Contents

Contributors xv
Preface xix

1

The Centrosome and Parthenogenesis
Thomas Küntziger and Michel Bornens

I. Introduction 1
II. Toward a Functional Description of the Centrosome 2
III. The Centrosome Organelle versus Self-Assembled Centers 12
IV. Centrosome Reproduction and the Parthenogenetic Activity of the Centrosome 13
V. Conclusion 18
References 19

2

γ-Tubulin
Berl R. Oakley

I. Centrosomes and Microtubule Nucleation 27
II. γ-Tubulin and the Tubulin Superfamily of Proteins 30
III. Distribution of γ-Tubulin in Cells 33
IV. Studies of γ-Tubulin Function 39
V. γ-Tubulin and Microtubule Assembly: Current Knowledge and Unanswered Questions 45
VI. Concluding Remarks 49
References 49

3

γ-Tubulin Complexes and Their Role in Microtubule Nucleation
Ruwanthi N. Gunawardane, Sofia B. Lizarraga, Christiane Wiese, Andrew Wilde, and Yixian Zheng

I. Introduction 55
II. Biochemical and Structural Studies of γTuRC and γTuSC 57
III. Evidence That γTuRC Is the Major Microtubule Nucleator at the Centrosome 64
IV. The Mechanism of Microtubule Nucleation 65
V. Concluding Remarks 69
References 70

4

γ-Tubulin of Budding Yeast
Jackie Vogel and Michael Snyder

I. Introduction 75
II. Tubulins of Yeast 80
III. Interactions between Tubulins 88
IV. The γ-Tubulin Complex in Yeast 91
V. Future Directions 95
References 97

5

The Spindle Pole Body of Saccharomyces cerevisiae: Architecture and Assembly of the Core Components
Susan E. Francis and Trisha N. Davis

I. Introduction 105
II. SPB Duplication and Assembly of the Mitotic Spindle 106
III. Structure of the SPB 107
IV. SPB Core Components 109
V. Assembly of the Core SPB Components 122
VI. Transcriptional Regulation of Core SPB Components 123
VII. Homologs of Spindle Pole Components in Other Organisms 124
VIII. Future Directions 125
References 128

6

The Microtubule Organizing Centers of Schizosaccharomyces pombe
Iain M. Hagan and Janni Petersen

I. Introduction 133
II. Cytoplasmic Microtubule Organizing Centers 136
II. Comparative Structural, Molecular, and Functional Aspects of the
Dictyostelium discoideum Centrosome
Ralph Gräf, Nicole Brusis, Christine Daunderer, Ursula Euteneuer,
Andrea Hestermann, Manfred Schliwa, and Masahiro Ueda

I. Introduction 161
II. Comparative Morphology of the Dictyostelium Centrosome 163
III. Comparative Analysis of Dictyostelium Centrosome Duplication 167
IV. Comparative Molecular Biology of the Dictyostelium Centrosome 171
V. Conclusions 179
   References 179

Are There Nucleic Acids in the Centrosome?
Wallace F. Marshall and Joel L. Rosenbaum

I. Introduction 187
II. Do Centrioles or Centrosomes Contain DNA? 188
III. Do Centrosomes Contain RNA? 197
IV. Conclusions 201
   References 202

Basal Bodies and Centrioles: Their Function and Structure
Andrea M. Preble, Thomas M. Giddings, Jr., and Susan K. Dutcher

I. Introduction to Centrioles and Basal Bodies 207
II. The Structure of Centrioles and Basal Bodies 212
III. The Function of Basal Bodies and Centrioles as Revealed by
    Mutational Analysis 221
IV. Basal Body/Centriole Replication 226
   References 228
10

Centriole Duplication and Maturation in Animal Cells
B. M. H. Lange, A. J. Faragher, P. March, and K. Gull

I. Overview 235
II. Centriole Lineage Patterns 236
III. Structural Features of Centriole Maturation and Duplication 236
IV. Centriolar Duplication, Maturation, and the Cell Cycle 239
V. Centriolar Maturation and Centriolar Function 242
VI. Ciliogenesis and Cell Cycle 244
VII. Future Developments and Directions 245
References 245

11

Centrosome Replication in Somatic Cells: The Significance of the G1 Phase
Ron Balczon

I. Introduction 251
II. The Cell Cycle in Somatic Mammalian Cells 251
III. Electron Microscopic Descriptions of Centrosome Doubling, and the Cellular Events of Centrosome Replication 252
IV. Spindle Pole Body Doubling in Yeast Cells 255
V. Events in G1 That Trigger Centrosome Replication in Somatic Mammalian Cells 260
VI. Summary 263
References 264

12

The Coordination of Centrosome Reproduction with Nuclear Events during the Cell Cycle
Greenfield Sluder and Edward H. Hinchcliffe

I. Introduction 267
II. The Events of Centrosome Reproduction 269
III. Controls for Centrosome Reproduction 271
IV. Coordination of Centrosome Reproduction with Nuclear Events in the Cell Cycle 276
References 286
Regulating Centrosomes by Protein Phosphorylation
Andrew M. Fry, Thibault Mayor, and Erich A. Nigg

I. Introduction 291
II. Protein Phosphorylation: A Major Theme in Cell Cycle Control 292
III. Centrosome and Spindle Pole Body Dynamics through the Cell Cycle 294
IV. In Control of Centrosome Duplication 295
V. Regulating Microtubule Nucleation 298
VI. Establishing a Bipolar Mitotic Spindle 300
VII. Creating the Zygotic Centrosome 305
VIII. Loss of Phosphorylation Control: Cancer Implications 306
IX. Perspectives: Into the Next Millennium 308
References 309

The Role of the Centrosome in the Development of Malignant Tumors
Wilma L. Lingle and Jeffrey L. Salisbury

I. Introduction 313
II. Centrosome Defects and Abnormal Mitoses in Cancer 316
III. Amplified Centrosomes and Aneuploidy 317
IV. Excess Pericentriolar Material Is Associated with High Frequency of Abnormal Mitoses 319
V. Centrosome-Associated Kinases and Cancer 320
VI. Tumor Suppressor Proteins and the Centrosome 321
VII. Maintenance of Cell and Tissue Polarity Minimizes Tumor Aggression in Model Systems 324
VIII. Conclusions 325
References 326

The Centrosome-Associated Aurora/Ipl-like Kinase Family
T. M. Goepfert and B. R. Brinkley

I. Introduction 331
II. The Aurora and Ipl-like Family: Structure, Regulation, and Substrates 333
III. Summary 339
References 340
16

Centrosome Reduction during Mammalian Spermiogenesis
G. Manandhar, C. Simerly, and G. Schatten

I. Introduction 343
II. Overview of Mammalian Spermiogenesis 345
III. Stages of Centrosome Reduction during Spermiogenesis 347
IV. Conclusions 358
   References 358

17

The Centrosome of the Early C. elegans Embryo: Inheritance, Assembly, Replication, and Developmental Roles
Kevin F. O'Connell

I. Why C. elegans? 365
II. Origin and Replication of the Zygotic Centrosomes 367
III. The Central Role of the Centrosome–Pronucleus Complex in Specifying AP Polarity 374
IV. Nuclear Positioning 378
V. Concluding Remarks 380
   References 381

18

The Centrosome in Drosophila Oocyte Development
Timothy L. Megraw and Thomas C. Kaufman

I. Introduction 385
II. The Germarium: Centrosomes Are Anchored to Achieve Polarized Cell Divisions 387
III. The Oocyte MTOC 391
IV. Meiosis 396
V. Summary 400
   References 402

19

The Centrosome in Early Drosophila Embryogenesis
W. F. Rothwell and W. Sullivan

I. Introduction 410
II. Ultrastructure 412
Centrosome Maturation

Robert E. Palazzo, Jacalyn M. Vogel, Bradley J. Schnackenberg, Dawn R. Hull, and Xingyong Wu

I. Introduction 449
II. Centrosome Maturation 451
III. Centrosome Structure and Microtubule Nucleation Potential 453
IV. The Role of the Centriole 457
V. The Procentrosome 458
VI. Paternal versus Maternal Centrosomes 460
VII. Summary 462
    References 463

Index 471
Contents of Previous Volumes 485