

|  |       |
|--|-------|
| <i>List of Figures</i>   | xv    |
| <i>List of Tables</i>  | xvii  |
| <i>Preface</i>   | xix   |
| <i>Ethical considerations for this book</i>                            | xxvii |
| <br>   |       |
| 1 Thermodynamics and sociological fundamentals                         | 1     |
| 1.1 Thermodynamic basics   | 1     |
| 1.1.1 Interactions between matter                                      | 1     |
| 1.1.2 Feynman diagram representation of interactions                   | 5     |
| 1.1.3 Basic parameters of thermodynamic                                | 8     |
| 1.1.4 Equilibrium thermodynamic and non-equilibrium thermodynamic      | 12    |
| 1.1.5 Linear approximations for nonlinear nonequilibrium thermodynamic | 14    |
| 1.1.6 Van der Waals equation and phase transition                      | 19    |
| 1.1.7 Case study: Critical temperature of water                        | 22    |
| 1.1.8 Relationship between thermodynamic parameters                    | 24    |

|       |   |    |
|-------|---|----|
| 1.2   | Theories of sociology   | 25 |
| 1.2.1 | The influence of thermodynamic theory on the development of sociology                   | 25 |
| 1.2.2 | Levels of sociological research   | 29 |
| 1.3   | Combining thermodynamic with sociological theory  | 32 |
| 1.3.1 | Limitations of applying the laws of thermodynamic in society                            | 32 |
| 1.3.2 | Quantification of social parameters   | 35 |
|       | References  | 41 |
| 2     | Information processing and the formation of society                                     | 45 |
| 2.1   | Information and biological interaction  | 45 |
| 2.1.1 | What is information   | 45 |
| 2.1.2 | Information and cognition   | 49 |
| 2.1.3 | Case study: Bitcoin mining and energy consumption                                       | 52 |
| 2.1.4 | Information and interaction   | 54 |
| 2.2   | Neural networks and cognition   | 60 |
| 2.2.1 | A simple neural network model   | 60 |
| 2.2.2 | Neural network growth and cognition   | 62 |
| 2.2.3 | Asynchrony between physiological growth and cognitive growth                            | 64 |
| 2.2.4 | Division of cognitive development stages based on artificial neural network brain model | 64 |
| 2.3   | Interaction between neural networks   | 67 |
| 2.3.1 | Information exchange between neural networks from a thermodynamic perspective           | 67 |
| 2.3.2 | Cognition and interaction   | 71 |
| 2.3.3 | Two types of interactions   | 75 |
| 2.3.4 | Case study: Use Feynman diagram to represent the spread of virus                        | 77 |
| 2.4   | Cognition and the formation of society  | 78 |
| 2.4.1 | A society based on the same cognition   | 78 |

|       |  |     |
|-------|--|-----|
| 2.4.2 | Three different social system structures           | 80  |
| 2.4.3 | Interaction between different societies            | 82  |
| 2.4.4 | Case study: Cultural conflict in schools           | 86  |
| 2.4.5 | Case study: Vietnam war                            | 89  |
|       | References   | 91  |
| 3     | Interactions in the social systems                 | 93  |
| 3.1   | Interaction between individuals                    | 93  |
| 3.1.1 | Social interaction and gender interaction          | 93  |
| 3.1.2 | The impact of information technology on society    | 95  |
| 3.1.3 | Social interactions                                | 95  |
| 3.1.4 | Gender interaction                                 | 97  |
| 3.1.5 | Case study: Gender flow in East Asian countries    | 98  |
| 3.1.6 | Statistical mean of interaction                    | 100 |
| 3.2   | Gender nucleus in family atom                      | 102 |
| 3.2.1 | Gender relations                                   | 102 |
| 3.2.2 | The formation of basic social members              | 106 |
| 3.2.3 | Case study: Dynamics of African lions              | 108 |
| 3.3   | Family atoms                                       | 110 |
| 3.3.1 | Kinship  | 110 |
| 3.3.2 | Formation of family atom                           | 111 |
| 3.3.3 | Interaction between family atoms                   | 115 |
| 3.4   | Interaction between societies                      | 117 |
| 3.4.1 | Nation and society                                 | 117 |
| 3.4.2 | Relatively independent social thermodynamic system | 117 |
| 3.4.3 | Case study: Disintegration of the Soviet Union     | 118 |
| 3.4.4 | Interaction between social thermodynamic systems   | 121 |
| 3.5   | Interaction within different age groups            | 124 |
| 3.5.1 | Human cognitive growth and interaction             | 124 |
| 3.5.2 | Children interaction                               | 127 |

|       |  |     |
|-------|--|-----|
| 3.5.3 | Case study: Academic differences of students in the background of Chinese and Western cultures | 129 |
| 3.5.4 | Adult group interaction  | 131 |
| 3.5.5 | Interaction of the elderly   | 133 |
|       | References   | 135 |
| 4     | Thermodynamic parameters of biological systems   | 137 |
| 4.1   | Comparison of biological and thermodynamic systems   | 137 |
| 4.1.1 | Energy input and output  | 137 |
| 4.1.2 | Relationship between various thermodynamic parameters  | 140 |
| 4.1.3 | Information flow   | 142 |
| 4.2   | Energy production and consumption in biological systems  | 144 |
| 4.2.1 | Levels of energy generation  | 144 |
| 4.2.2 | Composition of social energy   | 146 |
| 4.2.3 | Case study: Comparison of energy consumption between dinosaur society and human society        | 149 |
| 4.3   | Social space   | 152 |
| 4.3.1 | The volume of matter and biological social space   | 152 |
| 4.3.2 | Case study: Different versions of the Internet improve social space                            | 157 |
| 4.4   | Pressure on biological systems   | 160 |
| 4.4.1 | Composition of social pressure   | 160 |
| 4.4.2 | Case study: Information force received by customers on Black Friday                            | 163 |
| 4.5   | Temperature and entropy of biological systems  | 166 |
| 4.5.1 | The meaning of social temperature and entropy  | 166 |
| 4.5.2 | Case study: The relationship between climate change and the development of social civilization | 171 |
|       | References   | 176 |
| 5     | Basic social thermodynamic equations   | 179 |
| 5.1   | Overview   | 179 |

|       |  |     |
|-------|--|-----|
| 5.1.1 | Fundamental laws of thermodynamic systems  | 179 |
| 5.1.2 | The applicability of the laws of thermodynamics<br>in social thermodynamic systems | 181 |
| 5.2   | Equation of state  | 183 |
| 5.2.1 | The PVT equation for social systems  | 183 |
| 5.2.2 | Estimation of parameters   | 185 |
| 5.2.3 | A few examples   | 190 |
| 5.2.4 | Case study: Social temperature of wolves and<br>population size limits             | 195 |
| 5.2.5 | Thermodynamic zeroth law and society   | 197 |
| 5.3   | The first law of thermodynamics  | 199 |
| 5.3.1 | Energy conservation and internal energy  | 199 |
| 5.3.2 | Changes to internal energy due to work   | 201 |
| 5.3.3 | Thermal capacity and enthalpy  | 203 |
| 5.3.4 | Case study: The impact of Ukrainian wheat on Egypt                                 | 212 |
| 5.3.5 | Reversible and adiabatic processes   | 214 |
| 5.3.6 | Carnot cycle   | 220 |
| 5.3.7 | Case study: Holiday effect   | 222 |
| 5.4   | The second law of thermodynamics   | 226 |
| 5.4.1 | The formulation of the second law of<br>thermodynamics                             | 226 |
| 5.4.2 | Entropy  | 228 |
| 5.4.3 | Entropy increase of balanced system  | 232 |
| 5.4.4 | Free energy  | 234 |
|       | References   | 235 |
| 6     | Social thermodynamic phase transitions   | 237 |
| 6.1   | Changes in the number of social individuals  | 237 |
| 6.1.1 | Social thermodynamic system with variable<br>number of individuals                 | 237 |
| 6.1.2 | Variable particle number thermodynamic equations                                   | 238 |
| 6.2   | Conditions for thermal equilibrium   | 244 |

|       |   |     |
|-------|---|-----|
| 6.2.1 | Criteria for entropy  | 244 |
| 6.2.2 | Free energy criterion   | 250 |
| 6.2.3 | Case study: The impact of industrialization on a small town                               | 253 |
| 6.3   | Phase equilibrium   | 263 |
| 6.3.1 | Phase diagram   | 263 |
| 6.3.2 | Three social states   | 265 |
| 6.3.3 | Critical temperature  | 267 |
| 6.3.4 | Actual isotherms  | 270 |
| 6.3.5 | Equilibrium phase transition  | 274 |
| 6.3.6 | Social thermodynamic system well below critical temperature                               | 276 |
| 6.3.7 | Case study: Critical temperature in Soviet society  | 279 |
| 6.4   | The impact of information technology development on social thermodynamic parameters       | 285 |
| 6.4.1 | The role of information technology  | 285 |
| 6.4.2 | Information technology and changes in social thermodynamic system status                  | 286 |
| 6.4.3 | Case study: The impact of information technology on traditional society                   | 287 |
|       | References  | 292 |
| 7     | Social-oriented society   | 293 |
| 7.1   | The origin of social-oriented society   | 293 |
| 7.1.1 | The effect of temperature on social types   | 293 |
| 7.1.2 | History   | 296 |
| 7.1.3 | Case study: Thermodynamic parameters of Hun society                                       | 300 |
| 7.1.4 | Modern social-oriented society  | 306 |
| 7.1.5 | Case study: Thermodynamic parameters of Ukraine before and after the annexation of Crimea | 309 |
| 7.2   | Interaction method  | 314 |
| 7.2.1 | Gender interaction in social-oriented society   | 314 |

|       |   |     |
|-------|---|-----|
| 7.2.2 | Social interaction in social-oriented society   | 316 |
| 7.2.3 | Case study: The interaction of social-oriented society from the perspective of classic literary works | 319 |
| 7.3   | The two states and development of social-oriented society.  | 320 |
| 7.3.1 | Gaseous state   | 320 |
| 7.3.2 | Liquid state  | 321 |
| 7.3.3 | Development of social-oriented society  | 322 |
|       | References  | 324 |
| 8     | Family-oriented society   | 325 |
| 8.1   | The origin and development of family-oriented society   | 325 |
| 8.1.1 | The influence of warm climate on the formation of family-oriented society                             | 325 |
| 8.1.2 | Early family-oriented society   | 327 |
| 8.1.3 | Case study: Hakka people in southern China  | 329 |
| 8.1.4 | Modern family-oriented society  | 335 |
| 8.1.5 | Case study: Thermodynamic parameters within a family  | 336 |
| 8.2   | Interaction   | 338 |
| 8.2.1 | Interaction within the family   | 338 |
| 8.2.2 | Social interaction  | 342 |
| 8.2.3 | Calculation of thermodynamic parameters   | 345 |
| 8.2.4 | Case study: Urban density comparison of Tokyo and London  | 350 |
| 8.3   | Three states of family-oriented society   | 354 |
| 8.3.1 | Gaseous family-oriented society   | 354 |
| 8.3.2 | Liquid family-oriented society  | 356 |
| 8.3.3 | Case study: Roma society in Europe  | 357 |
| 8.3.4 | Solid family society  | 363 |
|       | References  | 365 |
| 9     | Balanced society  | 367 |
| 9.1   | The origin and development of balanced society  | 367 |

|       |   |     |
|-------|---|-----|
| 9.1.1 | The family-oriented society of ancient Greece and Rome  | 367 |
| 9.1.2 | The emergence of balanced society   | 368 |
| 9.1.3 | Diverse society   | 369 |
| 9.1.4 | Social changes in the Internet era  | 370 |
| 9.2   | Interaction of balanced society   | 372 |
| 9.2.1 | The interaction between social individuals and family atoms   | 372 |
| 9.2.2 | Interaction between gender molecular and family atom  | 373 |
| 9.3   | The nature of interfaces between multiple societies   | 374 |
| 9.3.1 | Multiple types of social contacts   | 374 |
| 9.3.2 | Space energy region   | 375 |
| 9.3.3 | Case study: A quantitative analysis of the academic differences of students from Chinese and Western cultural Backgrounds | 378 |
| 9.4   | Types of balanced society   | 383 |
| 9.4.1 | Gaseous balanced society  | 383 |
| 9.4.2 | Liquid balanced society   | 384 |
| 9.4.3 | Mixed state of balanced society   | 385 |
| 9.5   | Climate change and human social development   | 386 |
| 9.5.1 | Trends in climate change since the birth of the earth   | 386 |
| 9.5.2 | Energy generated by human activities  | 388 |
| 9.5.3 | Effects of heat generated by human society on the atmosphere  | 392 |
| 9.5.4 | Greenhouse gas effects  | 393 |
| 9.5.5 | Social Thermodynamic Parameters of Global Human Society   | 394 |
| 9.5.6 | Impact of climate change on human society   | 396 |
|       | References  | 404 |



*Appendix I: Commonly used international system of units (SI) units* 405

*Appendix II: Constants* 407

*Appendix III: Parameters used in this book and their meaning* 409

*Appendix IV: Important formulas* 411