

## Index

- Achaemenid civilisation, 176
- altruism, 171, 171
- apical loops, 36, 79
- apicoplast, 144
- atomic structure, 9
- Avery, Oswald, vii, 10
- Babbage, Charles, 13, 121, 188
- bacteriophage, 78, 84, 113, 118, 188
- base-pair, 3
  - base-pairing rules, 5
  - Hoogsteen base-pairs, 56
  - informational unit, 34, 39
  - mRNA-tRNA, 29
  - pairing rules, 34
  - stacking interactions, 46
  - Watson-Crick base-pairs, 56, 101, 104
- Bateson, William, 178
- Bayes, Thomas, 17
  - Bayesian logic, 16, 25, 49, 51, 160, 184
- bee, 31
  - eusociality, 175
  - UV perception, 30
- bit, 32
- blue-green algae. *See* cyanobacteria
- Boltzmann, Ludwig, 1–2, 6, 10, 14, 21, 174, 191
  - Boltzmann constant, 27, 31
  - Boltzmann entropy, 27, 133
- Bombyx mori*, 148
- Brillouin, Louis, 6, 24
- bromodomain, 125
- Buchnera*, 130, 137, 139
- byte, 32
- Cambridge University Botanic Garden, 178
- cancer, 179
- cell types, 147
- Central Dogma, 4
- Chaisson, Eric, 9, 35, 177
- chaperones, 115
- Chargaff, Erwin, 54
- chloroplasts, 71, 89, 110, 118, 128–132, 156
- chlroplasts, 140–142
- cleaner fish, 139
- coacervates, 107, 125, 157, 161, 168
- codescript, 17, 20, 22, 24, 27, 29–52, 157, 169
  - evolution, 170, 174
- codon-anticodon interactions, 56, 101–102
- codon-anticodon pairing, 102
- coenzyme, 162, 164, 165, 169
- cofactors. *See* coenzymes
- compartmentalisation, 108, 125, 166–169
- complexity, viii, 1, 18, 22
  - definition, 8, 93
  - evolution, 8
  - hierarchy, 9, 43, 95
- Crick, Francis, viii, 3, 4, 54, 58
- cyanobacteria, 129, 133, 142, 144
- cytosine methylation, 125, 127, 150
- Darwin, Charles, 1, 2, 157, 160, 178
  - Darwin's finches, 140
  - Darwinian, 22
  - Darwinian evolution, 184
  - Darwinian theory, 174
  - natural selection, 155, 183
  - Xanthopan*, 179
- Darwinism, 2, 151
- Dawkins, Richard, 17, 135, 137, 152
- de Candolle, Augustin, 152
- decoder, 28–31, 49, 52
- dinoflagellates, 86, 131, 144
- dipole moment, 60
- dipteran, 148
- diversity, viii, 8, 18, 22, 35, 43, 93, 96, 120, 140, 144, 178
  - definition, 9
  - epigenetic diversity, 179
  - genetic diversity, 147, 179
  - genomic diversity, 172
- DNA, 3
  - 'double helix', 3
  - A-DNA, 57, 61, 185
  - alternative structures, 67–72
  - B-DNA, 58, 61, 77
  - chemical structure, 5
  - cruciforms, 72
  - DNA bubble, 65
  - DNA information, 56
  - DNA packaging, 53, 62, 71, 83–85
  - DNA supercoiling, 16, 62, 68
  - energy store, 16, 64
  - handedness, 65
  - H-DNA, 56

- DNA (cont.)
  - information carrier, vii
  - information content, 86
  - junk DNA, 121, 148–149, 153
  - repetitive, 56, 148
  - slipped loops, 72
  - topological domains, 67
  - Z-DNA, 72–73
- DNA bases
  - 5-methylcytosine, 5
  - hydroxymethyluracil, 5
  - N6-methyladenine, 5
- DNA gyrase, 66
- Dps, 71
- Echium*, 43
- Eddington, Arthur, 7
- energy flux, 5, 9, 173, 174
- energy rate density, 174
- entropy, vii, 6, 7, 8, 10, 13–14, 19–22, 24, 26, 26, 31, 39, 62, 81, 98, 103, 110, 114, 133, 144, 167, 190
- epigenetics, 50, 124
- eusocial, 174
- evolution
  - emergent events, 15, 44, 51, 83, 92, 130, 142, 154–155, 169
- fig, 144
- fig wasp, 144, 179
- gene, jumping, 127
- genetic code, 11
  - complexity, 167
  - degeneracy, 37
  - early evolution, 105
  - evolution, 48, 99–100, 102–103, 166
  - expansion, 109
  - information processing, 29
  - nature, 50
  - triplet assignment, 101
  - universality, 29
- genomic integration, 131
- green leaf volatiles. *See* volatile organic compounds
- Hadean era, 159
- Harrapan civilisation, 173
- helical repeat, 44, 46, 77, 83, 189
- Henslow, John Stevens, 178
- heterochromatin protein 126
- histone, 37, 50
  - histone octamer, 63
  - modification, 50
- hologenome, 128–133, 135, 137–140
- HP1. *See* heterochromatin protein 1
- hydrogenosomes, 141
- Hydrothermal vents, 158
- imprinting
  - genomic imprinting, 50
- information
  - analogue, 13, 44, 46, 57, 83, 130, 188
  - cultural, 175–177
  - digital, 13, 29, 34–36, 43–44, 45, 46, 50–52, 57, 60, 122, 184, 188, 191
  - information storage, 12, 32, 48, 84, 86, 96
- informative interaction, 32, 33, 40, 48
- intrinsically disordered polypeptides, 38, 107, 125, 167–168
- Jaynes, Edwin Thompson, 27, 52
- kin selection, 171, 175
- Lamarck, Jean-Baptiste, 2, 151, 152
- Lamarckian, 125, 177, 181
- Lamarckism, 2, 151, 176
- Landauer, Rolf, 24, 31–34
- Laplace, Pierre-Simon, 17
- Lego, 20, 24, 25, 39, 169
- Lewis, Gilbert, 13, 18, 39
- lichens, 128, 131–134
- Linaria vulgaris*, 150
- Linear A, 31, 34
- Linear B, 31
- linking number, 77, 190
- Lotka, Alfred, 1, 1, 5–6
- Luhmann, Niklas, 94
- Malthus, Thomas Robert, 152
- Manduca sexta*, 120
- Margulis, Lynn, 140
- Maxwell, James Clerk, 22, 24, 36
- Maxwell's demon, 22, 24, 31–32, 167
- Mayr, Ernst, 172
- meiosis, 56, 77, 145, 151, 181
- mitochondria, 29, 71, 89, 110, 128–132, 144–145, 156
- mitosis, 55, 77
- mitosomes, 141
- Mixotricha paradoxa*, 135, 137
- mobile genetic elements, 153
- modularity, 24, 123–124, 155–156, 166, 191
- mud-pot, 157
- murmuration, 171, 172
- mycorrhiza, 134, 138

## INDEX

211

- Na+. *See* sodium
- Na+/K+ ratio, 25
- negentropy, vii, 8, 14, 18, 24, 34, 48, 50, 191
- nucleoid, 64, 70, 80, 86, 108
- Nuragic civilisation, 179
- Oparin, Alexander, 157
- pangenome, 177
- Paris japonica*, 86, 89
- pH, 156
- phase separation, 105, 107, 109, 119, 157, 167
- phosphorylation, 112, 125
- photosynthesis, 98, 128, 142
  - efficiency, 155
- plectoneme, 36, 65, 68, 79
- polyploidy, 148
- potassium, 156, 158, 159, 189
- ppGpp, 116, 118
- Protopterus aethiopicus*, 89
- replication, 5, 15, 46, 53, 55–56, 63, 65, 69, 76, 78, 82–84, 86, 88, 91, 127, 146, 168–170, 178, 184, 187
- reverse gyrase, 55, 69, 185
- ribosome, 5, 14–15, 29, 105, 110, 113, 185
- RNA, 3
  - chemical structure, 5
  - processing, 50
  - ribosomal RNA, 187
- RNA bases
  - hydroxymethyluracil, 5
  - hypoxanthine, 102
  - inosine, 101
- RNA polymerase, 68, 70, 75, 79–80, 87, 105–111, 116–117, 129
- Rosa gallica*, 149
- Rosamund, Fair, 149
- Saccharomyces cerevisiae*, 81, 89
- Schrödinger, Erwin, vii–viii, 2, 6, 8, 11, 14, 17, 20, 24, 34, 50, 174, 183
- selenocysteine, 29, 102
- Shannon, Claude, vii, 13, 26, 28
  - Shannon entropy, 13, 21, 26, 27, 28, 35
- Simon, Herbert, 25
- smokers, 157, 158, 159
- sodium, 156, 158, 160
- Szilard, Leo, 30–31, 39
- Thermodynamics
  - Second Law, 6, 7, 22, 24, 32
- Thermus thermophilus*, 69
- topoisomerase, 62
- toroid, 37, 65, 166
- transposition, 50, 149–150
- transposon, 127
- twist, DNA
  - definition, 75
- variegation, 149
- VOCs. *See* volatile organic compounds
- volatile organic compounds, 120
- von Neumann, John, vii, 13–14, 26
- Wallace, Alfred, 2
- warm little pond, 155, 157
- Watson, James, viii, 3, 54, 58
- What is Life?, vii–viii, 14, 20, 154
- Wilson, Edmund Beecher, 108
- Wilson, Edward Osborne, 9, 175
- wobble base-pair, 98, 100
- Wood-Ljungdahl pathway, 162, 164
- wood-wide net. *See* mycorrhiza
- writhe, DNA, 65, 67–68, 74, 76, 78–81
  - definition, 75
- zooanthellae, 92, 138, 144