

Contents

Foreword	ix
Preface: Summary of the Symposium	1
The Significance of Fractals for Biology and Medicine. An Introduction and Summary <i>Ewald R. Weibel</i>	2
Fractal Geometry and Biomedical Sciences	7
A Fractal's Lacunarity, and how it can be Tuned and Measured <i>Benoit B. Mandelbrot</i>	8
Spatial and Temporal Fractal Patterns in Cell and Molecular Biology <i>Theo F. Nonnenmacher</i>	22
Chaos, Noise and Biological Data <i>Bruce J. West, W. Zhang and H.J. Mackey</i>	38
Fractal Landscapes in Physiology & Medicine: Long-Range Correlations in DNA Sequences and Heart Rate Intervals <i>C.-K. Peng, S.V. Buldyrev, J.M. Hausdorff, S.Havlin, J.E.M.Mietus, M. Simons, H.E. Stanley, and A.L. Goldberger</i>	55
Fractals in Biological Design and Morphogenesis	67
Design of Biological Organisms and Fractal Geometry <i>Ewald R. Weibel</i>	68
Fractal and Non-Fractal Growth of Biological Cell Systems <i>Petre Tautu</i>	86
Evolutionary Meaning, Functions and Morphogenesis of Branching Structures in Biology <i>Giuseppe Damiani</i>	104
Relationship Between the Branching Pattern of Airways and the Spatial Arrangement of Pulmonary Acini — A Re-Examination from a Fractal Point of View <i>Hiroko Kitaoka and Tohru Takahashi</i>	116
Multivariate Characterization of Blood Vessel Morphogenesis in the Avian Chorioallantoic Membrane (CAM): Cell Proliferation, Length Density and Fractal Dimension <i>Haymo Kurz, Jörg Wilting and Bodo Christ</i>	132
Phyllotaxis or Self-Similarity in Plant Morphogenesis <i>François Rothen</i>	141

Fractals in Molecular and Cell Biology	159
Evolutionary Interplay Between Spontaneous Mutation and Selection: Aleatoric Contributions of Molecular Reaction Mechanisms <i>Werner Arber</i>	160
Error Propagation Theory of Chemically Solid Phase Synthesized Oligonucleotides and DNA Sequences for Biomedical Application <i>Zeno Földes-Papp, Armin Herold, Hartmut Seliger and Albrecht K. Kleinschmidt</i>	165
Fractional Relaxation Equations for Protein Dynamics <i>Walter G. Glöckle and Theo F. Nonnenmacher</i>	174
Measuring Fractal Dimensions of Cell Contours: Practical Approaches and their Limitations <i>Gerd Baumann, Andreas Barth and Theo F. Nonnenmacher</i>	182
Fractal Properties of Pericellular Membrane from Lymphocytes and Leukemic Cells <i>Gabriele A. Losa</i>	190
Cellular Sociology: Parametrization of Spatial Relationships Based on Voronoi Diagram and Ulam Trees <i>Raphaël Marcellipoil, Franck Davoine and Michel Robert-Nicoud</i>	201
A Fractal Analysis of Morphological Differentiation of Spinal Cord Neurons in Cell Culture <i>Tom G. Smith, Jr. and E.A. Neale</i>	210
Fractal Dimensions and Dendritic Branching of Neurons in the Somatosensory Thalamus <i>Klaus-D. Kniffki, Matthias Pawlak and Christiane Vahle-Hinz</i>	221
Fractal Structure and Metabolic Functions	231
Organisms as Open Systems <i>Manfred Sernetz</i>	232
Transfer to and across Irregular Membranes Modelled by Fractal Geometry <i>Bernard Sapoval</i>	241
Scaling and Active Surface of Fractal Membranes <i>Ricardo Gutfraind and Bernard Sapoval</i>	251
Structure Formation in Excitable Media <i>Martin Lüneburg</i>	266
Colony Morphology of the Fungus <i>Aspergillus Oryzae</i> <i>Shu Matsuura and Sasuke Miyazima</i>	274

Estimation of the Correlation Dimension of All-Night Sleep EEG Data with a Personal Super Computer <i>Peter Achermann, Rolf Hartmann, Anton Gunzinger, Walter Guggenbühl, and Alexander A. Borbély</i>	283
Fractals in Pathology	291
Changes in Fractal Dimension of Trabecular Bone in Osteoporosis: A Preliminary Study <i>C.L. Benhamou, R. Harba, E. Lespessailles G. Jacquet, D. Tourliere and R. Jennane</i>	292
Use of the Fractal Dimension to Characterize the Structure of Cancellous Bone in Radiographs of the Proximal Femur <i>Curtis B. Caldwell, John Rosson, James Surowiak and Trevor Hearn</i>	300
Distribution of Local-Connected Fractal Dimension and the Degree of Liver Fattiness from Ultrasound <i>Carl J.G. Evertsz, C. Zahlten, H.-O. Peitgen, I. Zuna, and G. van Kaick</i>	307
Fractal Dimension as a Characterisation Parameter of Premalignant and Malignant Epithelial Lesions of the Floor of the Mouth <i>Gabriel Landini and John W. Rippin</i>	315
Modelling	323
Modelling HIV/AIDS Dynamics <i>Philippe Blanchard</i>	324
Morphological Diagnosis Turns from Gestalt to Geometry <i>Vittorio Pesce Delfino, Teresa Lettini, Michele Troia, and Eligio Vacca</i> ...	331
Fluorescence Recovery after Photobleaching Studied by Total Internal Reflection Microscopy: An Experimental System for Studies on Living Cells in Culture <i>Torsten Mattfeldt, Theo F. Nonnenmacher, Armin Lambacher, Walter G. Glöckle and Otto Haferkamp</i>	351
Anomalous Diffusion and Angle-Dependency in the Theory of Fluorescence Recovery after Photobleaching <i>Walter G. Glöckle, Torsten Mattfeldt, and Theo F. Nonnenmacher</i>	363
List of Speakers	373
List of Participants	376
Index	382