

CONTENTS

PREFACE		v
INTRODUCTION		1
PART1	SUCCEEDING PHASES OF EVOLUTION	6
1.1	Metabolic Evolution	6
1.2	Macromolecular Evolution	10
1.3	Subcellular Evolution	12
1.4	Chromosomal Evolution	16
1.5	Genomic Evolution	18
1.6	Development Evolution	21
	The origins of development	22
1.7	Behavioural Evolution	25
	1.7.1 Origin of nervous systems and their influence on evolution	26
	The nerve net	26
	Reflex arcs	26
	The ganglionic nervous system	27
	The brain	28
	Selective pressures	29
	Behaviour and evolution	29
1.8	Conclusion	32
PART2	LEVELS OF EVOLUTION	35
2.1	Contemporary Comparative Evolution	35
	2.1.1 Evolution of resistance to toxic agents	37
	Bacteria	38
	Fungi	39
	Plants	40
	Insects	41
	Origins of resistance	43
	2.1.2 Domestication and breeding of plants and animals	45
	Plant domestication and breeding	46
	Animal domestication and breeding	50
	Hormonal change and artificial selection	54
	2.1.3 Conclusion	54
2.2	Evolution at the Species Level	57
	2.2.1 Apparent noncorrelation between protein and morphological evolution	58
	2.2.2 Evidence for developmental evolution	58
	2.2.3 Regulatory change in developmental evolution	60
	2.2.4 Structural and regulatory genes	61

2.2.5	Frequency of regulatory versus structural change	61
2.2.6	Regulatory changes in developmental genes	62
2.2.7	Adaptive significance of regulatory change	63
2.2.8	Location of genetic changes affecting regulation	64
2.2.9	Mechanisms of transcriptional control in animals	65
2.2.10	Transcriptional control in other organisms	69
2.2.11	DNA organisation and gene expression	70
2.2.12	Mechanisms for changing signal sequences of genes	70
2.2.13	Conclusion	73
2.3	Formation of Higher Categories	74
2.3.1	Prokaryotes	75
2.3.2	Plants	79
	Developmental patterns	80
	Developmental evolution	82
2.3.3	Animals	84
	Early embryogeny	85
	Cell lineages	86
	Cellular movement	87
	Induction	88
	Heterochrony	89
	Developmental switches	89
	Polarity and segmentation	90
	Homoeosis and evolution	92
2.3.4	Conclusion	93
PART3	MECHANISMS OF GENETIC CHANGE	96
3.1	Role of Mutation in Evolution	97
3.1.1	Rates of spontaneous mutation	97
3.1.2	Dampening of mutational expression	99
3.1.3	A test of buffering efficiency	101
3.1.4	Tests of evolutionary effectiveness of point mutation	101
3.2	Viral Evolution	104
3.3	Prokaryotic Evolution	108
3.3.1	Plasmids and transposons	108
3.3.2	Sequence substitution	109
3.3.3	Gene duplication	110
3.3.4	Point mutation	111
3.4	Eukaryotic Evolution	112
3.4.1	Role of intervening sequences	112
3.4.2	Gene conversion	116
3.4.3	Reverse transcription	117
3.4.4	Transposition	119
3.5	Conclusion	121

PART 4	THE EVOLUTIONARY POTENTIAL OF LIVING ORGANISMS	123
4.1	The Continuity of Evolution	123
4.2	Evolutionary Stasis	125
4.3	Criteria in Assessing Evolutionary Potential	126
4.4	Comparative Aspects	127
4.5	Evolutionary Assessment of the Major Phyla and Classes	128
4.5.1	Prokaryotes	128
4.5.2	Protista	133
	Algae	134
	Protozoa	134
4.5.3	Fungi	138
4.5.4	Plants	141
4.5.5	Invertebrates	145
4.5.6	Vertebrates	153
	Fishes	153
	Amphibians and reptiles	155
	Birds	156
	Mammals	159
	Vertebrate molecular genetics	161
4.6	Conclusion	164
4.6.1	The present status of evolution	165
4.6.2	Causes of decline in the progress of evolution	166
	GENERAL CONCLUSIONS	169
	GLOSSARY	172
	APPENDIX 1 THE GENETIC CODE FOR RNA	176
	APPENDIX 2 THE GEOLOGICAL TIME SCALE	177
	APPENDIX 3 THE KINGDOMS AND PHYLA OF ORGANISMS	178
	APPENDIX 4 THE CLASSES OF VERTEBRATES AND ORDERS OF MAMMALS	180
	REFERENCES	181
	INDEX	214