

CONTENTS

Preface	xiii
1. Introduction	1
<i>Mark O.J. Olson</i>	
The Importance of the Nucleolus to the Cell	1
The Complexity of Ribosome Biogenesis	2
Advances in Our Understanding of the Nucleolus	4
A New Era for the Nucleolus	7
2. Nucleolar Ultrastructure in Vertebrates	10
<i>Wilhelm Mosgoeller</i>	
Historical Note—Introduction	10
Nucleolar Internal Morphology	11
Nucleolar Appearance Reflects Activity	12
Cytochemical Characterization	14
Structure Relates to Function?	15
Functional Interpretation of Nucleolar Components	17
Nucleolus in Human Sciences	18
3. The Nucleolar Ultrastructure in Yeast	21
<i>Isabelle Léger-Silvestre and Nicole Gas</i>	
Cryomethods Provide Insights into the Yeast	
Nucleolar Organization	22
The Yeast Nucleolus Resembles the Higher Eukaryotic Nucleolus	22
Dynamics of Assembly of the Yeast Nucleolus	25
The Nucleolus an Integrated Part of the Nucleus	26
4. Dynamics of Nucleolar Components	29
<i>Thierry Cheutin, Tom Misteli and Miroslav Dundr</i>	
Dynamics of Ribosomal RNA	30
Dynamics of the RNA Polymerase I Transcription Complex	31
Dynamics of Components of Pre-Ribosomal RNA Processing	
and Ribosome Assembly	33
Dynamics of Various Nucleolar Proteins	33
Trafficking to and through the Nucleolus	35
Implications of Nucleolar Dynamics	36
5. Behavior of the Nucleolus during Mitosis	41
<i>Danièle Hernandez-Verdun</i>	
Disassembly of Nucleolus at the Beginning of Mitosis	43
Nucleolus during Mitosis	46
Assembly of the Nucleolus at Exit of Mitosis	50
6. Structure and Organization of Vertebrate Ribosomal DNA	58
<i>James E. Sylvester, Iris L. Gonzalez and Edward B. Mougey</i>	
rDNA Gene Structure and Variation	60

7. The Structure of rDNA Chromatin	73
<i>José M. Sogo and Fritz Thoma</i>	
Approaching Chromatin Structure and Function with Psoralen	
Crosslinking and Restriction Enzymes	73
Chromatin Structure of the rDNA Intergenic Spacer	74
Two Different Classes of Chromatin Coexist in the 35S	
Coding Region	78
Regulation of rDNA Transcription	79
Replication of rDNA	80
Inheritance and Establishment of Chromatin and Transcription	
during Replication	81
HOT1 Dependent Recombination in rDNA	83
8. Ribosomal DNA Transcription in Mammals	88
<i>Alice Cavanaugh, Iwona Hirschler-Laszkiewicz</i>	
<i>and Lawrence I. Rothblum</i>	
General Background	89
rDNA Transcription	92
Formation of Preinitiation Complexes	109
Regulation of rDNA Transcription	110
9. Transcription of rDNA in the Yeast <i>Saccharomyces cerevisiae</i>	128
<i>Masayasu Nomura, Yasuhisa Nogi and Melanie Oakes</i>	
rDNA Structure and Cis-Elements	128
Pol I, Transcription Factors, and the Mechanism for rRNA	
Transcription Initiation	131
Regulation of rRNA Synthesis	138
Silencing of Pol II Transcription in rDNA	142
Nucleolar Structures and rRNA Transcription	145
10. Three-Dimensional Organization of rDNA and Transcription	154
<i>Dominique Ploton, Marie-Françoise O'Donohue, Thierry Cheutin,</i>	
<i>Adrien Beorchia, Hervé Kaplan and Marc Thiry</i>	
Organization of Actively Transcribed rDNA Genes	155
Relating rRNA Gene Transcription to Its in Situ Organization	
through a Three Dimensional Approach	157
Relating 47 S Pre-rRNA Synthesis to Nucleolar Compartments	
at the Ultrastructural Level	159
In Situ Organization of a Transcriptionally Active rRNA Gene:	
Toward a Model	160
Visualising Maturation of Pre-rRNA Transcripts	162
Three-Dimensional Visualisation of Pre-rRNAs Synthesis	
and Processing	162

11. Pre-Ribosomal RNA Processing in Multicellular Organisms	170
<i>Susan A. Gerbi and Anton V. Borovjagin</i>	
Internal Modifications: 2'-O-Methylation and Pseudouridylation	171
Addition of Ribosomal Proteins	171
Ribosomal RNA Processing	173
12. Pre-Ribosomal RNA Processing and Assembly in <i>Saccharomyces cerevisiae</i>: The Machine That Makes the Machine	199
<i>Hendrik A. Raue</i>	
Genetic Organization and Transcription of Yeast rRNA Genes	200
Modification of Precursor-rRNA: How and Why?	200
Pre-rRNA Processing	202
Cis-Acting Elements Required for Pre-rRNA Processing	204
The Processing/Assembly Machinery and Its Components	207
13. The snoRNPs and Related Machines: Ancient Devices That Mediate Maturation of rRNA and Other RNAs	223
<i>Edouard Bertrand and Maurille J. Fournier</i>	
Early History	224
More Recent Landmarks and Breakthroughs	225
snoRNP Structure and Function	225
C/D snoRNPs	225
H/ACA snoRNPs	229
The MRP snoRNP	230
What Roles Do the C/D and H/ACA snoRNPs Play in rRNA Cleavage?	230
Modification of rRNA and U6 snRNA by snoRNPs	231
Effects of the Nm and Y Modifications	232
Do Modifying snoRNPs Influence Other Aspects of Ribosome Synthesis?	232
When Do snoRNPs Act?	233
Related RNAs and RNPs	234
Archaeal Guide RNAs	234
Small Cajal Body RNAs (scaRNAs)	236
Telomerase RNA	237
Tissue-Specific, Imprinted snoRNAs	237
Just What Is a snoRNA, Anyway?	239
Biogenesis of snoRNPs	239
Synthesis of snoRNAs	239
snoRNP Assembly	240
Trafficking and Localization	243
Exploiting snoRNPs	245

14. Ribosomal Subunit Assembly	258
<i>Jesús de la Cruz, Dieter Kressler and Patrick Linder</i>	
Methods to Approach Ribosomal Subunit Assembly	259
Compilation of Trans-Acting Factors Involved	
in r-Subunit Assembly	263
From the Processosome to the Tollervey Model	271
The 66S Preribosomal Particles	276
Ribosomal Subunit Assembly in Higher Eukaryotes	279
15. Nuclear Export of Ribosomal Subunits	286
<i>Arlen W. Johnson</i>	
Export of the Large Subunit	287
Export to the Cytoplasm	290
Export of 40S Subunits	296
16. Proteomics of the Nucleolus	302
<i>Yun Wah Lam, Archa H. Fox, Anthony K.L. Leung, Jens S. Andersen, Matthias Mann and Angus I. Lamond</i>	
Isolation of Nucleoli	303
Separation of Nucleolar Proteins for MS Analysis	305
MS Analysis and Protein Identification	307
Validation of MS Data	309
Presentation and Publication of Data	310
17. Trafficking of Spliceosomal Small Nuclear RNAs	
 through the Nucleolus	315
<i>Thilo Sascha Lange</i>	
The Relationship between Spliceosomal RNAs and the Nucleolus	316
Mechanisms of Nucleolar Trafficking of Spliceosomal RNAs	320
18. Nontraditional Roles of the Nucleolus	329
<i>Mark O.J. Olson</i>	
Viral Components in the Nucleolus	329
Regulation of Tumor Suppressor and Oncogene Activities	332
Cell Cycle Regulation in Yeast	333
Signal Recognition Particle Assembly	334
Nucleolar Processing of RNA pol III Synthesized Transcripts	334
Tissue-Specific Expression of Small Nucleolar RNAs	335
Yeast as a Model System for Aging	336
Aging in Mammals	336
Index	343