

Contents

1	Introduction	1
	References	8
2	The First Vertebrates, Jawless Fishes, the Agnathans	11
2.1	Ostracoderms	11
2.2	Marine or Freshwater Origins?	13
2.3	Feeding	16
2.4	Bone, a Chemical Store	16
2.5	Heterostraci	19
2.6	Osteostraci	23
	References	30
3	The Earliest Jawed Vertebrates, the Gnathostomes	33
3.1	The Evolution of Jaws	33
3.2	The Evolution of Paired Fins	37
3.3	Placoderms, Dominant Vertebrates of the Devonian	37
3.4	Evolutionary Significance of the Oldest Vertebrates: The Origin of Bone	42
3.4.1	Aspidin	43
3.4.2	Dentine	46
3.5	The Origin of Teeth	49
3.5.1	Genes and the Origin of Teeth—Dermal or Oral	50
3.6	Evolutionary Comments	54
	References	56
4	Evolution of Modern Fishes: Critical Biological Innovations	59
4.1	Chondrichthyes, Advanced Cartilaginous Fishes	61
4.1.1	Subclass: Elasmobranchii	61
4.1.2	Subclass: Holocephali	65
4.2	Osteichthyes, Advanced Bony Fishes: Teleostomes	66
4.2.1	Class: Acanthodii	66
4.2.2	Class: Actinopterygii	68
4.2.3	Subclass: Cladista	69
4.2.4	Subclass: Chondrostei	69

4.2.5	Subclass: Neopterygii	72
4.2.6	Class: Sarcopterygii.	74
4.3	Scales: Organization of the Integumentary Skeleton in Gnathostomes	77
4.4	Scales and Swimming Hydrodynamics.	81
4.5	Feeding in Fishes	84
4.6	Reception of External Mechanical Stimuli in Fishes	85
4.6.1	Lateral Line System	87
4.6.2	Electroreception	88
4.6.3	Function of Electroreception.	93
4.6.4	Electrocommunication	94
4.7	Hydrodynamics and Buoyancy in Fishes	94
	References	97
5	Tetrapods and the Invasion of Land	99
5.1	Global Environmental Changes	99
5.2	Tetrapods and Cladistics.	100
5.3	Paraphyletic Origins.	105
5.4	Descendents of the Sarcopterygian Fishes and the Move onto Land	108
5.5	The First Tetrapods	114
5.6	The Evolution of Terrestrial Vertebrate Locomotion	115
5.7	From Fins to Limbs.	117
5.8	The Problems of Breathing on Land	123
	References	126
6	Crucial Vertebrate Innovations	129
6.1	Best Foot Forward.	129
6.2	The Amniotic Egg.	131
6.3	The Reptile Integument	137
6.4	Scale Types	138
6.5	Temporal Openings and Classification of Reptiles.	146
	References	149
7	Dinosaur Integument	153
7.1	More than Skin Deep.	153
7.2	Organic Analysis of the Dinosaur Integument.	167
7.3	Dinosaur Eggs and Embryos.	169
7.4	The Dermis in Dinosaurs	176
7.5	Dinosaur Skin Modified as a Sail in Temperature Control?	180
7.6	Dinosaur Tracks and Traces	181
7.7	Pterosaurs.	189
	References	189

8 Mammal-Like Reptiles 193

8.1 In the Shadow of the Dinosaurs 193

8.2 Pelycosaurs 194

8.3 Therapsids 197

8.4 The Evolution of Hair 201

8.5 Cynodonts and the Origin of Modern-Day Mammals 205

8.6 The First Mammals 207

8.7 Mammals Emerge into the Light 210

References 218

9 Reptiles Return to the Sea 221

9.1 Problems of Developing Fresh Sea-Legs 221

9.2 A Serpent Threaded Through a Turtle 222

9.3 The Fastest of Them All 233

9.4 Last of the Great Marine Reptiles 236

9.4.1 Disease, Injuries, and Bone Repair in Mosasaurus Hoffmanni and Their Wider Implications 242

9.4.2 Mosasaur Integument 248

9.4.3 Extinction 251

References 252

Index 255