



An Introduction to the
Invertebrates

Second Edition

Janet Moore

CAMBRIDGE

Contents

<i>List of boxes</i>	page xi
<i>Preface</i>	xiii
<i>Acknowledgements</i>	xv
<i>Illustration acknowledgements</i>	xvii

Chapter 1	The process of evolution: natural selection	1
1.1	What was Darwin's theory of natural selection?	1
1.2	What was Mendel's theory of heredity?	2
1.3	What is the cellular basis of heredity?	3
1.4	What is the origin of genetic variation?	5
1.5	What is the nature of genes?	6
1.6	What is the role of chance in evolution?	6
1.7	At what level does natural selection act?	7
1.8	What in general does evolution produce?	7

Chapter 2	The pattern of evolution: methods of investigation	11
2.1	How should we classify animals?	11
2.2	How can we use morphology to trace phylogeny?	12
2.3	How can we use fossils to investigate phylogeny?	14
2.4	Can the fossil record date the earliest appearance of animals?	16
2.5	How can we use molecules to trace phylogeny?	18
2.6	Which molecules are used?	19
2.7	How is molecular information obtained?	20
2.8	How is molecular information processed?	20
2.9	How reliable is molecular taxonomy?	21
2.10	What is the present state of phylogenetic enquiry?	22

Chapter 3	Porifera	23
3.1	What are the distinguishing characters of sponges?	23
3.2	What different kinds of sponge are known?	25
3.3	How do sponges make a living?	26
3.4	What changes have evolved during sponge history?	28
3.5	How are sponges related to other phyla?	30
3.6	How have sponges become so successful?	31

Chapter 4	Cnidaria	32
4.1	Why do we regard Cnidaria as simple?	32
4.2	What kinds of Cnidaria are known?	34
4.3	How do Cnidaria make a living?	35
4.4	How has so much diversity been possible?	40

4.5	What is the ecological importance of coral reefs?	43
4.6	How are Cnidaria related to each other and to other phyla?	45
<hr/> Chapter 5 On being a worm		47
5.1	Why are there so many different kinds of worm?	47
5.2	How can muscles move a worm?	48
5.3	What worm phyla are known?	54
5.4	Do Ctenophora belong among the worms?	63
<hr/> Chapter 6 Platyhelminthes and Acoelomorpha		65
6.1	What is the body plan of the platyhelminths?	65
6.2	What groups of worms constitute the Platyhelminthes?	66
6.3	What are the Acoelomorpha?	67
6.4	What is specialised about modern platyhelminths?	69
6.5	How are platyhelminths related to each other?	73
6.6	How are platyhelminths related to other phyla?	73
<hr/> Chapter 7 Nemertea		75
7.1	What are the principal groups of nemertines?	77
7.2	How do nemertines resemble platyhelminths?	78
7.3	How do nemertines differ from platyhelminths?	78
7.4	What diversity exists among nemertines?	84
7.5	How do nemertines develop?	85
7.6	How are nemertines related to other phyla?	86
<hr/> Chapter 8 Nematoda		90
8.1	What are the distinctive characters of nematodes?	91
8.2	How are these characters related to the cuticle and fluid pressure?	91
8.3	How is the phylum subdivided?	95
8.4	Why are nematodes useful for developmental studies?	95
8.5	Why has <i>Caenorhabditis elegans</i> been studied so thoroughly?	96
8.6	How are nematodes related to other animals?	99
8.7	Conclusion	100
<hr/> Chapter 9 Annelida		101
9.1	What is an annelid?	102
9.2	What annelids are there?	104
9.3	What are the advantages of the coelom and of metamerism?	105
9.4	How does a coelom introduce complexity?	108
9.5	How do annelids reproduce and feed?	115

9.6	How are annelids related to each other?	117
9.7	How are annelids related to other phyla?	118

Chapter 10	Mollusca: general and Gastropoda	120
-------------------	---	-----

10.1	What is the basic molluscan body plan?	120
10.2	How can such an animal function?	121
10.3	What is the shell and how may it be used?	123
10.4	What are the main groups of molluscs?	125
10.5	What are the Aculifera?	125
10.6	What is unusual about the Monoplacophora?	126
Gastropoda		127
10.7	How is the molluscan body plan modified in gastropods?	127
10.8	How may gastropods feed?	130
10.9	Why are many gastropods hermaphrodites?	132
10.10	Conclusion	133

Chapter 11	Mollusca: Bivalvia and Cephalopoda	135
-------------------	---	-----

Bivalvia		135
11.1	How is the molluscan body plan modified in bivalves?	135
11.2	What is the range of bivalves?	135
11.3	How do bivalves feed?	137
11.4	What kinds of muscle are there in bivalves?	138
Scaphopoda		139
11.5	How is the molluscan body plan modified in Scaphopoda?	139
Cephalopoda		139
11.6	How is the molluscan body plan modified in Cephalopoda?	140
11.7	What Cephalopods are known?	140
11.8	How is <i>Nautilus</i> able to survive?	142
11.9	How have some cephalopods become so active?	144
11.10	What has limited the evolution of cephalopods?	151
11.11	What are the evolutionary relationships of molluscs?	152

Chapter 12	Arthropoda: general	153
-------------------	----------------------------	-----

12.1	What defines an arthropod?	154
12.2	What are the key features of arthropod cuticle?	154
12.3	How are arthropod internal cavities organised?	160
12.4	What makes possible the great activity of arthropods?	161
12.5	What are the closest relations of arthropods?	165

Chapter 13	Crustacea	168
-------------------	------------------	-----

13.1	What is distinctive about crustaceans?	168
13.2	What are the main kinds of crustacean?	169
13.3	How have crustaceans colonised fresh water and land?	171
13.4	What may limit the size of Crustacea?	177

13.5	What are the special features of parasitic crustaceans?	177
13.6	What is the role of crustacean larvae?	178
13.7	How are Crustacea related to each other?	180
<hr/>		
Chapter 14	Chelicerata and Myriapoda	181
Chelicerata		181
14.1	What are chelicerates?	181
14.2	Why is <i>Limulus</i> of special interest?	182
14.3	What are pycnogonids?	184
14.4	What are arachnids?	185
14.5	How did arachnids colonise the land?	186
Myriapoda		189
14.6	What are myriapods and how do they move?	189
14.7	How well are myriapods adapted to life on land?	191
<hr/>		
Chapter 15	Insecta	192
15.1	What is an insect?	192
15.2	Why are insects such successful land animals?	193
15.3	How are insects able to fly?	195
15.4	What is distinctive about insect life cycles?	201
15.5	What are the main orders of insects?	202
15.6	How could social behaviour have evolved?	209
15.7	Why has study of the fruit fly <i>Drosophila</i> been so important?	210
<hr/>		
Chapter 16	Animals with lophophores	213
16.1	What is a lophophore?	213
16.2	Which animals have lophophores?	213
16.3	Are animals with lophophores protostomes or deuterostomes?	216
16.4	What are the relationships of Entoprocta?	218
16.5	Should there be a group called 'Lophophorata'?	219
<hr/>		
Chapter 17	Echinodermata	222
17.1	What is unique about echinoderms?	222
17.2	What is unusual but not unique about echinoderms?	224
17.3	How do different echinoderms feed and move?	225
17.4	Do the larvae illuminate echinoderm evolution?	232
<hr/>		
Chapter 18	Invertebrate Chordata and Hemichordata	236
Chordata		236
18.1	What are the chordate characters?	236
18.2	Which are the invertebrate chordates?	238
18.3	How are the invertebrate chordates related?	240

Hemichordata	241
18.4 What are the hemichordates?	241
18.5 What do enteropneusts and pterobranchs have in common?	243
18.6 Where do the hemichordates fit in to the deuterostomes?	244

Chapter 19 Development	247
---------------------------------	-----

19.1 How do animals develop?	247
19.2 What makes different animals develop differently?	248
19.3 What is the pattern of cleavage in invertebrates?	248
19.4 How do invertebrates gastrulate?	252
19.5 How is polarity established?	254
19.6 How do cells acquire positional information?	255
19.7 What happens in later development?	256
19.8 What can studies of regeneration tell us about development?	257
19.9 How do genes regulate development?	257
19.10 What are Hox genes and how do they work?	259
19.11 What is 'evo-devo'?	261
19.12 Conclusion	261

Chapter 20 Invertebrate evolutionary history	263
---	-----

20.1 How can we trace the course of evolution?	263
20.2 How have genes provided enough raw material for evolution?	264
20.3 How can genes help us to trace evolution?	265
20.4 What do genes tell us about relationships between the earliest phyla?	265
20.5 How do genes relate the protostome phyla?	267
20.6 Where do the smaller protostome phyla fit in?	271
20.7 How do genes relate the deuterostome phyla?	273
20.8 What do molecules tell us about relationships within phyla?	276
20.9 Can we now define homology?	280
20.10 Conclusion	282

<i>Further reading</i>	283
<i>Glossary</i>	294
<i>Index</i>	313