

Contents

1 Introduction	1
Mathematical and physical principles of construction	5
The geometrical environment of a cell	6
Historical perspective	8
Choice of examples	12
2 Putting cells together	14
Curvatures and pressures	15
Combining two cells	18
The biology of the two-cell contact	20
Three cells	23
Four cells	25
Cells inside a rigid wall	28
Viscous resistance to cellular movement	32
Concentric plane arrays of cells	36
Extended plane compression models	36
3 The division of a surface	37
Proof that the average value of n must be 6	37
The exchange of sides resulting from mitosis	38
The steady state of a tissue	40
Equilibrium of the steady state	40
The diversity of cells	42
Departure from the steady state	43
Relationship of steady-state theory to observation	45
Polygons on a closed surface	46
Perimeter check	51
The polyhedral cell	52
4 The division of space	54
The problem of intrusive growth	55

The Kelvin proofs	57
A working hypothesis for mitosis in polyhedral cells	63
The mitotic cycle for polyhedral forms	64
The limits of extrapolation	65
Standards of observational accuracy	66
Analysis of data	67
Variability of polyhedral grade	68
Difficulties of volumetric measurement	69
Polyhedral cells at a surface	70
5 The faces of cells	73
Sides, edges, and vertices	73
The origins of new cell faces	74
An equation of equilibrium for cell faces	76
Face form and face area	76
Surface and volume in large polyhedra	79
A census of faces	81
Algebraic models for the generation of cell-face frequencies	82
The allocation of faces to cells	86
The significance of extreme polygons	88
6 The geometry of differentiation	90
Examples of wave propagation	98
Wave dynamics in tissues	108
7 Structural analysis of complex tissues	114
Contact diversity in the steady state	117
Idioblastic classification of cells	120
Examples of cellular interaction	124
A system of intercellular exchange	126
A worked example in taxonomy	134
Envoi	139
<i>References</i>	142
<i>Index</i>	147