

Contents

List of Contributors, ix

Foreword, xiii

L. R. M. COCKS

1 Major Events in the History of Life

1.1 Origin of Life, 3

C. R. WOESE & G. WÄCHTERSCHÄUSER

1.2 Precambrian Evolution of Prokaryotes and Protists, 9

A. H. KNOLL

1.3 Precambrian Metazoans, 17

M. A. FEDONKIN

1.4 Origin of Hard Parts — Early Skeletal Fossils, 24

B. RUNNEGAR & S. BENGTSON

1.5 Late Precambrian–Early Cambrian Metazoan Diversification, 30

S. CONWAY MORRIS

1.6 Evolutionary Faunas, 37

J. J. SEPKOSKI, JR

1.7 Early Diversification of Major Marine Habitats

1.7.1 Infauna and Epifauna, 41

W. I. AUSICH & D. J. BOTTJER

1.7.2 Plankton, 49

R. B. RICKARDS

1.7.3 Reefs, 52

C. T. SCRUTTON

1.8 Terrestrialization

1.8.1 Soils, 57

V. P. WRIGHT

1.8.2 Plants, 60

D. EDWARDS & N. D. BURGESS

1.8.3 Invertebrates, 64

P. A. SELDEN

1.8.4 Vertebrates, 68

A. C. MILNER

1.9 Flight

1.9.1 Arthropods, 72

R. J. WOOTTON

1.9.2 Vertebrates, 75

K. PADIAN

1.10 Angiosperms, 79

M. E. COLLINSON

1.11 Grasslands and Grazers, 84

J. R. THOMASSON & M. R. VOORHIES

1.12 Hominids, 88

R. L. SUSMAN

2 The Evolutionary Process and the Fossil Record

2.1 Molecular Palaeontology, 95

G. B. CURRY

2.2 Speciation, 100

B. CHARLESWORTH

2.3 Microevolution and the Fossil Record, 106

P. R. SHELDON

2.4 Heterochrony, 111

K. J. McNAMARA

2.5 Red Queen Hypothesis, 119

M. J. BENTON

2.6 Hierarchy and Macroevolution, 124

N. ELDRIDGE

2.7 Patterns of Diversification, 130

P. W. SIGNOR

2.8 Coevolution, 136

S. CONWAY MORRIS

2.9 Adaptation, 139

P. W. SKELTON

2.10 Evolution of Large Size, 147

M. J. BENTON

2.11 Rates of Evolution — Living Fossils, 152

D. C. FISHER

2.12 Mass Extinction: Processes

2.12.1 Earth-bound Causes, 160

A. HALLAM

2.12.2 Extra-terrestrial Causes, 164

D. JABLONSKI

2.12.3 Periodicity, 171

J. J. SEPKOSKI, JR

2.13 Mass Extinction: Events

2.13.1 Vendian, 179

M. A. S. McMENAMIN

2.13.2 End-Ordovician, 181

P. J. BRENCHLEY

2.13.3 Frasnian–Famennian, 184

G. R. MCGHEE, JR

2.13.4 End-Permian, 187

D. H. ERWIN

2.13.5 End-Triassic, 194

M. J. BENTON

- 2.13.6 Cretaceous–Tertiary (Marine), 198
F. SURLYK
- 2.13.7 Cretaceous–Tertiary (Terrestrial), 203
L. B. HALSTEAD
- 2.13.8 Pleistocene, 207
E. L. LUNDELIUS, Jr

3 Taphonomy

- 3.1 Decay Processes, 213
P. A. ALLISON
- 3.2 The Record of Organic Components and the Nature of Source Rocks, 217
P. FARRIMOND & G. EGLINTON
- 3.3 Destructive Taphonomic Processes and Skeletal Durability, 223
C. E. BRETT
- 3.4 Transport – Hydrodynamics
- 3.4.1 Shells, 227
J. R. L. ALLEN
- 3.4.2 Plant Material, 230
R. A. SPICER
- 3.4.3 Bones, 232
A. K. BEHRENSMEYER
- 3.5 Fossil Concentrations and Life and Death Assemblages, 235
F. T. FÜRSICH
- 3.6 Ostracod Deposits, 239
C. E. BRETT
- 3.7 Flattening, 244
D. E. G. BRIGGS
- 3.8 Diagenesis
- 3.8.1 Skeletal Carbonates, 247
M. E. TUCKER
- 3.8.2 Carbonate Nodules and Plattenkalks, 250
P. A. ALLISON
- 3.8.3 Pyrite, 253
P. A. ALLISON
- 3.8.4 Phosphate, 256
L. PRÉVÔT & J. LUCAS
- 3.9 Taphofacies, 258
C. E. BRETT & S. E. SPEYER
- 3.10 Anatomical Preservation of Fossil Plants, 263
A. C. SCOTT
- 3.11 Taphonomy of Fossil-Lagerstätten
- 3.11.1 Overview, 266
A. SEILACHER
- 3.11.2 Burgess Shale, 270
S. CONWAY MORRIS
- 3.11.3 Upper Cambrian ‘Orsten’, 274
K. J. MÜLLER
- 3.11.4 Hunsrück Slate, 277
J. BERGSTRÖM
- 3.11.5 Mazon Creek, 279
G. C. BAIRD

- 3.11.6 Holzmaden, 282
R. WILD
- 3.11.7 Solnhofen Lithographic Limestones, 285
G. VIOHL
- 3.11.8 Grube Messel, 289
J. L. FRANZEN
- 3.11.9 Baltic Amber, 294
T. SCHLÜTER
- 3.12 Completeness of the Fossil Record, 298
C. R. C. PAUL

4 Palaeoecology

- 4.1 Morphology, 307
L. LUGAR
- 4.2 Composition and Growth of Skeleton, 314
B. RUNNEGAR
- 4.3 Biomechanics, 318
P. A. SELDEN
- 4.4 Hydrodynamics, 322
M. LaBARBERA
- 4.5 Populations, 326
G. B. CURRY
- 4.6 Coloniality, 330
B. R. ROSEN
- 4.7 Stromatolites, 336
S. M. AWRAMIK
- 4.8 Reefs and Carbonate Build-ups, 341
B. R. ROSEN
- 4.9 Encrusters, 346
P. D. TAYLOR
- 4.10 Reconstructing Ancient Plant Communities, 351
A. C. SCOTT
- 4.11 Trace Fossils, 355
S. G. PEMBERTON, R. W. FREY & T. D. A. SAUNDERS
- 4.12 Evidence for Diet, 362
J. E. POLLARD
- 4.13 Predation
- 4.13.1 Marine, 368
C. E. BRETT
- 4.13.2 Terrestrial, 373
J. A. MASSARE & C. E. BRETT
- 4.14 Parasitism, 376
S. CONWAY MORRIS
- 4.15 Palaeopathology, 381
L. B. HALSTEAD
- 4.16 Trophic Structure, 385
J. A. CRAME
- 4.17 Evolution of Communities, 391
A. J. BOUCOT
- 4.18 Biofacies, 395
P. J. BRENCHLEY
- 4.19 Fossils as Environmental Indicators
- 4.19.1 Climate from Plants, 401
R. A. SPICER

- 4.19.2 Temperature from Oxygen Isotope Ratios, 403
T. F. ANDERSON
- 4.19.3 Salinity from Faunal Analysis and Geochemistry, 406
J. D. HUDSON
- 4.19.4 Oxygen Levels from Biofacies and Trace Fossils, 408
D. J. BOTTJER & C. E. SAVRDA
- 4.19.5 Depth from Trace and Body Fossils, 411
G. E. FARROW

5 Taxonomy, Phylogeny, and Biostratigraphy

- 5.1 Rules of Nomenclature
- 5.1.1 International Codes of Zoological and Botanical Nomenclature, 417
M. E. TOLLITT
- 5.1.2 Disarticulated Animal Fossils, 419
R. J. ALDRIDGE
- 5.1.3 Disarticulated Plant Fossils, 421
B. A. THOMAS
- 5.1.4 Trace Fossils, 423
S. R. A. KELLY
- 5.2 Analysis of Taxonomy and Phylogeny
- 5.2.1 Overview, 425
R. A. FORTEY
- 5.2.2 Cladistics, 430
P. L. FOREY
- 5.2.3 Evolutionary Systematics, 434
A. J. CHARIG
- 5.2.4 Stratophenetics, 437
P. D. GINGERICH
- 5.2.5 Problematic Fossil Taxa, 442
S. BENGTSON
- 5.3 Analysis of Taxonomic Diversity, 445
A. B. SMITH
- 5.4 Vicariance Biogeography, 448
L. GRANDE
- 5.5 Palaeobiogeography, 452
C. R. NEWTON
- 5.6 Biostratigraphic Units and the Stratotype/Golden Spike Concept, 461
C. H. HOLLAND
- 5.7 Zone Fossils, 466
M. G. BASSETT
- 5.8 International Commission on Stratigraphy, 468
M. G. BASSETT
- 5.9 International Geological Correlation Programme, 469
J. W. COWIE

- 5.10 Global Boundary Stratotypes
- 5.10.1 Overview, 471
J. W. COWIE
- 5.10.2 Precambrian–Cambrian, 475
J. W. COWIE
- 5.10.3 Ordovician–Silurian, 478
C. R. BARNES & S. H. WILLIAMS
- 5.10.4 Silurian–Devonian, 480
C. H. HOLLAND
- 5.11 Fossils and Tectonics, 482
R. A. FORTEY & L. R. M. COCKS

6 Infrastructure of Palaeobiology

- 6.1 Computer Applications in Palaeontology, 493
J. A. KITCHELL
- 6.2 Practical Techniques
- 6.2.1 Preparation of Macrofossils, 499
P. J. WHYBROW & W. LINDSAY
- 6.2.2 Extraction of Microfossils, 502
R. J. ALDRIDGE
- 6.2.3 Photography, 505
D. J. SIVETER
- 6.2.4 Electron Microscopy, 508
D. CLAUGHER & P. D. TAYLOR
- 6.2.5 Determination of Thermal Maturity, 511
J. E. A. MARSHALL
- 6.3 Museology
- 6.3.1 Collection Care and Status Material, 515
P. R. CROWTHER
- 6.3.2 Collection Management and Documentation Systems, 517
P. R. CROWTHER
- 6.3.3 Exhibit Strategies, 519
R. S. MILES
- 6.4 Societies, Organizations, Journals, and Collections, 522
J. NUDDS & D. PALMER
- 6.5 History of Palaeontology
- 6.5.1 Before Darwin, 537
J. C. THACKRAY
- 6.5.2 Darwin to Plate Tectonics, 543
P. J. BOWLER
- 6.5.3 Plate Tectonics to *Paleobiology*, 547
J. W. VALENTINE
- 6.5.4 The Past Decade and the Future, 550
A. HOFFMAN

Index, 557