Movers and shakers

Motion Analysis of Living Cells
edited by David R. Soll and Deborah Wessels
Wiley: 1998. Pp. 298. £115, $150

Graham A. Dunn

Cell behaviour is suddenly a hot topic. Stimulated by the mapping of the human genome, cell biologists are searching for an equally systematic approach to assigning function to gene products, and the motion analysis of living cells is a promising candidate. A large part of a cell's active genome, coding for a vast complex of signalling and regulating agents, as well as for the components of the motile machinery itself, has a potentially measurable influence on cell motility.

Until now, the stumbling block in investigating these effects has been the technical difficulty of detecting and characterizing subtle changes in cell motility, but the analysis of cell motion has now found a fairy godmother. Computer-assisted microscopy has transformed it from a painstaking and tedious chore into an elegant method of data collection and analysis. This new volume, edited by David R. Soll and Deborah Wessels, reveals the recent upsurge of ever more sophisticated ways of characterizing cell behaviour and gives a glimpse into their often stunning visual appeal. After years of obscurity and neglect, Cinderella has finally been invited to the Cell Biology Ball.

The coverage of this multi-author work is very broad, ranging from bacterial chemotaxis and actin-based propulsion of bacterial pathogens to neural crest migration, growth-cone motility and tumour metastasis. Indeed, the topics are so disparate that it is difficult to discern a common thread. Even the theme of motion analysis indicated by the title has not been adhered to by all of the authors, although there is certainly enough of this to make the book a valuable source of methods for quantifying many aspects of cell motility.

The editors' own contributions on the motile dynamics of *Dictyostelium* amoebae reveal the amazing wealth of quantitative detail that can now be extracted from moving cells by computer-assisted microscopy. One table lists 400 numbers that were generated by the movement of a single amoeba during three minutes! This would have pleased Lord Kelvin, who once said that if one cannot reduce one's knowledge of the natural world to numbers then it is of a meagre and unsatisfactory kind. It is a shame he is no longer around to interpret them.

When the ball is over and the glittering coach turns once again into a pumpkin, Prince Charming must discover whose foot will fit into the glass slipper. Few of the techniques described have sufficient scope to qualify as general approaches, and only one paper tackles the important problem of analysing the movement of cultured vertebrate cells. These cells are often so thinly spread in culture that their automatic recognition by computer presents a particular challenge, and the authors have developed a sophisticated, semi-automated procedure for detecting cell contours. If I were less modest, I would draw their attention to a fully automatic and intrinsically more accurate approach, based on phase-shifting interference microscopy, that has been in routine use in my own laboratory for several years.

The main argument for developing fully automated methods is that the immense diversity presented by cultured vertebrate cells, even if derived from a single clone, dictates that around a hundred or more cells must be recorded over many hours to detect a subtle experimental effect. Even semi-automated methods can soon become wearisome when dealing with the many thousands of cell outlines generated in a single experiment.

Although the automated analysis of cell behaviour is still very much in its infancy, it is clear from these pages that it is already beginning to make an impact at the core of cell research. Moreover, I suspect that it will soon make a much more profound contribution to our knowledge, not only of how cells move, but of how they communicate with each other, respond to their environment and generally cooperate to build and maintain whole organisms. More distant applications may even include routine clinical screening and diagnosis. In time, this book may well be seen as a herald of a new era in cell biology. □

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Breaking the law

Maxwell's Demon: Why Warmth Disperses and Time Passes
by Hans Christian von Baeyer
Random House: 1998. Pp. 185. $25

Peter T. Landsberg

Adolf von Baeyer won a Nobel prize for chemistry in 1905 for his work on organic dyes and hydroaromatic compounds. His name, this book tells us, appears alongside those of other luminaries of science on a plaque outside the headquarters of the German Physical Society in the former East Berlin.

His great-grandson, Hans Christian von Baeyer, spends his summers in Paris engaged in the "*vulgarisation de la science*". Here he has written for the general reader a popularized introduction to thermodynamics, the second half of which gives the life history, so far, of a 'demon'. This amusing creature was introduced by James Clerk Maxwell but was named by Lord Kelvin. They thought it could help to violate the second law of thermodynamics, by sorting out the fast molecules in a gas from the slow ones to produce a temperature difference in a gas that was previously at a uniform temperature.

Von Baeyer discusses the ups and downs of the demon's life, pointing out that it was thought to have been 'killed' (on paper only, of course) several times, only to emerge again with a new trick up its sleeve. Perhaps it might have been emphasized more that the second law is in fact valid in the domain of macroscopic physics, whatever manipulations one imagines to be carried out with atoms. In the course of the story, entropy and probability theory are also discussed.

This is an enjoyable book that is easy to read. Much of the history of thermodynamics related by von Baeyer is familiar, and one would not expect much novelty in this area. But the story is skilfully put together: von Baeyer has read widely, and discusses very fully Richard Feynman's ratchet-and-pawl device for possibly breaking the second law. Perhaps he misses the odd trick by not mentioning that the demon has also entered recent discussions on quantum computing. Occasionally one may question his judgement, for example when he introduces a parable in chapter 8 that does not seem to add much to the story.

The law of conservation of energy is "as close to an absolute truth as our uncertain age will permit". Well put! But readers may recall the uncertainty principle, which allows energy to be 'borrowed', breaking conservation, if this is done for a short enough time. □

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