

Foreword 7

Preface 8

Introduction 17

I Origins

Abiogenesis 29

Symbiogenesis 34

Reproductive Functions 38

Life as Computation 43

Artificial Life 48

Thermodynamics 55

Dynamic Stability 62

Complexification 65

Virality 72

Compression 80

Embodiment 86

Daisyworld 88

Élan Vital 93

2 Survival

Being in Time 99

Batting Average 102

(No) Things in Themselves 106

Anthropic Principle 111

The *Umwelt* Within 113

Latent Variables 117

Modeling 120

Learning by Evolving 122

Cause by Effect 125

Goodness and Truth 127

Are Feelings Real? 130

INTERLUDE The Prehistory of Computation 134

3 Cybernetics

Love and War 155

Killer App 159

Behavior, Purpose,
and Teleology 163

Negative Feedback 169

How We Know Universals 175

Perceptrons 177

Deep Learning 185

Closing the Loop 188

4 Learning

Unkneading 195

Transfer 200

Green Screen 204

Grandmother Cell 209

Final Causes 213

Meathead 217

Neuromodulators 222

Bootstrapping 225

Beyond Reward 228

5 Other Minds

Forking Paths 235

Children of Time 238

Sphexish 242

Matryoshka Dolls 248

Intelligence Explosion 251

Crew of Eight 257

Homunculus 263

Illusion and Reality 267

6 Many Worlds

Au Revoir 271

Will What You Will 275

| | | | |
|----------------------------|-----|------------------------------------|-----|
| What It Is Like to Be | 281 | Babel Fish | 416 |
| Weird | 284 | Testament | 420 |
| Entanglement | 288 | Long Tails | 423 |
| Zombie-Free | 293 | In-Context Learning | 426 |
| Alters | 296 | Mary's Room | 434 |
| M-I-B | 299 | Parity Check | 442 |
| The Interpreter | 306 | As If | 451 |
| Multifractal Boundaries | 312 | | |
| 7 Ourselves | | INTERLUDE No Perfect | |
| Block Diagram | 317 | Heroes or Villains | 462 |
| Recurrence | 320 | | |
| Efference Copy | 324 | 10 Evolutionary Transition | |
| Phenomenality | 327 | Periodization | 469 |
| Blindsight | 333 | Transitions | 472 |
| Subbasement | 339 | Vulnerability | 476 |
| Neocortex | 342 | Pecking Order | 480 |
| Social Neuroscience | 345 | Economics | 483 |
| | | X-Risk | 491 |
| 8 Transformer | | Free Lunch | 494 |
| Language | 353 | Utility | 499 |
| Sequence to Sequence | 358 | Big Tent | 505 |
| Prediction Is All You Need | 362 | Limits to Growth | 511 |
| Semantic Cosmology | 366 | Tears of Joy | 518 |
| Alignment | 373 | Beyond Alignment | 524 |
| Attention | 376 | | |
| But Is It Neuroscience? | 381 | <i>Acknowledgments</i> | 530 |
| No Introspection | 387 | <i>About the Author</i> | 534 |
| Step by Step | 391 | <i>The Antikythera Book Series</i> | 535 |
| | | <i>Glossary</i> | 538 |
| 9 Generality | | <i>Bibliography</i> | 553 |
| Single System | 399 | <i>Image Credits</i> | 597 |
| Hive Mind | 401 | <i>Index</i> | 599 |
| Modalities | 408 | | |
| Pure Speech | 412 | | |