

Contents

Abbreviations

1. Genomic rearrangements in prokaryotes	1
Douglas E. Berg	
Introduction	1
Homologous Recombination and Genome Organization	1
Intermolecular recombination	3
Recombination between direct repeats	4
Unequal intermolecular crossing-over	4
Recombination between inverted repeats: 'permitted' and 'forbidden' chromosomal inversions	4
Homologous recombination and phase variation: <i>Neisseria gonorrhoeae</i> pilin genes	6
Site-specific Recombination	7
Integration and excision of phage λ	8
Resolution of transposition co-integrates	14
Site-specific recombination and <i>colE1</i> plasmid stability	15
Cre-loxP recombination: P1 lysogenization and plasmid maintenance	16
DNA inversion and phase variation	17
DNA excision and nitrogen fixation in cyanobacteria	20
DNA rearrangement that changes transcription specificity	20
Transposition	21
Overview	21
Transposition mechanisms	24
Insertion specificity	26
Consequences of intramolecular transposition	27
Regulation of transposition	28
Illegitimate Recombination	32
Rearrangements associated with DNA breakage	32
Deletions associated with initiation and termination of replication	34
Illegitimate recombination associated with direct and inverted repeats	35
Duplications and deletions in phage λ	40
	ix

Acknowledgements	43
References	43
2. Antigenic variation in African trypanosomes: genetic recombination and transcriptional control of VSG genes	51
Lex H.T. Van der Ploeg	
Introduction	51
African Trypanosomes and Immune-evasion	51
The cell surface coat and antigenic variation	52
Structure of the cell surface coat	53
The flagellar pocket	55
Ploidy, Life-cycle, and Chromosome Structure	55
Karyotype analysis	56
Karyotype variability	58
Chromosome and nuclear structure	58
DNA Recombinational Mechanisms in Differential VSG Gene Expression	60
Structure of expression sites	61
General description of antigenic switches	62
Antigenic switches as a result of VSG gene displacement at an active expression site	63
Antigenic switches resulting from differential transcriptional control of expression sites	67
Control of expression site switching	73
Identification of Transcriptional Initiation Sites	74
Discontinuous transcription and <i>trans</i> -splicing	74
Polygenic transcription of VSG gene expression sites by α -amanitin-insensitive RNA polymerases	77
Trypanosomes in the Insect Vector and Expression Site	
Transcriptional Control	80
Procyclic trypanosomes and DNA recombinational events	81
Metacyclic trypanosomes	82
Evolution of the VSG Gene Repertoire	83
Unequal sister chromatid exchange and retroposition	83
Segmental gene conversion	85
Concluding Remarks	85
Acknowledgements	85
References	85
3. DNA amplification in eukaryotes	99
George R. Stark, Michelle Debatisse, Geoffrey M. Wahl, and David M. Glover	
Introduction	99
Developmentally Regulated rDNA Amplification	100

rDNA amplification in ciliates	100
rDNA amplification in amphibian oocytes	101
Gene Amplification During the Development of Dipteran Flies	101
Cell division and polytenization during dipteran development	101
The distribution of replication origins in <i>Drosophila</i> chromosomes	103
Differential replication of DNA in polytene chromosomes	105
Amplification of single copy genes	107
Amplification of Genes Mediating Resistance to Toxic Agents in Whole Organisms	115
Amplification in Mammalian Cells in Culture	116
Amplification in drug-resistant cell lines	116
Multidrug resistance	116
Parameters of amplification	117
Amplification as an abnormal event	118
Mammalian Gene Amplification <i>In Vivo</i>	118
Amplification of oncogenes	118
Correlation of amplification with metastasis	120
General methods to detect or clone amplified genes	120
Stimulation of Amplification	121
Stimulation by exogenous agents	121
Amplificator cell lines	122
Amplification and other chromosomal abnormalities	123
Forms and Structures of Amplified DNA	123
Cytological manifestations: interrelationships of ECRs and DMs	123
Characterization of DMs	126
Characterization of ECRs	126
Novel joints in amplified DNA	127
Evolution of Amplified DNA	128
Preferential reamplification	128
Stability of amplified DNA	129
Mechanisms of Amplification in Mammalian Cells	129
Replication-driven mechanisms	130
Segregation-driven mechanisms	133
Prospects for the Future	136
References	138
Index	151