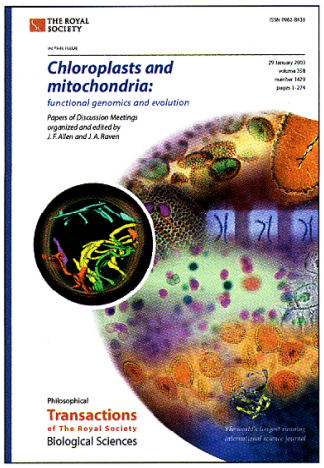

Chloroplasts and Mitochondria: Functional Genomics And Evolution — Philosophical Transactions of The Royal Society. Biological Sciences, Volume 358, number 1429

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Evolutionary biology attracts controversy and stimulates thought. In June 2002, The Royal Society held a Discussion Meeting on the evolution and functional genomics of chloroplasts and mitochondria. Clever polemicists pitted their wits against each other before an enthralled audience. The famous spats between T.H. Huxley and Bishop Wilberforce, as they fought over the implications of Darwin's founding thoughts on evolution, may have been a little more ferocious than the differing opinions expressed here, but not by much.

It is the difficulty in proving anything about events that happened 3 or 4 billion years ago that gives evolutionary biology its intellectual edge. It is an area where outrageous conjecture is permissible, indeed necessary, to set hypotheses that can then be tested by whatever means are available. Some proposals find support; others do not. Evolutionary biology depends on robust characters who are prepared to get it wrong.

The proceedings of the Royal Society's meeting, together with a sister meeting held by the Novartis Foundation on 'The molecular evolution of photosynthesis and respiration' are recorded in the January 2003 issue of the *Philosophical Transactions of the Royal Society*. This volume can't really be described as a book. It is the regular monthly edition of that erudite periodical (the world's longest running international science journal).

Moreover, most 'books' tend to give a potted, sanitized version of prevailing thought. This series of papers does not have that single edited train of thought running through it. Views on the evolution of mitochondria and chloroplasts do have substantial areas of agreed dogma. No one doubts, anymore, that they are relics of bacterial endosymbionts; the mitochondria deriving from an alpha-proteobacterium and the chloroplast from a photosynthetic cyanobacterium. It is not that long ago that these, now accepted, dogmas were themselves the subject of raging polemics. Plenty of room for disagreement remains on the absolute identity of the symbionts, the selective forces that drove the symbioses and the pressures that have shaped cells and their organelles since then.

The great thing about this volume is that not only are the presentations from the meeting presented as written papers, the discussion sections too have been recorded verbatim. The disagreements are all there. Unlike a regular volume, which may be read, and frequently taken at face value by the uninitiated reader, here, one is able to identify areas where agreement is lacking and to formulate one's own views.

One of the great divides in opinion is that relating to the selective pressures that led to the alpha-proteobacterial ancestor of the mitochondrion entering into an endosymbiotic relationship with another cell. This event, according to some well-argued cases, was the same event that led to the emergence of eukaryotic cells (although the identity of the other partner, related somehow to an archaebacterial prokaryote, remains contentious).

William Martin ('Hydrogen Bill') argues persuasively that the proto-mitochondrion emerged from an anaerobe in order to produce hydrogen required by its partner in a world whose atmosphere was in flux.

Siv Anderson also believes that a changing atmosphere drove the symbiotic union, although she posits that the mitochondrion arose to scavenge oxygen.

In either case, it is conjecture on events that occurred in response to prevailing geophysical conditions 3.8 billion years ago that drove the emergence of eukaryotic cells.

Martin's domination of the floor throughout the Royal Society meeting, with his unparalleled ability to draw on molecular, biochemical and geophysical data, is clearly reflected in his contributions to the published extracts from the discussions. His chapter, which tweaks the hydrogen hypothesis and also proposes a geophysical scheme to describe the emergence of cellular life is the most audacious in the volume.

However, Tom Cavalier-Smith, W.F. Doolittle and a variety of other proponents of different views have also waded in with some lively debate.

While evolutionary polemics became the central theme of the meeting, there are many key practical questions associated with our understanding of these organelles. Chloroplasts, for example, are central to the fixation of energy from sunlight and are therefore fundamental to life on earth. No wonder that there is a huge interest in how these organelles function, in unison with the rest of the cells in which they reside. Several papers cover the main aspects of organelle function.

Relic plastids, which have lost photosynthetic capacity, are also present in numerous organisms, including apicomplexan parasites such as those that cause malaria. The so-called apicoplast is essential to the parasites, thus providing a pharmaceutical dimension to these organelles as well.

The downside of having such a mix of facts and views is that it makes tough reading for the uninitiated. A skilled editor, who could sift through these highly personalized accounts and rationalize the facts that have gained common acceptance, while treating favoured conjecture for what it is, would produce a very fine, and much needed, monograph. So the strength of this volume, its eclectic mix of hard facts and prolonged conjecture, is also its weakness.

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