

# Contents

<b>1</b>	<b>Introduction</b>	1
<b>2</b>	<b>Suggested Angiosperm Ancestors</b>	5
2.1	Gnetales	5
2.2	Gigantopteriales	7
2.3	Glossopteridales	8
2.4	<i>Sanmiguelia</i>	9
2.5	<i>Leptostrobus</i>	9
2.6	<i>Caytonia</i>	10
2.7	Bennettitales	12
2.8	<i>Umkomasia</i>	13
2.9	<i>Problematospermum</i>	13
2.10	Dirhopalostachyaceae	14
2.11	<i>Ktalenia</i>	15
2.12	<i>Pentoxylales</i>	15
2.13	Summary	16
<b>3</b>	<b>Angiosperms: Characters and Criteria</b>	17
3.1	Angiospermous Characters	17
3.1.1	Leaf Venation	18
3.1.2	Vessel Elements in the Xylem	19
3.1.3	Closed Carpel, or Enclosed Ovule/Seed	19
3.1.4	Bitegmic Ovule	20
3.1.5	Double Fertilization	20
3.1.6	Tetrasporangiate Anther	21
3.1.7	Pollen Tube	21
3.1.8	Tectate-Columellate Pollen Grains	22
3.1.9	Developmental Pattern	23
3.1.10	Chemical Species	23
3.2	Criterion for Criteria	24
3.3	Criterion for Fossil Angiosperms	24
<b>4</b>	<b>Background for the Plant Fossils</b>	29
4.1	Stratigraphy	29

4.2	Faunas . . . . .	34
4.2.1	The Jiulongshan Fauna . . . . .	34
4.2.2	The Yixian Fauna . . . . .	35
4.3	Floras . . . . .	35
4.3.1	The Jiulongshan Flora . . . . .	35
4.3.2	The Yixian Flora . . . . .	36
<b>5</b>	<b>Flowers from the Early Cretaceous . . . . .</b>	<b>37</b>
5.1	<i>Chaoyangia</i> . . . . .	37
5.1.1	Previous Studies . . . . .	37
5.1.2	Misunderstanding and Clarification . . . . .	38
5.1.3	New Information . . . . .	42
5.1.4	Emended Diagnosis . . . . .	52
5.1.5	Description . . . . .	53
5.1.6	Development . . . . .	55
5.1.7	Pollination . . . . .	56
5.1.8	Affinity . . . . .	56
5.1.9	Problem Unsolved . . . . .	63
5.2	<i>Archaeofructus</i> . . . . .	64
5.2.1	<i>Archaeofructus</i> , a Great Discovery . . . . .	64
5.2.2	Controversies over <i>Archaeofructus</i> . . . . .	67
5.2.3	Diagnosis After Emendation . . . . .	68
5.2.4	Ecology of <i>Archaeofructus</i> . . . . .	69
5.2.5	The Discovery of <i>Archaeofructus</i> . . . . .	69
5.3	<i>Sinocarpus</i> . . . . .	70
5.4	<i>Callianthus</i> . . . . .	71
5.4.1	Previous Studies . . . . .	71
5.4.2	Misunderstanding and Clarification . . . . .	72
5.4.3	New Information . . . . .	72
5.4.4	Diagnosis . . . . .	77
5.4.5	Description . . . . .	78
5.4.6	Development . . . . .	81
5.4.7	Pollination and Dispersal . . . . .	84
5.4.8	Affinity . . . . .	86
<b>6</b>	<b>Flower-Related Fossils from the Jurassic . . . . .</b>	<b>91</b>
6.1	<i>Schmeissneria</i> . . . . .	91
6.1.1	Previous Studies . . . . .	91
6.1.2	Misunderstandings and Clarifications . . . . .	94
6.1.3	New Information . . . . .	96
6.1.4	Emended Diagnosis . . . . .	106
6.1.5	Description . . . . .	109
6.1.6	Development . . . . .	115
6.1.7	Pollination . . . . .	118
6.1.8	Fruit Dispersal . . . . .	119
6.1.9	Affinity . . . . .	119

6.1.10	Ecology and Environment . . . . .	121
6.1.11	Comparison with Other Relatives . . . . .	121
6.1.12	Summary . . . . .	122
6.2	<i>Xingxueanthus</i> . . . . .	122
6.2.1	Background . . . . .	122
6.2.2	Features of the Plant . . . . .	122
6.2.3	Description . . . . .	131
6.2.4	Affinity . . . . .	134
6.2.5	Evolutionary Implications . . . . .	135
6.2.6	Problem Unsolved . . . . .	136
6.2.7	Summary . . . . .	137
6.3	<i>Solaranthus</i> . . . . .	137
6.3.1	Possibly Related Previous Studies . . . . .	137
6.3.2	New Information and Implications . . . . .	138
6.3.3	Diagnosis and Description . . . . .	145
6.3.4	Affinity . . . . .	151
6.3.5	Implications for the Origin of Angiosperms . . . . .	152
6.4	General Summary . . . . .	153
<b>7</b>	<b>Trace of Possible Angiosperms in the Jurassic</b> . . . . .	<b>155</b>
7.1	Taxon A . . . . .	155
7.1.1	Diagnosis . . . . .	155
7.2	Taxon B . . . . .	159
7.2.1	Diagnosis . . . . .	160
<b>8</b>	<b>Making of the Flower</b> . . . . .	<b>163</b>
8.1	Definition of a Carpel . . . . .	163
8.1.1	Difficulties for Applying the Classic Definition . . . . .	163
8.1.2	Converging on a New Definition . . . . .	164
8.1.3	Derivation of the Carpel . . . . .	169
8.2	Ovule . . . . .	173
8.3	Placenta . . . . .	174
8.3.1	Isolation of Placenta from Carpel . . . . .	174
8.3.2	Origin of Placenta . . . . .	176
8.4	Enclosing Ovules . . . . .	178
8.5	Flower . . . . .	179
8.6	Angiosperm Prototype and Its Relationship to Other Seed Plants . . . . .	180
8.7	Merits of the Unifying Theory . . . . .	182
8.7.1	Simplicity and Directness . . . . .	182
8.7.2	Evidence from Various Fields . . . . .	182
8.7.3	Difficulties Negotiated . . . . .	182
8.7.4	Wide Applicable Range . . . . .	184
8.7.5	Controversies Settled . . . . .	184
8.8	General Regularities in Seed Plant Evolution . . . . .	184
8.8.1	Enclosure . . . . .	184

8.8.2	Overgrowth and Reduction . . . . .	185
8.8.3	Sterilization and Neofunctionalization . . . . .	185
8.8.4	Fusion . . . . .	185
8.8.5	Diverted Development . . . . .	185
8.9	Problems Unsolved . . . . .	186
8.9.1	From Unisexual to Bisexual . . . . .	186
8.9.2	Boundary Between Cordaitales-Like Plants and Angiospermae . . . . .	186
8.9.3	Prediction and Test . . . . .	186
8.10	Implications for Seed Plant Phylogeny . . . . .	187
<b>9</b>	<b>General Conclusions . . . . .</b>	<b>189</b>
9.1	Origins and Ancestors of Angiosperms . . . . .	189
9.1.1	Time of Origin . . . . .	189
9.1.2	Location and Habitat of Early Angiosperms . . . . .	190
9.1.3	Ancestors . . . . .	191
9.2	Monophyly or Polyphyly . . . . .	192
9.3	Animals and Plants . . . . .	192
9.4	Road to Success . . . . .	193
9.5	The Idiosyncrasy of Angiospermae or a Grade of Evolution? . . . . .	193
9.6	Digging Deeper . . . . .	194
<b>10</b>	<b>Appendix . . . . .</b>	<b>195</b>
10.1	List of Morphological Characters Used for Cladistic Analysis . . . . .	195
10.2	Morphological Matrix . . . . .	199
10.3	List of Fauna Elements . . . . .	204
10.3.1	The Jiulongshan Fauna . . . . .	204
10.3.2	The Yixian Fauna . . . . .	205
10.4	List of Flora Elements . . . . .	208
10.4.1	The Jiulongshan Flora . . . . .	208
10.4.2	The Yixian Flora . . . . .	209
10.5	Morphological Matrix for Seed Plant Cladistics . . . . .	210
	<b>References . . . . .</b>	<b>213</b>
	<b>Index . . . . .</b>	<b>235</b>



<http://www.springer.com/978-3-642-01160-3>

The Dawn Angiosperms  
Uncovering the Origin of Flowering Plants

Wang, X.

2010, XXII, 238 p., Hardcover

ISBN: 978-3-642-01160-3