

Contents

Preface	v
Introduction: the problem and its importance	1
1 The evolutionary significance of differentiation	4
1.1 The origins of differentiation	4
1.2 Stem cells and loss of plasticity	15
1.3 Cellular senescence and dedifferentiation	18
1.4 Evolution of differentiation at the molecular level	19
1.5 Gene duplication in evolution and differentiation	31
2 Differential gene expression	34
2.1 How do cellular differences arise during normal embryonic development, or in the growth of organisms from single cells?	35
2.2 Following early development, are all adult tissues committed cell populations only ever expressing some genes and not others in their cells? When new proteins appear in response to changes in the environment are they due to development of new lines of cells from stem cells?	42
2.3 Given that populations of differentiated cells can alter their expression, does this necessarily involve cell division?	49
2.4 If changes in gene expression occur between divisions, how are they controlled? Such changes are normally viewed at the level of the protein product. Are these changes transcriptional or post-transcriptional?	59
3 Control mechanisms in gene expression	63
3.1 Transcriptional control and alterations in gene frequency	63
3.2 Post-transcriptional control	96
4 The cytoplasm in differentiation	103
4.1 Modification of nuclear gene activity by cytoplasmic molecules	106
4.2 Pre-existing cytoplasmic structures which are necessary for the synthesis of new structures	109

4.3 Heterokaryons and nuclear transplants	112
4.4 Cytoplasmic DNA	119
5 The role of hormones	134
5.1 Pheromones	135
5.2 Hormone-like substances exchanged between species	135
5.3 Vertebrate steroid hormones	136
5.4 Vertebrate non-steroid hormones	137
5.5 Neurosecretory hormones	142
5.6 Insect hormones	144
5.7 Plant hormones	148
5.8 Chalcones	152
5.9 General comments	155
6 Episomes, viruses and abnormal genetic elements	156
6.1 Episomes and plasmids in bacteria	156
6.2 Virus infection and latency	159
6.3 Abnormal genetic elements	160
7 The cell surface and cell contact	163
7.1 Cell to cell contact	163
7.2 Cell movement	167
7.3 Cellular response to surface molecules	171
7.4 General comment	172
8 Controlled and uncontrolled differentiation	173
8.1 Gene expression in allophenic mice	173
8.2 Cancer and differentiation	176
8.3 Oncogenic viruses and cancer	180
8.4 Chemical interference with differentiation—the use of BUdR	185
9 Differentiation—The present perspective	188
9.1 Questions of special significance in the field of differentiation	190
9.2 Techniques and systems of special promise in the field of differentiation	191
References	193
Additional references	207
Index	209