

Contents

Preface	XIII
Acknowledgements	XVII
Acknowledgements for reproductions of previously published material	XVIII
Chapter 1. Introduction	1
1.1. Peculiarities of palynology in arid lands	5
1.2. Arid lands — definitions and terminology	10
1.2.1. Definitions	10
A. Climatic — 10; B. Agricultural — 11; C. Botanical — 11; D. Palynological — 13	
1.2.2. Classification of arid regions	21
1.3. Concepts and aims of this book	23
Chapter 2. Recent pollen spectra in arid lands	29
2.1. Pollen production	30
2.2. Pollen transportation	38
2.2.1. Eolian	39
2.2.2. Fluvatile	53
A. Rivers flowing to the sea — 56; B. Inland rivers — 58; C. Wadis — 60	
2.2.3. Sea currents	61
2.2.4. Groundwater	63
2.2.5. Animals	69
2.3. Pollen deposition, preservation and differential destruction	78
Chapter 3. Sediment–pollen relations in arid lands	85
3.1. Weathering	87
3.1.1. Insolation	88
3.1.2. Winds	88
3.1.3. Floods	92
3.1.4. Chemical	93
3.1.5. Biological	95

3.2. Sediment transport	96
3.2.1. Winds	96
3.2.2. Water	98
3.2.3. Animals and man	99
3.3. Depositional environments	100
3.3.1. Wadis and streams	100
3.3.2. Inland sebkhas and salt-pans	104
3.3.3. Lakes and marshes	107
3.3.4. Springs and oases	110
3.3.5. Eolian	113
3.3.6. Soils	116
3.3.7. Caves and rockshelters	120
3.3.8. Archeologic and prehistoric sites	122
3.3.9. Organic	127
3.3.10. Coastal, deltaic and marine	127
A. Coastal — 127; B. Deltaic — 131; C. Marine — 132	
3.3.11. Environments of deposition, accidentally located in arid lands	135
3.4. Cementation	138
3.5. Polyphase inclusion of pollen in sediments	140
3.5.1. Multiple transporting agents	141
3.5.2. Dust	142
3.5.3. Redeposition	142
3.5.4. Water infiltration and cementation	143
3.5.5. The role of springs	144
3.5.6. Human and animal activity	145
3.5.7. Artificial contaminations	145
3.6. Quantitative relations of pollen and sediments in various arid lands environments	146
 Chapter 4. Sampling	 149
4.1. Airborne pollen	153
4.2. Recent sediments	154
4.3. Water	158
4.4. Outcrops	160
4.5. Boreholes	162
4.6. Archeologic and prehistoric sites	165
4.7. Biogenic substances	167
 Chapter 5. Extraction	 169
5.1. General	171
5.1.1. Sample size	171
5.1.2. The influence of chemicals on palynomorphs	172

- 5.1.3. Filtration 173
- 5.1.4. Mechanical separation 174
- 5.1.5. Gravity separation 175
- 5.1.6. Centrifugation 177
- 5.1.7. Washing 177
- 5.1.8. Mixing 178
- 5.1.9. Acetolysis 178
- 5.1.10. Staining 179
- 5.1.11. Picking the last drop from the test tube 179
- 5.1.12. Mounting media 180
- 5.1.13. Keeping the residue 181
- 5.1.14. Electron microscopy 181
- 5.2. A basic extraction method 182
- 5.3. Clastic sediments 185
 - 5.3.1. Unconsolidated sediments 185
 - 5.3.2. Fine clastics 187
 - 5.3.3. Coarse clastics 189
- 5.4. Other substances 195
 - 5.4.1. Chemical precipitates 195
 - 5.4.2. Organic deposits 197
 - 5.4.3. Soils and subsoil crusts 198
 - 5.4.4. Water 199
 - 5.4.5. Exotic substances 200
- Chapter 6. Identification, counting and presentation 203**
- 6.1. Identification 203
 - 6.1.1. Preservation, differential destruction and identification 204
 - 6.1.2. Level of systematic identifications 212
 - 6.1.3. Ideal vs. practical identifications 215
 - 6.1.4. Identification of polyphase processes 217
 - A. Identification of polyphase processes by state of preservation — 217;
 - B. Identification of redeposition by physico-chemical properties of the ex-
ine — 220
- 6.2. Counting 222
- 6.3. Presentation of the results 225
 - 6.3.1. Factual presentation 226
 - 6.3.2. Graphic considerations 227
 - 6.3.3. Selective presentation 229
 - A. Grouping — 230; B. Partial presentation — 232; C. Omissions — 233;
 - D. Combination of adjacent samples — 234; E. Correction factors — 235
- Chapter 7. Principles of interpretation 239**
- 7.1. Recent pollen spectra — a tool for interpreting the past 240

7.1.1. Vegetation–environment relationships	241
7.1.2. Anthropogenic effects	243
7.1.3. Recent pollen spectra as vegetation representatives	248
7.1.4. Relationships of exact sample location and recent pollen spectra	252
7.2. Arboreal pollen as a basis for interpretation	256
7.2.1. Pollen of indigenous trees	256
A. Regional indigenous trees — 257; B. Trees of water enriched environments — 262; C. Trees of anthropogenic environments — 263	
7.2.2. Imported arboreal pollen	265
7.3. Non-arboreal pollen as a basis for interpretation	269
7.3.1. The entire non-arboreal spectrum	271
7.3.2. Grouping and partial non-arboreal spectra	274
7.3.3. Ratios of pairs of taxa	277
7.3.4. Pollen morphology	278
7.4. Grouping in pollen spectra and diagrams	278
7.4.1. AP/NAP ratios	279
7.4.2. Grouping by environments	284
Chapter 8. Reconstruction of past environments	289
8.1. Vegetation	290
8.2. Climate	298
8.2.1. Pollen–climate transfer functions	306
8.3. Transport	310
8.3.1. Winds	311
8.3.2. Rivers	314
8.3.3. Other transporting agents	315
8.4. Environments of deposition	315
8.4.1. Marine	316
8.4.2. Continental	322
8.5. Structure and landscape	326
8.5.1. Regional palynostratigraphy and structure	327
8.5.2. Local vegetation, structure and landscape	334
Chapter 9. Regional reconstruction of past arid environments: the late Cenozoic of Israel	341
9.1. Terminology	343
9.2. Pollen diagrams for the late Cenozoic of Israel	345
9.2.1. Presentation	347
9.2.2. Palynostratigraphy and paleoenvironments	349
A. The Miocene (Ma, Mb and Mc) — 349; B. The Pliocene (Pa, Pb) — 355;	
C. The Preglacial Pleistocene (QI, QII) — 362; D. The Glacial Pleistocene–Holocene (QIII through QX) — 367	

<i>Contents</i>	XI
9.3. Development of the desert system in Israel	372
9.3.1. The Neogene	373
9.3.2. The Quaternary	373
A. Interstadial — 375; B. Pluvial — 379; C. Interpluvial — 381	
9.4. Paleoclimatic models	382
9.4.1. The Neogene	382
9.4.2. The Quaternary	383
9.4.3. Conclusion — paleoclimates	388
Chapter 10. Pollen analysis of archeological sites in arid lands	391
10.1. The significance of samples collected from archeological sites in arid lands	393
10.1.1. Stratigraphic considerations	393
10.1.2. Preferential inclusion and deficiency of taxa in anthropogenic deposits	396
10.2. Recognition of anthropogenic and livestock activities	399
10.2.1. Cultivated plants	399
10.2.2. Ruderal plants	401
10.2.3. Man induced changes in the natural vegetation	402
10.3. Archeopalynology in Israel	405
10.3.1. Chronology and paleoenvironments of prehistoric industries in Israel ...	406
A. Conclusion — 415	
10.3.2. Archeopalynology of late QIX and QX palynozones in Israel	416
Chapter 11. Pre-late Cenozoic palynology of arid lands	429
11.1. Constraints and precautions	429
11.2. Identifying paleoaridity by species diversity	434
11.2.1. Species diversity and dominance — the recent model	434
A. Diversity and dominance in marine environments — 437; B. Diversity and dominance in terrestrial environments — 438	
11.2.2. Species–taxon relationships in paleopalynology	443
11.2.3. Paleoaridity reconstructions by taxa diversity and dominance gradients	446
11.3. Reconstructing paleoaridity from index taxa (by Y. Eshet)	456
11.3.1. Triassic aridity in Israel	458
A. General geology — 459; B. Materials and methods — 461; C. Palynological zonation — 461; D. Results — 463	
11.3.2. Taxa diversity and dominance in the Triassic of Israel	464
References	467
References Index	487
Subject Index	493