natural world may to some extent reflect "the very way our brains work". In biology, however, it is not a tremendous feat to imagine things otherwise than they really are. Why sex, for example? — and why two sexes and not three? The causal-explanatory answer is not easy but the teleological answer that sexuality is "a diversity-generating device" is satisfying and makes sense of what would otherwise be a puzzle.

The second sense in which we may read

Jacob's antithesis is that in which all scientific enquiry is a duologue between the possible and the actual, between what *might* be true and what is in fact the case.

This conception, in which I myself am a firm believer, is sufficiently permissive to make room for myth as an important element in man's attempt to explain his condition, for "whether mythic or scientific, the view of the world that man builds is always largely a product of his imagination". Reflection on this theme allows Jacob to divagate interestingly and amusingly on myths that bear upon sexuality. But of course myths, however effectively they may appease curiosity or dispel the disquiet of ignorance, always fail that difficult exam in which our imaginings are measured up against reality. Yet even in the most "scientific" explanations today there is just a faint hint of the explanatory glibness of the myth — and it is for this reason, I think, that Jacob is a little reserved about natural selection: he does not believe in the universal explanatory value of any one formula.

Needless to say, no one with any understanding of the intellectual tradition to which Jacob belongs and of which he is so able a spokesman could entertain even momentarily the suspicion that Jacob himself is in any serious sense a mystic.

It is an added merit of this book that there is no Message, and that it is altogether