

A paean to living things

Christian de Duve

What is Life? By Lynn Margulis and Dorion Sagan. *Simon and Schuster: 1995.* Pp. 207. \$40.

A LITTLE over 50 years have gone by since the publication of the much acclaimed — and discussed — *What is Life?* by the theoretical physicist Erwin Schrödinger, a pioneer of wave mechanics who also kept an interest in the biology of his day (see the review by C. R. Welch in *Trends in Biochemical Sciences* 20, 45–48; 1995). Anyone who has read Schrödinger's sober and penetrating attempt to single out the key properties of life as he knew it might expect to find that a book of the same title published half a century later contained the carefully distilled quintessence of our present understanding of living processes, which is so much more profound and detailed than were the inklings available to Schrödinger. This, however, is not the goal the famous mother-and-son team have set themselves in this — their fourth — joint opus. There is hardly any mention of modern biochemistry, cell biology or molecular biology in this luxuriously produced extravaganza. We are treated, instead, to such definitions as: "Life is a material process, sifting and surfing over matter like a strange slow wave ... a controlled artistic chaos... a planetary exuberance... the watery membrane-bound encapsulation of spacetime... the strange new fruit of individuals evolved by symbiosis... a network of crosskingdom alliances ... the transmutation of sunlight."

Remarks of this sort conclude each of the nine chapters in which the authors, after a number of introductory generalities, sweep over the four-billion-year history of life on Earth in a smooth, vivid style, which, however, often eschews factual complexities in favour of anecdotal information, poetic imagery or philosophical digressions. Readers acquainted with the authors' previous works will recognize

■ Christian de Duve's airs some further thoughts on the origin of life in the recently published *What is Life? The Next Fifty Years* edited by Michael P. Murphy and Luke A. J. O'Neill. The book arose from a conference held in 1993 to celebrate the fiftieth anniversary of Schrödinger's original book of the same title. Other contributors speculating on the future of life include Jared Diamond, Manfred Eigen, Stephen Jay Gould, John Maynard Smith, Roger Penrose and Stuart Kauffman. Cambridge University Press, £17.95, \$24.95.

some familiar themes. There is the impassioned defence of the much-maligned bacteria, which the authors see as identified in the public mind only with the production of diseases, the fervent allegiance to James Lovelock's Gaia hypothesis and, especially, Margulis's main contribution to science, the endosymbiotic theory of the origin of

ENTOMBED in stone — Carboniferous limestone containing the fossilized remains of crinoids. These primitive echinoderms have delicate feathery arms radiating from a central stem made of calcite plates, or ossicles, that, as shown here, often break off from the fossils. From *An Illustrated Guide to Fossils* by Chris Pellant. Clearly written, well organized and abundantly illustrated. Dragon's World, £19.95.



eukaryotic cells. This she presents in her customary truncated version which leaves out such important eukaryotic features as the cytomembrane system, cytoskeletal elements other than microtubules (which she believes to have been brought in by symbiotic spirochaetes) and, especially, phagocytosis, notwithstanding the probable role of this process in endosymbiont adoption. These themes are entertainingly woven into a patchy, almost pointillist narrative, enlivened by sumptuous pictures and colourful vignettes drawn from the authors' rich lore of biological oddities. Those who know the gist of the topic will find many choice bits to enjoy. How much uninformed readers will discern of the realities behind the metaphors is not clear.

They will get the philosophical message, however, and it is one that most scientists will receive with some surprise, if not dismay. Purposefulness, consciousness and freedom to choose are identified as properties common to all living beings. In a discussion of chemotaxis, for example, microbes are said to "make selections", to "choose". An amoeba, deprived of its favourite food, turns "reluctantly" to less delectable fare. This is not just poetic

licence. "At even the most primordial level," we are told, "living seems to entail sensation, choosing, mind.... All [organic beings] are sentient, possessing the internal teleology of the autopoietic imperative Life is matter that chooses."

In the authors' depiction of evolution, Darwinian selection plays second fiddle to sentient, willful, goal-oriented selection. Darwin himself, in their lengthy discussion of his dispute with Samuel Butler, comes out as something of a fraud, guilty of ignoring the contributions of others, including his own grandfather Erasmus, for the sake of self-promotion. Margulis and Sagan clearly bend in favour of Butler rather than Darwin, to the point of expressing sympa-

thy with Butler's Lamarckian view that the consciously learned may eventually enter the realm of the hereditary unconscious, although they concede that "it seems doubtful that children will ever be born reading and writing".

In an epilogue to his *What is Life?*, entitled "On Determinism and Free Will", Schrödinger rejected Western philosophies in favour of Vedantic beliefs. The Chilean biologist Francisco Varela, who is warmly commended by Margulis and Sagan for his "autopoietic" view of life as an "emergent holarchy", has embraced Buddhism. Although Margulis and Sagan do not advocate any particular creed, their brand of anti-Darwinian 'bacterio-mysticism' will no doubt be hailed by many a creationist, as well as by all those who, for one reason or another, are disenchanted with contemporary science, which they accuse of being overly materialistic, deterministic and reductionist. □

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