Developmental controversy

Cell Cycle and Cell Differentiation. (Results and Problems in Cell Differentiation: a Series of Topical Volumes in Developmental Biology, Volume 7.) Edited by J. Reinert amd H. Holtzer. Pp. xiii+331. (Springer: Berlin and New York, 1975.) DM69; $29.50.

As editors of Cell *Cycle and Cell Differentiation.* Reinert and Holtzer have put together chapters on some of the currently most interesting topics in developmental biology. This monograph can be roughly divided into two parts: the first four chapters deal with different cell types whose differentiation depends on a critical stage in the cell cycle, the remaining chapters either equivocally touch on the dependence of differentiation on the cell cycle itself, or argue that it may be irrelevant to differentiation.

The book begins with a chapter on myogenesis by S. R. Dienstman and H. Holtzer, the latter being currently one of the most prominent protagonists of the idea of the 'quantal cell cycle' as a key to understanding cellular differentiation. The next three chapters also echo the same theme of coupling of cell division or cell cycle to the differentiation of erythroid cells (H. Weintraub), of neuronal specificity (R. K. Hunt) and neurogenesis (C. H. Phelps and E. Pfeiffer). Those authors by and large agree with Holtzer's concepts but also urge caution before all the conclusions regarding lineage-dependence of differentiation are definitively accepted. The question of the mechanism of quantal cell cycle is however left unanswered, nor is it clear if such a cycle plays a 'causal' or a 'permissive' role in the expression of a developmental programme.

R. C. King gives a good account of the exploitation of genetics and hormones (particularly ecdysone) in evaluating the role of cell division during oogenesis in *Drosophila,* but avoids a clearcut conclusion about the causal role for the cell cycle or cell division. The book then takes a major turn with two short chapters by P. Lawrence and J. B. Gurdon who come out against quantal mitosis as essential for differentiation. Lawrence uses his work on pattern formation in larval and adult cuticle development in the insect, *Oncopeltus,* a process regulated by juvenile hormone, to argue that whereas asymmetric cell divisions may generate diversity it is not certain that symmetric mitosis leads to differentiation of daughter cells. Gurdon turns to his group's work on nuclear transplantation to argue that cell division is not essential for all differentiative processes. He proposes that what may be important is cyclic condensation and swelling of chromosomes; the latter would pick-up a new set of cytoplasmic regulatory proteins during their postmitotic decondensation. It seems to me that there is room for Holtzer's quantal cell cycle idea as well as those of Lawrence's and Gurdon's and that these need not be mutually exclusive.

Four chapters depict the importance of studying differentiation in simpler organisms before attempting to interpret the more complex phenomena of animal cells. These include morphogenesis in the prokaryote, *Caulobacter* (N. B. Wood and L. Shapiro), plants in general (F. Meins, Jr), plant tumour formation as a differentiative process (A. C. Braun) and cell differentiation in *Neurospora* (R. E. Nelson, C. P. Selitrennikoff and R. W. Siegel). None of the authors of these chapters provide strong evidence for or against the idea of a quantal cell cycle as the basis of cell differentiation and hint that many morphogenetic changes can be dissociated from growth and cell division. Meins, after discussing mathematical analysis of several well known plant differentiative kinetic models, emphasises the well-known totipotency of differentiated plant cells which strongly suggests that cytodifferentiation results from epigenetic rather than permanent genetic modifications. Tsanev takes the reader back to animal cells with a detailed and fresh analysis of the very complex changes associated with hepatic regeneration, a very popular model for temporal analysis of functional changes and DNA synthesis but one which does not clarify the role of the cell cycle in differentiation and goes on to suggest that one should separately consider the activities of 'tissue-specific' and 'mitotic' genes. Th.W. Borun makes a plea for considering histones as important for early cell differentiation and not to regard them merely as 'glue' for keeping inactive genes repressed. He distinguishes the simple multiplicity of histones from the micro-heterogeneity generated by their phosphorylation, acetylation and methylation particularly of histones.

For students of developmental biology, *Cell Cycle and Cell Differentiation* will be most valuable for bringing together views of some of the most original workers in this field, but the controversy it generates about the essential role of quantal cell division may be more apparent than real. The monograph once again shows how far we still are from, or even how futile it may be to search for, a unified hypothesis for the oldest unsolved problem of biology.

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