The what, why and wherefore of cells

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Ultrastructure, Macromolecules, and Evolution. By Lawrence S. Dillon. Pp.708. ISBN 0-306-40528-8. (Plenum: 1981.) £43.79, $69.50.

IN THIS second part of an intended trilogy, Lawrence Dillon interweaves discussion of evolutionary and cell structural relationships in order to consider genetic mechanisms working at the cellular level and to reconsider phylogeny from a cellular viewpoint. This is a formidable task because of the breadth and depth of information which must be assembled, assimilated and analysed. In terms of defining general principles, Dillon succeeds admirably; in terms of accurately documenting his background data, he fails in certain areas. Most of these failures are inconsequential to the ultimate conclusions, but they are disconcerting nevertheless.

The author has arranged his material into four areas of comparative cytology: cell motility, secretory organelles, energy-processing organelles, and karyo- and cytokinesis. He begins with a detailed account of the structural chemistry of membranes in general, giving an excellent historical perspective. Oddly, he follows this with four somewhat uneven chapters on cell motility before returning again to membrane-based systems. Motility is covered in chapters on microtubules and microfilaments, cytoplasmic movement, the flagellum and the basal apparatus. There are some serious problems in this area, to which I will return below.

Secretory systems are dealt with in two chapters — the endoplasmic reticulum and the Golgi apparatus are treated as a continuum, the "endomembrane system", while the lysosome, peroxisome and related structures are dealt with as the "vesicular system". This manner of presentation is quite informative in a comparative sense and it is logically and clearly arranged.

Three closely-correlated chapters are devoted to "energy-oriented organelles". The first discusses general aspects of cell respiration and includes a lucid consideration of the evolution of the tricarboxylic acid cycle; the remaining two cover mitochondria and chloroplasts, their comparative structure, replication and development in numerous organisms. Here, Dillon presents a well-balanced account of the two contending theories for the phylogenetic origin of these organelles: the endosymbiotic concept and the episome theory. He clearly favours the latter and presents additional evidence for it, based mainly upon some compelling evolutionary considerations.

Dillon ends this work with a comparison of both nuclear and cytoplasmic division mechanisms in a multitude of organisms. Here, considering the abundance of information now available, I would have liked to see further examples, mention of odd exceptions and more detail, but the coverage is certainly adequate for the author's purposes. Tacked on to this final chapter are Dillon's two principal conclusions, concerning the inadequacy of simple mechanistic theory (i.e. the central dogma and self-assembly) to account for the development of cell structures and his well-stated contention that the phylogenetic stages of evolution, examined in terms of cellular evolution, allow no clear division between plants and animals, protozoans and algae, or even prokaryotes and eukaryotes. Certainly not everyone will agree with his views, but he raises many points that cannot be ignored.

The problems in the motility chapters, mentioned previously, range from simple inaccuracy (outer doublet B-subfibres contain 10 or 11 protofilaments, not 9; p.73 and p.143) and typographic atrocities (actinomysin for actinomycin, p.255; actinomyosin for actomyosin, p.407), to gross errors in reporting published conclusions (no analysis of doublet A and B tubulin components ever showed a specific number of residue differences, p.174) and unwarranted generalizations (in only one species has the ciliary membrane been shown to differ from the flagellar membrane, p.163). Also there are mistakes and misjudgements in citation priority, attributing the right facts to the wrong workers, and making overly broad generalizations from authors' more conservative conclusions. These, however, are no more than minor flaws which may easily be corrected in a second edition.

Perhaps more seriously, the dust jacket promises a new concept of flagellar movement. Dr Dillon argues against the widely-accepted sliding filament theory, concluding that it simply isn't so because microtubules are attached to the basal body. He begins his arguments by not mentioning Peter Satir's classic work on the subject, and by not considering that sliding is local and constrained and that the axoneme may twist in response to sliding. He concludes that the tubules themselves must change length, ignoring the work of D. P. Costello who argued all of this a decade ago and did so far more convincingly. The book would be much better off without this "new concept", particularly since it has nothing to do with Dillon's major premise.

Chemical differences in tubulins are central to Dillon's prime example for the workings of the cellular genetic mechanism (pp.174–176; p.558). With a simple self-assembly mechanism, how do the tubulins of the outer doublets and central pair sort themselves out from each other and from cytoplasmic tubulin and, furthermore, when assembled into a 9 + 2 structure, how are dynein, nexin and spoke sites specified? The author contends that the mechanisms must be enzymatic. If the tubulins are really as different as Dillon implies, they should be able to sort themselves out easily (specific recognition sites) and also to specify binding sites when assembled (differences in surface lattice). In reality, however, the tubulins are not very different and some observed differences are probably due to post-translational modification, perhaps even after assembly. The truth of the mechanisms probably lies somewhere between these two viewpoints. This potentially important example sorely lacks authority and is likely to mislead the casual reader.

As an evolutionary exposition, *Ultrastructure, Macromolecules, and Evolution* is unique; nowhere is such a broad sweep presented so succinctly in a single source. The references, cited with full title and grouped by chapter at the end of the book, are quite valuable in their own right. This will be a useful reference book for those interested in comparative ultrastructure and certain phylogenetic aspects of biochemistry, and could also serve as a text for a graduate-level cell structure--function--evolution course, leading students easily back to the original source material. □

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The healing way

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Tissue Repair and Regeneration. Handbook of Inflammation, Vol.3. Edited by L.E. Glynn. Pp.579. ISBN 0-444-80278-9. (Elsevier/North-Holland Biomedical: 1981.) $136.50, Dfl.280.

REPAIR is essential to life, but what governs whether the body replaces damaged or dead tissue by tissue indistinguishable from the original, by scar or by a mixture of both, is a mystery. A distinguished international group of contributors here present a series of reviews concerning certain aspects of this problem. It is the third of five volumes dealing with inflammation, the first two of which dealt with chemical messengers and cell biology.