

# Contents

- Introduction ..... 1
- 1 Historical Survey ..... 3
  - 1.1 The Age of Myths ..... 3
  - 1.2 The Middle Ages ..... 6
  - 1.3 Recent Times ..... 9
  - 1.4 The Problem of Defining “Life” ..... 12
  - References ..... 16
- 2 The Cosmos, the Solar System and the Primeval Earth ..... 17
  - 2.1 Cosmological Theories ..... 17
  - 2.2 Formation of the Bioelements ..... 21
  - 2.3 The Formation of the Solar System ..... 23
  - 2.4 The Formation of the Earth ..... 26
  - 2.5 The Primeval Earth Atmosphere ..... 31
  - 2.6 The Primeval Ocean (the Hydrosphere) ..... 36
  - References ..... 39
- 3 From the Planets to Interstellar Matter ..... 43
  - 3.1 Planets and Satellites ..... 43
    - 3.1.1 Mercury ..... 43
    - 3.1.2 Venus ..... 44
    - 3.1.3 Mars ..... 45
    - 3.1.4 Jupiter ..... 47
    - 3.1.5 Jupiter’s Moons ..... 48
    - 3.1.6 Saturn and Its Moon Titan ..... 53
    - 3.1.7 Uranus and Neptune ..... 57
    - 3.1.8 The Dwarf Planet Pluto and Its Moon, Charon ..... 58
  - 3.2 Comets ..... 59
    - 3.2.1 The Origin of the Comets ..... 59
    - 3.2.2 The Structure of the Comets ..... 60

3.2.3	Halley's Comet	61
3.2.4	Comets and Biogenesis	62
3.3	Meteorites	65
3.3.1	The Classification of Meteorites	66
3.3.2	Carbonaceous Chondrites	67
3.3.3	Micrometeorites	71
3.4	Interstellar Matter	72
3.4.1	Interstellar Dust	73
3.4.2	Interstellar Gas	76
3.4.3	Interstellar Molecules	77
	References	81
<b>4</b>	<b>"Chemical Evolution"</b>	<b>87</b>
4.1	The Miller–Urey Model Experiments	87
4.2	Other Amino Acid Syntheses	89
4.3	Prebiotic Syntheses of Nucleobases	92
4.4	Carbohydrates and their Derivatives	100
4.5	Hydrogen Cyanide and its Derivatives	103
4.6	Energy Sources for Chemical Evolution	107
4.6.1	Energy from the Earth's Interior and from Volcanoes	108
4.6.2	UV Energy from the Sun	110
4.6.3	High-Energy Radiation	111
4.6.4	Electrical Discharges	112
4.6.5	Shock Waves	113
4.7	The Role of the Phosphates	114
4.7.1	General Considerations	114
4.7.2	Condensed Phosphates	116
4.7.3	Experiments on the "Phosphate Problem"	116
	References	122
<b>5</b>	<b>Peptides and Proteins: the "Protein World"</b>	<b>125</b>
5.1	Basic Considerations	125
5.2	Amino Acids and the Peptide Bond	125
5.3	Activation	127
5.3.1	Chemical Activation	127
5.3.2	Biological Activation	128
5.4	Simulation Experiments	130
5.4.1	Prebiotic Peptides	131
5.4.2	Prebiotic Proteins	138
5.5	New Developments	139
	References	143

<b>6</b>	<b>The “RNA World”</b>	145
6.1	Introduction	145
6.2	The Synthesis of Nucleosides	146
6.3	Nucleotide Synthesis	147
6.4	The Synthesis of Oligonucleotides	150
6.5	Ribozymes	162
6.6	Criticism and Discussion of the “RNA World”	165
6.7	The “Pre-RNA World”	167
	References	178
<b>7</b>	<b>Other Theories and Hypotheses</b>	181
7.1	Inorganic Systems	181
7.2	Hydrothermal Systems	185
7.2.1	Introduction	185
7.2.2	Geological Background	186
7.2.3	Syntheses at Hydrothermal Vents	188
7.2.4	Other Opinions	190
7.2.5	Reactions under Supercritical Conditions	191
7.2.6	Fischer-Tropsch Type Reactions	192
7.3	The Chemoautotrophic Origin of Life	193
7.4	De Duve’s “Thioester World”	204
7.5	Prebiotic Reactions at Low Temperatures	208
7.6	Atomic Carbon in Minerals	210
	References	211
<b>8</b>	<b>The Genetic Code and Other Theories</b>	215
8.1	The Term “Information”	215
8.2	The Genetic Code	216
8.3	Eigen’s Biogenesis Theory	222
8.4	Kuhn’s Biogenesis Models	227
8.5	Dyson’s “Origins” of Life	231
8.6	The Chemoton Model	235
	References	235
<b>9</b>	<b>Basic Phenomena</b>	237
9.1	Thermodynamics and Biogenesis	237
9.2	The Thermodynamics of Irreversible Systems	240
9.3	Self-Organisation	243
9.4	The Chirality Problem	247
	References	254
<b>10</b>	<b>Primeval Cells and Cell Models</b>	257
10.1	Palaeontological Findings	257
10.2	The Problem of Model Cells	263
10.2.1	Some Introductory Remarks	264
10.2.2	The Historical Background	266

10.2.3 New Developments .....	266
10.3 The Tree of Life .....	273
References .....	280
<b>11 Exo/Astrobiology and Other Related Subjects .....</b>	<b>283</b>
11.1 Extraterrestrial Life .....	284
11.1.1 Life in Our Solar System .....	284
11.1.2 Extrasolar Life .....	293
11.2 Artificial Life (AL or ALife) .....	306
11.3 The “When” Problem .....	308
References .....	310
<b>Epilogue .....</b>	<b>315</b>
<b>List of Abbreviations .....</b>	<b>317</b>
<b>Glossary of Terms .....</b>	<b>321</b>
<b>Index .....</b>	<b>327</b>



<http://www.springer.com/978-3-540-78822-5>

Chemical Evolution and the Origin of Life

Rauchfuss, H.

2008, XXIII, 339 p., Hardcover

ISBN: 978-3-540-78822-5