Hunt Institute for Botanical Documentation
5th Floor, Hunt Library
Carnegie Mellon University
4909 Frew Street
Pittsburgh, PA 15213-3890
Telephone: 412-268-2434
Email: huntinst@andrew.cmu.edu
Web site: www.huntbotanical.org

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About the Institute
The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

D. Morey

Chronology of some of the major ideas that entered into the evolution of the Natural System from its reinception about 1550 to Antoine Laurent Jussieu (1748-1836)

1550. Conrad Gesner (1516-1565) Professor of natural history at Zurich. Insisted that a plant have constancy before it could be considered a species. Felt that the aspects of the fruit and flower were the key to the nature of the plant. Published almost 100% on Zoology.

Andrea

1583. Andrew Cesalpino. (1519-1603) Professor at Pisa. Physician to Pope Clement VIII. Plants separated into groups on the features of the fruit and the seed.

1628. Prince Frederich Cesi ( ) Are all plants linked in a chainlike relationship?

1650. Johachim Jung (1587-1657) Held professorial appointments at Lubeck, Helmstadt, and was rector at the Johaneum in Hamburg. Denied trees and herbs as natural separations. Lamented the fact that botanists seemed more engrossed with the finding of new plants rather than with the correct reference to genera and species. This remarkable man also doubted the existence of spontaneous generation.

1680. Robert Morison (1620-1683) Held the Chair at Oxford 1670- . Entirely devoted to systematics and Charles II. Attempted certain correlations of fruit, seed, inflorescence, anatomy, and physiology.

1682. Nehamiah Grew (1628-1711) Physician, Secretary of Royal Soc. 1677. Stamens act as the male organ in the production of seed.

1686. John Ray (1628-1705) Recognized embryo and endosperm. Saw that not all plants had two cotyledons.

1690. Augustus Quirinus Bachmann (Rivinus) 1652-1725) The German Ray. From 1691 he was professor of botany, physiology, materia medica, and chemistry at Leipsic. He was an astronomer and injured his eyes looking at sun spots. Felt that perianth segment numbers were of great importance. Had monopetalae-tetrapetalae-hexapetalae-polypetalae, etc.

1694. Joseph Pitton de Tournefort (1656-1708) Professor at Jardin des Plantes 1683. Corolla features prime but established the concept of the Diclines.

1691. Rudolf Jacob Camerarius (1665-1721) Established sexuality in plants by experimentation.

1702. J. Henry Burkhard ( ) In letter to Liebnitz comments that are not the stamens very important aspect of the plant?

1703. John Ray (see above) separates dicots and monocots on basis of leaf venation and stellar anatomy.

1714. Pontedera, Jules (1688-1757) Composites most advanced polypets.

1716. Chretien Knaut (1654-1716) Cohesion of perianth segments treated as a trend.

1720. Pierre Magnol (1638-1715) Fusion of sepals and the relationship of the petals to the sepals as concerns position.

1736-1781 Carl Linne discovers the stamens, carpels, sepals, petals, placentation and many things that were not there at all. Linnaeus 1707-1778. 5 or 6 systems

1742. Haller, Albrecht von (1708-1777) Finally defines sepal, petal, and tepal with some indication of the consequences.

1753. Linnaeus. Binomial nomenclature. Book- Families of Plants

1763. Michel Adanson. (1727-1806) Minute description of all the features of a plant.

1773. Subordination of characteristics. A. L. Jussieu (1748-1836).

1805. Augustin Pyramus de Candolle. Theorie Elementaire.

Michaud - Biographie General - good cover of scientists

Sachs - History of Botany

Hooker, Ellison - Pioneers of Plant Study

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THE NATURAL SYSTEM OF A. L. JUSSIEU

The system of A. L. Jussieu is expounded in his Genera plantarum secundum, Paris 1791.

There are 15 classes, 100 order, and 136 genera incertae sedis

INDEX METHODI

Acotyledones..... Class I

Monocotyledones..... Stamina Hypogyna II
Perigyna III
Epigyna IV

Dicotyledones..... Apetalae — Stamina Epigyna V
Perigyna VI
Hypogyna VII
Corolla Hypogyna VIII
Perigyna antheris IX

Monopetalae — Epigyna connatis X
Antheris distinctis XI

Polypetalae — Stamina Epigyna XII
Hypogyna XIII
Perigyna XIV

Diclines irregulares XV

Linear order of classes and orders.

Class I:
1. Fungi
2. Alage
3. Hepaticae
4. Musci
5. Filices
6. Naiades

Class II:
7. Ariodeae
8. Typhae
9. Cyperoidae
10. Graminae
11.

Class III.
11. Palmae
12. Asparagi
13. Junci
14. Lilia
15. Bromeliae
16. Asphodeli
17. Narcissi
18. Irides

Class IV:
19. Musae
20. Cannae
21. Orchides
22. Hydrocharides

Class V:
23. Aristolocaciae

Class VI:
24. Elaeagni
25. Thymeleae
26. Proteae
27. Lauri
28. Polygoneae
29. Atriplices

Class VII:
30. Amaranthi
31. Plantagines
32. Nyctagineae
33. Plumbagineae

Class VIII:
34. Lysimachiae
35. Pediculares
36. Acanthi
37. Jasmineae
38. Vitices
39. Labiatae
40. Scrophulariae
41. Solanae
42. Borragineae
43. Convolvuli
44. Polemonia
45. Bignoniae
46. Gentianae
47. Apocineae
48. Sapotae

Class IX:
49. Guaiacanae
50. Rhododendra
51. Ericae
52. Campanulaceae

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Class X:
53. Cichoraceae
54. Cinerocephalae (Div. of compositae)
55. Corymbiferae

Class XI:
56. Dipsaceae
57. Rubiaceae
58. Caprifolia

Class XII:
59. Araliae
60. Umbelliferae

Class XIII:
61. Ranunculaceae
62. Papaveraceae
63. Cruciferae
64. Capparides
65. Sapindi
66. Acera

Class XIII(cont.):
67. Malpighiae
68. Hyperica
69. Guttiferae
70. Aurantia (citrus)
71. Meliae
72. Vites
73. Gerania
74. Malvaceae
75. Magnoliae
76. Anonae
77. Menisperma
78. Berberides
79. Tiliaceae
80. Cisti
81. Rutaceae
82. Caryophylleae

Class XIV:
83. Sempervivae
84. Saxafragae

Class XIV (cont.):
85. Cacti
86. Portulaceae
87. Ficoideae
88. Onagrae
89. Myrti
90. Malastomae
91. Salicariae
92. Rosaceae
93. Leguminosae
94. Terebintaceae
95. Rhamni

Class XV:
96. Euphorbiae
97. Cucurbitaceae
98. Urticae
99. Amentaceae
100. Coniferae

Beyond this there are 136 general Incertae sedis.

* * * * *

All spelling after A. L. Jussieu.

Notes of interest:
In the order of Naiades the following genera plus others are to be found: Hippuris, Chara, Ceratophyllum, Miriophyllum, Potomogenton, Callitriche, and Lemna.

In the Atriplices: Phytolacca, Rivinia, Camphorata, Spinacia, and Chenopodium

Campanulaceae contains Gesneria

Caprifolia contains Cornus and Hedera

Ranunculaceae: Podophyllum

Capparidaceae: Marcgravia, Drosera, Reseda

Aurantaceae: Camelia, Thea, Citrus

Malvaceae: Bombax, Theobroma, Sterculia

Magnolia: Dillenia, Ochna, Quassia

Berberides: Hamamelis

Tiliaceae: Flacurita, Bixa

Rutaceae: Zygophyllum, Guaiacum

Caryophyllaceae: Linum, Frankenia

Cacti: Ribes cactus

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Portulacaceae: Turnera, Tamarix

Onagrae: Mentzelia

Myrti: Philadelphus, Eucalyptus

Terebintaceae: Connarus, Rhus, Zanthoxyllum, Ptelia, Averrhoa, Juglans

Rhamni: Staphylea, Celastrus, Ilex

Cucurbitaceae: Passiflora, Carica

Urticae: Ficus, Gunnera, Piper, Gnetum

Amentaceae: Liquidamber, Platanus, Myrica, Salix, Ulmus, Betula, Quercus, Corylus

Coniferae: Casuarina

From Genera incertae sedis: Weigela, Sauvagia, Begonia, Nepenthes, Pandanus

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THE DE CANDOLLE TAXONOMIC SYSTEM

Augustine Pyramus DeC

Serg. Magnay

(Taken from THEORIE ELEMENTAIRE DE LA BOTANIQUE, 3rd ed., Paris, 1844.)

I. PHANEROGAMAE:--vascular plants with embryos fertilized sexually; floral organs more or less symmetrical.

A. DICOTYLEDONES (EXOGENAE):--vascular tissue in concentric rings, the younger elements on the outside; embryos with opposite or whorled cotyledons.

1. Sub-class THALAMIFLORAE:--petals distinct, inserted on the torus.

1. Ranunculaceae
2. Dilleniaceae
3. Magnoliaceae
4. Anonaceae
5. Menispermaceae
6. Berberidaceae
7. Podophyllaceae
8. Nymphaeaceae
9. Papaveraceae
10. Fumariaceae
11. Cruciferae
12. Capparidaceae
13. Resedaceae
14. Flacourtiaceae
15. Bixaceae
16. Cistaceae
17. Violaceae
18. Droseraceae
19. Polygalaceae
20. Tremandraceae
21. Pittosporaceae
22. Frankeniaceae
23. Caryophyllaceae
24. Linaceae
25. Malvaceae
26. Bombacaceae
27. Byttneriaceae
28. Tiliaceae
29. Elaeocarpaceae
30. Dipterocarpaceae
31. Chlenaceae
32. Ternstroemiaceae
33. Theaceae
34. Olacaceae
35. Aurantiaceae
36. Hypericaceae
37. Guttiferae
38. Marograviaceae
39. Hippocrateaceae
40. Erythroxylaceae
41. Malpighiaceae
42. Aceraceae
43. Hippocastanaceae
44. Rhizobolaceae
45. Sapindaceae
46. Meliaceae
47. Ampelidaceae (Vitaceae)
48. Geraniaceae
49. Tropaeolaceae
50. Balsaminaceae
51. Oxalidaceae
52. Zygophyllaceae
53. Rutaceae
54. Simarubaceae
55. Ochnaceae
56. Coriariaceae

2. Sub-class CALYCIFLORAE:--petals free or more or less united, and always inserted on the calyx (perigynous).

57. Celastraceae
58. Rhamnaceae
59. Bruniaceae
60. Samydaceae
61. Homalinaceae
62. Chailletiaceae
63. Aquilariaceae
64. Terebinthaceae
65. Leguminosae
66. Rosaceae
67. Calycanthaceae
68. Granataceae (Punicaceae)
69. Myrtaceae
70. Combretaceae
71. Vochysiaceae
72. Rhizophoraceae
73. Onagraceae
74. Haloragidaceae
75. Ceratophyllaceae

CALYCIFLORAE (cont.)

76. Lythraceae
77. Tamariscaceae
78. Melastomaceae
79. Alangiaceae
80. Philadelphaceae
81. Myrtaceae
82. Cucurbitaceae
83. Passifloraceae
84. Loasaceae
85. Turneraceae
86. Fouquieraceae
87. Portulacaceae
88. Paronychiaceae
89. Crassulaceae
90. Ficoides (Aizoaceae)
91. Cactaceae
92. Grossulariaceae
93. Saxifragaceae
94. Umbelliferae
95. Araliaceae
96. Hamamelidaceae
97. Cornaceae
98. Loranthaceae
99. Caprifoliaceae
100. Rubiaceae
101. Valerianaceae
102. Dipsacaceae
103. Calyceraceae
104. Compositae
105. Stylidiaceae
106. Lobeliaceae
107. Campanulaceae
108. Cyphiaceae
109. Goodeniaceae
110. Rousseaceae
111. Gesneriaceae
112. Sphenocleaceae
113. Columelliaceae
114. Napoleonaceae
115. Vaccinieae
116. Ericaceae
117. Epacridaceae
118. Pyrolaceae
119. Francoaceae
120. Monotropaceae

3. Sub-class COROLLIFLORAE:--petals united into a corolla distinct from the calyx, and usually hypogynous.

121. Lentibulariaceae
122. Primulaceae
123. Myrsinaceae
124. Aegiceraceae
125. Theophrastaceae
126. Sapotaceae
127. Ebenaceae
128. Oleaceae
129. Jasminaceae
130. Apocynaceae
131. Asclepiadaceae
132. Loganiaceae
133. Gentianaceae
134. Bignoniaceae
135. Cyrtandraceae
136. Sesamaceae
137. Polemoniaceae
138. Convolvulaceae
139. Hydrophyllaceae
140. Boraginaceae
141. Hydroleaceae
142. Labiatae
143. Verbenaceae
144. Acanthaceae
145. Selaginaceae
146. Globulariaceae
147. Myoporaceae
148. Solanaceae
149. Scrophulariaceae
150. Plumbaginaceae
151. Plantaginaceae

1924

A Generation of memorially Eminent Botanists - Irelease.

Families as we know are considered as orders here, and are divided into tribes.

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Theory

1. Estimating relative importance of organs
   a. Pistil more important than nectaries or glands; leaf more important than stipules both important :. must consider both - vegetative + reproductive. Scale, then, that classification.
2. Causes of error in evaluating organs:
   Relative importance of organs out of plant:
   Most important in embryo.
   - stamens + pistil
   - tissues around embryo.
   - albumen
   - calyx
   - leaves-

Plants with more parts advanced - result of fusion from " " fewer " primitive.

3. Points of view.
   1. Presence or absence.
   2. Number
   3. Color, odor -

Law of symmetry
" " abortion, fusion

For convenience, must have a "linear" system, but is not natural.

Two alternatives
1. Simple → complex - Jussieu.
2. Complex → simple - D.C.

Vegetative organs -
"Vessels" - vascular
most imp -
Exogeny - Dicots
Endogeny - Monocots

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4. Sub-class MONOCHLAMYDEAE:--calyx and corolla reduced to a single envelope.

152. Nyctaginaceae
153. Amaranthaceae
154. Chenopodiaceae
155. Phytolaccaceae
156. Polygonaceae
157. Lauraceae
158. Myristicaceae
159. Proteaceae
160. Thymeliaceae
161. Santalaceae
162. Elaeagnaceae
163. Aristolochiaceae
164. Cytinaceae
165. Begoniaceae
166. Euphorbiaceae
167. Monimiaceae
168. Urticaceae
169. Chloranthaceae
170. Piperaceae
171. Juglandaceae
172. Amentaceae
173. Casuarinaceae
174. Coniferae
175. Cycadaceae

B. MONOCOTYLEDONES (ENDOGENAE):--vascular tissues in scattered bundles; embryo with solitary or alternate cotyledons.

176. Hydrocharidaceae
177. Alismaceae
178. Podostemonaceae
179. Najadaceae
180. Orchidaceae
181. Drymyrhizaceae
182. Cannaceae
183. Musaceae
184. Iridaceae
185. Haemodoraceae
186. Amaryllidaceae
187. Dioscoreaceae
188. Smilaceae
189. Hypoxidaceae
190. Gilliesiaceae
191. Liliaceae
192. Pontederiaceae
193. Colchicaceae
194. Butomaceae
195. Juncaceae
196. Restiaceae
197. Commelinaceae
198. Palmaceae
199. Pandanaceae
200. Typhaceae
201. Araceae
202. Cyperaceae
203. Gramineae

II. CRYPTOGAMAE:--composed entirely of cellular tissue; sexual organs lacking, or having reproductive organs very different from those of the Phanerogams.

A. AETHEOGAMS (SEMIVASCULAR CRYPTOGAMS):--sex organs present; vascular tissue present, at least during some phase of the life of the plant.

1. Vascular tissue and stomata present.

204. Equisitaceae
205. Marsiliaceae
206. Lycopodiaceae
207. Ferns

2. Vascular tissue and stomata rare or absent.

208. Mosses
209. Liverworts

B. AMPHIGAMS (CELLULAR CRYPTOGAMS):--sex organs and vascular tissues absent.

210. Lichens
211. Hypoxylons (Pyrenomycetes)
212. Fungi
213. Algae

CONDENSED OUTLINE OF THE SYSTEM

I. PHANEROGAMAE
- A. Class EXOGENAE (Dicots)
  - 1. Sub-class THALAMIFLORAE
  - 2. Sub-class CALYCIFLORAE
  - 3. Sub-class COROLLIFLORAE
  - 4. Sub-class MONOCHLAMYDEAE
- B. Class ENDOGENAE (Monocots)

II. CRYPTOGAMAE
- A. Class AETHEOGAMAE (Bryophytes and Pteridophytes)
- B. Class AMPHIGAMAE (Thallophytes)

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Bentham + Hooker -

1st Nat. system - John Ray - a nat. system shows species + families in natural order.

Only things to make it natural is its Cohorts.

Bentham - 1800-84. Sam. Bentham (father) general

George Bentham oldest son -

J.D. Hooker - 1817 - 1911.

In system, most influenced by D.C., and written to correct Endlicher's "Genera Plantarum" (1840-60).

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SYSTEM OF BENTHAM AND HOOKER. 1862-1883.

DICOTYLEDONES.

I. POLYPETALAE.

Series i. THALAMIFLORAE. Petal and stamens hypogynous.

Cohort 1. RANALES. Orders. 1,Ranunculaceae; 2,Dilleniaceae; 3,Calycanthaceae; 4,Magnoliaceae; 5,Anonaceae; 6,Menispermaceae; 7,Berberideae; 8,Nymphaeaceae.
2. PARIETALES. Orders. 9,Sarraceniaceae; 10,Papaveraceae; 11,Cruciferae; 12,Capparideae; 13,Resedaceae; 14,Cistineae; 15,Violarieae; 16,Canellaceae; 17,Bixineae.
3. POLYGALINEAE. Orders. 18,Pittosporeae; 19,Tremandreae; 20,Polygaleae; 21,Vochysiaceae.
4. CARYOPHYLLINAE. Orders. 22,Frankeniaceae; 23,Caryophylleae; 24,Portulaceae; 25,Tamariscineae.
5. GUTTIFERALES. Orders. 26,Elatineae; 27,Hypericineae; 28,Guttiferae; 29,Terstroemiaceae; 30,Dipterocarpeae; 31,Chlaenaceae.
6. MALVALES. Orders. 32, Malvaceae; 33,Sterculiaceae; 34,Tiliaceae.

Series ii. DISCIFLORAE. Stamens usually definite, inserted upon or inside or outside of a development of the floral axis which forms a ring or cushion at the base of the ovary, or is broken up into glands. Ovary superior.

Cohort 7. GERANIALES. Orders. 35,Lineae; 36,Humiriaceae; 37,Malpighiaceae; 38, Zygophylleae; 39,Geraniaceae; 40,Rutaceae; 41,Simarubeae; 42,Ochnaceae; 43,Burseraceae; 44,Meliaceae; 45,Chailletiaceae.
8. OLACALES. Orders. 46, Olacineae; 47,Ilicineae; 48,Cyrilleae.
9. CELASTRALES. Orders. 49,Celastrineae; 50,Stackhousieae; 51,Rhamneae; 52,Ampelideae.
10. SAPINDALES. Orders. 53,Sapindaceae; 54,Sabiaceae; 55,Anacardiaceae. Ordines anomali. 56,Coriarieae; 57,Moringeae.

Series iii. CALYCIFLORAE. Petals and stamens perigynous. Ovary often more or less enclosed by the development of the floral axis, sometimes inferior.

Cohort 11. ROSALES. Orders. 58,Connaraceae; 59,Leguminosae; 60,Rosaceae; 61,Saxifrageae; 62,Crassulaceae; 63,Droseraceae; 64,Hamamelideae; 65,Bruniaceae; 66,Haloragaeae.
12. MYRTALES. Orders. 67,Rhizophoraceae; 68,Combretaceae; 69,Myrtaceae; 70,Melastomaceae; 71,Lythrarieae; 72,Onagrarieae.
13. PASSIFLORALES. Orders. 73,Samydaceae; 74,Loaseae; 75,Turneraceae; 76,Passifloreae; 77, Cucurbitaceae; 78,Begoniaceae; 79,Datiscaeae.
14. FICOIDALES. Orders. 80,Cacteae; 81,Ficoideae.
15. UMBELLALES. Orders. 82,Umbelliferae; 83,Araliaceae; 84,Cornaceae.

GAMOPETALAE.

Series i. INFERAE. Ovary inferior. Stamens as many as corolla-lobes; rarely fewer.

Cohort 1. RUBIALES. Orders. 85,Caprifoliaceae; 86,Rubiaceae.
2. ASTERALES. Orders. 87,Valerianeae; 88,Dipsaceae; 89,Calycereae; 90,Compositae.
3. CAMPANALES. Orders. 91,Stylideae; 92,Goodenovieae; 93,Campanulaceae.

Series ii. HETEROMERAE. Ovary generally superior. Stamens as many as corolla-lobes, or more; epipetalous or free from the corolla. Carpels more than two.

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Cohort 4. ERICALES. Orders. 94, Ericaceae; 95, Vaccinieae; 96, Monotropeae; 97, Epacrideae; 98, Diapensiaceae; 99, Lennoaceae.

5. PRIMULALES. Orders. 100, Plumbagineae; 101, Primulaceae; 102, Myrsineae.

6. EBANALES. Orders. 103, Sapotaceae; 104, Ebanaceae; 105, Styraceae.

Series iii. BICARPELLATAE. Ovary generally superior. Stamens alternate with the corolla-lobes and equal in number or fewer. Carpels usually two.

Cohort 7. GENTIANALES. Orders. 106, Oleaceae; 107, Salvadoraceae; 108, Apocynaceae; 109, Asclepiadaceae; 110, Loganiaceae; 111, Gentianaceae.

8. POLEMONIALES. Orders. 112, Polemoniaceae; 113, Hydrophyllaceae; 114, Boragineae; 115, Convolvulaceae; 116, Solanaceae.

9. PERSONALES. Orders. 117, Scrophularineae; 118, Orobanchaceae; 119, Lentibularieae; 120, Columelliaceae; 121, Gesneraceae; 122, Bignoniaceae; 123, Pedalineae; 124, Acanthaceae.

10. LAMIALES. Orders. 125, Myoporineae; 126, Selagineae; 127, Verbenaceae; 128, Labiatae.

Ordo anomalus: 129, Plantagineae.

MONOCHLAMYDEAE.

Series i. CURVEMBRYEAE. Embryo curved round the generally mealy albumen. Ovules generally solitary. Flowers usually hermaphrodite. Stamens equal in number to or fewer than the perianth-segments.

Orders. 130, Nyctagineae; 131, Illecebraceae; 132, Amarantaceae; 133, Chenopodiaceae; 134, Phytolaccaceae; 135, Batideae; 136, Polygonaceae.

Series ii. MULTIOVULATAE AQATICAE. Submerged herbs. Ovary syncarpous. Ovules numerous.

Order. 137, Podostemaceae.

Series iii. MULTIOVULATAE TERRESTRES. Terrestrial herbs or shrubs. Ovary syncarpous. Ovules numerous.

Orders. 138, Nepenthaceae; 139, Cytinaceae; 140, Aristolochiaceae.

Series iv. MICREMBRYEAE. Embryo very small in copious albumen. Ovary syncarpous or apocarpous. Ovules usually solitary.

Orders. 141, Piperaceae; 142, Ch loranthaceae; 143, Myristiceae; 144, Monimiaceae.

Series v. DAPHNALES. Ovary usually monocarpellary. Ovules solitary or in pairs. Generally trees or shrubs with hermaphrodite flowers. Perianth sepaloid in one or two species.

Orders. 145, Laurineae; 146, Proteaceae; 147, Thymeleaceae; 148, Penaeaceae; 149, Elaeagnaceae.

Series vi. ACHLAMYDOSPOREAE. Ovary unilocular; 1-3 ovuled. Seeds devoid of testa, albumin naked. Perianth sepaloid or petaloid.

Orders. 150, Loranthaceae; 151, Santalaceae; 152, Balanophoreae.

Series vii. UNISEXUALES. Flowers unisexual. Ovary syncarpous or monocarpellary. Ovules solitary or in pairs. Seeds albuminous or exalbuminous. Perianth sometimes absent.

Orders. 153, Euphorbiaceae; 154, Balnopseae; 155, Urticaceae; 156, Platanaceae; 157, Leitnerieae; 158, Juglandeae; 159, Myricaceae; 160, Casuarineae; 161, Cupuliferae.

Series viii. ORDINES ANOMALI. Near the last series, but not closely allied to any other order. Flowers often unisexual.

Orders. 162, Salicineae; 163, Lacistemaceae; 164, Empetraceae; 165, Ceratophylleae.

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GYMNOSPERMAE.

Orders. 166,Gnetaceae; 167,Coniferae; 168,Cycadaceae.

MONOCOTYLEDONES.

Series i. MICROSPERMAE. At least the inner perianth petaloid. Ovary inferior, generally unilocular with three parietal placentas. Seeds very small, numerous and exalbuminous.
Orders. 169, Hydrocharideae; 170,Burmanniaceae; 171,Orchideae.

Series ii. EPIGYNAE. At least the inner perianth petaloid. Ovary with few exceptions inferior. Albumin copious.
Orders. 172,Scitamineae; 173,Bromiliaceae; 174,Haemodoraceae; 175,Irideae; 176,Amaryllideae; 177,Taccaceae; 178,Dioscoreaceae.

Series iii. CORONARIEAE. At least the inner perianth petaloid. Ovary free. Albumin copious.
Orders. 179,Roxburghiaceae; 180,Liliaceae; 181,Pontederiaceae; 182,Philydraceae; 183,Xyrideae; 184,Mayaceae; 185,Commelinaceae; 186,Rapataceae.

Series iv. CALYCINAE. Perianth small, sepaloid, somewhat stiff or herbaceous. Ovary free. Albumin copious.
Orders. 187,Flagellariae; 188,Juncaceae; 189,Palmae.

Series v. NUDIFLORAE. Perianth 0 or reduced to scales or setae. Ovary superior. Carpels solitary, or if many, syncarpous. 1-many ovuled. Seeds usually albuminous.
Orders. 190,Pandaneae; 191,Cyclanthaceae; 192,Typhaceae; 193,Aroideae; 194, Lemnaceae.

Series vi. APOCARPEAE. Perianth in 1 or 2 series or 0. Ovary superior. Carpels solitary or free. Seeds exalbuminous.
Orders. 195,Triurideae; 196,Alismaceae; 197,Naiadaceae.

Series vii. GLUMACEAE. Flowers in heads or spikelets, subtended by generally imbricated bracts. Perianth small, scale-like or glumaceous, or 0. Ovary 1-ovuled or divided into 1-ovuled loculi. Seeds albuminous.
Orders. 198,Eriocauleae; 199,Centrolepideae; 200,Restiaceae; 201,Cyperaceae; 202,Gramineae

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Engler's system -

Life - Doctorate 1866 on Saxifraga
phylogeny as a stream
Eichler attracted, appointed Eng. as curator at
Munich - helped Eich. on Fl. of Brazil with
Geraniales - anatomical work, led to Araliaceae
study -
1878 Engler curator at Munich.
1886 - 1st system - Guide to Plants of Botanic
Garden at -
1900 - Pflanzenreich - keys down to species
all plants simplest to highest.
Orthodox monographs - 96 Vols by specialists.
Died in 1930, age 86.

System derived from Eichler -
1. W.O. perianth most primitive -
2. Plants w/ undifferentiated perianth -
1 Hypo, Peri, Epig
2. Spiral, cyclic -
3. Apocarpy, syncarpy
4. Polypets, sympets
1. Hypog, Peri, Epig -
2. Actino - zygomorphy -

Rigorous arrangement on floral morphology.
Emphasized tendencies rather than step by
step combinations.

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Engler's System of Angiosperms

Arrangement according to Engler & Diels--Syllabus der Pflanzenfamilien, 11th edition, Berlin, 1936. (Suborders bracketed.)

Numbering according to arrangement used in 5th edition of Syllabus, 1907. These numbers correspond to those used in Engler--Pflanzenreich, and those used in Dalla Torre & Harms--Genera Siphonogamarum, Leipzig, 1900-1907. (Parenthetical numbers indicate segregate families established since 5th edition of Syllabus.)

Asterisks indicate families which have been radically changed in systematic position (or which include genera which have been radically changed in systematic position) between the 1st and ~~5th~~ 11th editions of the Syllabus.

Class MONOCOTYLEDONEAE

PANDANALES
- 8. Typhaceae
- 9. Pandanaceae
- 10. Sparganiaceae

HELOBIAE
- 13. Aponogetonaceae
- 11. Potamogetonaceae
- 12. Najadaceae
- 14. Scheuchzeriaceae
- 15. Alisma(ta)ceae
- 16. Butomaceae
- 17. Hydrocharitaceae

TRIURIDALES
- 18. Triuridaceae

GLUMIFLORAE
- 19. Gramineae
- 20. Cyperaceae

PRINCIPES
- 21. Palmae

SYNANTHAE
- 22. Cyclanthaceae

SPATHIFLORAE
- 23. Araceae
- 24. Lemnaceae

FARINOSAE
- 25. Flagellariaceae
- 26. Restionaceae
- 27. Centrolepidaceae
- 28. Mayacaceae
- 29. Xyridaceae
- 30. Eriocaulaceae
- 30a. Thurniaceae
- 31. Rapateaceae
- 32. Bromeliaceae
- 33. Commelinaceae
- 34. Pontederiaceae
- 34a. Cyanastraceae
- 35. Philydraceae

MONOCOTS (cont.)

LILIIFLORAE
- 36. Juncaceae
- 37. Stemonaceae
- 38. Liliaceae
- 39. Haemodoraceae
- 40. Amaryllidaceae
- 41. Velloziaceae
- 42. Taccaceae
- 43. Dioscoreaceae
- 44. Iridaceae

SCITAMINEAE
- 45. Musaceae
- 46. Zingiberaceae
- 47. Cannaceae
- 48. Marantaceae

MICROSPERMAE
- 49. Burmanniaceae
- 50. Orchidaceae

Class DICOTYLEDONEAE

Subclass Archichlamydeae

VERTICILLATAE
- 51. Casuarinaceae*

PIPERALES
- 52. Saururaceae
- 53. Piperaceae
- 54. Chloranthaceae

HYDROSTACHYALES
- 114. Hydrostachyaceae*

SALICALES
- 56. Salicaceae

GARRYALES
- 56a. Garryaceae*

MYRICALES
- 57. Myricaceae

BALANOPSIDALES
- 58. Balanopsidaceae

DICOTS (cont.)

LEITNERIALES
- 59. Leitneriaceae

JUGLANDALES
- 60. Juglandaceae

JULIANALES
- 60b. Julianaceae

BATIDALES
- 60a, 81. Batidaceae*

FAGALES
- 61. Betulaceae
- 62. Fagaceae

URTICALES
- 63. Ulmaceae
- -- Rhoipteleaceae
- 64. Moraceae
- 65. Urticaceae

PODOSTEMONALES
- 113. Podostemonaceae*

PROTEALES
- 66. Proteaceae

SANTALALES
- 72. Olacaceae
- 71. Opiliaceae
- (72.) Octoknemataceae
- 70. Grubbiaceae
- 69. Santalaceae
- 68. Myzodendraceae
- 67. Loranthaceae

ARISTOLOCHIALES
- 74. Aristolochiaceae
- 75. Rafflesiaceae
- 76. Hydnoraceae

BALANOPHORALES
- 73. Balanophoraceae

POLYGONALES
- 77. Polygonaceae

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DICOTS (cont.)

CENTROSPERMAE
78. Chenopodiaceae
79. Amaranthaceae
80. Nyctaginaceae
83. Phytolaccaceae
(83.)Gyrostemonaceae
(83.)Achatocarpaceae
84. Aizoaceae
85. Portulacaceae
86. Basellaceae
87. Caryophyllaceae

RANALES
88. Nymphaeaceae
89. Ceratophyllaceae
90. Trochodendraceae
(90a. Cercidiphyllaceae
91. Ranunculaceae
92. Lardizabalaceae
93. Berberidaceae
94. Menispermaceae
95. Magnoliaceae
(98.)Himantandraceae
96. Calycanthaceae
97. Lactoridaceae
98. Anonaceae
(98.)Eupomatiaceae
99. Myristicaceae
100. Gomortegaceae
101. Monimiaceae
102. Lauraceae
103. Hernandiaceae

RHOEDALES
104. Papaveraceae
107, 196. Capparidaceae
105. Cruciferae
106. Tovariaceae
108. Resedaceae
109. Moringaceae
(164.)Bretschneideraceae

SARRACENIALES
110. Sarraceniaceae
111. Nepenthaceae
112. Droseraceae

ROSALES
115. Crassulaceae
116. Cephalotaceae
117. Saxifragaceae
118. Pittosporaceae
(112.)Byblidaceae
119. Brunelliaceae
120. Cunoniaceae
121. Myrothamnaceae
122. Bruniaceae
123. Hamamelidaceae
(112.)Roridulaceae
123a. Eucommiaceae

DICOTS (cont.)

ROSALES (cont.)
124. Platanaceae
125. Crossosomataceae
126. Rosaceae
127. Connaraceae
128. Leguminosae

PANDALES
--- Pandaceae

GERANIALES
130. Oxalidaceae
129. Geraniaceae
131. Tropaeolaceae
132, 133. Linaceae
134. Erythroxylaceae
135. Zygophyllaceae
136. Cneoraceae
137. Rutaceae
138. Simarubaceae
139. Burseraceae
140. Meliaceae
(165.)Akaniaceae
141. Malpighiaceae
142. Trigoniaceae
143. Vochysiaceae
144. Tremandraceae
145. Polygalaceae
146. Dichapetalaceae
147. Euphorbiaceae
(147.)Daphniphyllaceae
148. Callitrichaceae

SAPINDALES
149. Buxaceae
150. Empetraceae
151. Coriariaceae
152. Limnanthaceae
153. Anacardiaceae
154. Cyrillaceae
155. Pentaphyllaceae
156. Corynocarpaceae
157. Aquifoliaceae
158. Celastraceae
159. Hippocrateaceae
244. Salvadoraceae
160. Stackhousiaceae
161. Staphyleaceae
162. Icacinaceae
(157.)Aextoxicaceae
163. Aceraceae
164. Hippocastanaceae
165. Sapindaceae
166. Sabiaceae
167. Melianthaceae
78a. Didiereaceae
168. Balsaminaceae

DICOTS (cont.)

RHAMNALES
169. Rhamnaceae
170. Vitaceae

MALVALES
171. Elaeocarpaceae
172. Chlaenaceae
174. Tiliaceae
175. Malvaceae
177. Bombacaceae
176, 178. Sterculiaceae
179. Scytopetalaceae

PARIETALES
180. Dilleniaceae
(180.)Actinidiaceae
181. Eucryphiaceae
(187.)Medusagynaceae
182. Ochnaceae
(182.)Strasburgeriaceae
183. Caryocaraceae
184. Marcgraviaceae
185. Quiinaceae
186. Theaceae
187. Guttiferae
188. Dipterocarpaceae
189. Elatinaceae
190. Frankeniaceae
191. Tamaricaceae
193. Cistaceae
194. Bixaceae
195. Cochlospermaceae
197. Canellaceae
198. Violaceae
55, 199. Flacourtiaceae
200. Stachyuraceae
201. Turneraceae
202. Malesherbiaceae
203. Passifloraceae
204. Achariaceae
205. Caricaceae
206. Loasaceae
207. Datiscaceae
208. Begoniaceae
209. Ancistrocladaceae

OPUNTIALES
210. Cactaceae

MYRTIFLORAE
211. Geissolomataceae
212. Penaeaceae
213. Oliniaceae
173, 214. Thymelaeaceae
215. Elaeagnaceae

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DICOTS (cont.)

MYRTIFLORAE (cont.)
216. Lythraceae
--- Heteropyxidaceae
217. Sonneratiaceae
217a. Crypteroniaceae
218. Punicaceae
219. Lecythidaceae
220. Rhizophoraceae
(229.) Nyssaceae*
(229.) Alangiaceae*
221. Combretaceae
222. Myrtaceae
223. Melastoma(ta)ceae
(224.) Hydrocaryaceae
224. Oenotheraceae
225. Halorrhag(id)aceae
225a. Hippuridaceae
82. Thelygonaceae*
226. Cynomoriaceae

UMBELLIFLORAE
227. Araliaceae
228. Umbelliferae
229. Cornaceae

subclass Metachlamydeae

DIAPENSIALES
235. Diapensiaceae

ERICALES
230. Clethraceae
231. Pirolaceae
233. Ericaceae
234. Epacridaceae

PRIMULALES
235a. Theophrastaceae
236. Myrsinaceae
237. Primulaceae

PLUMBAGINALES
238. Plumbaginaceae

EBENALES
239. Sapotaceae
(199.) Hoplestigmataceae*
240. Ebenaceae
(241.) Diclidantheraceae
242. Symplocaceae
241. Styracaceae
(241.) Lissocarpaceae

DICOTS (cont.)

CONTORTAE
243. Oleaceae
(245.) Desfontaineaceae
245. Loganiaceae
246. Gentianaceae
247. Apocynaceae
248. Asclepiadaceae

TUBIFLORAE
249. Convolvulaceae
250. Polemoniaceae
192. Fouquieraceae*
232. Lennoaceae*
251. Hydrophyllaceae
252. Borraginaceae
253. Verbenaceae
254. Labiatae
255. Nolanaceae
256. Solanaceae
257. Scrophulariaceae
258. Bignoniaceae
259. Pedaliaceae
260. Martyniaceae
261. Orobanchaceae
262. Gesneriaceae
263. Columelliaceae
264. Lentibulariaceae
265. Globulariaceae
266. Acanthaceae
267. Myoporaceae
268. Phrymaceae

PLANTAGINALES
269. Plantaginaceae

RUBIALES
270. Rubiaceae
271. Caprifoliaceae
272. Adoxaceae
273. Valerianaceae
274. Dipsaceae

CUCURBITALES
275. Cucurbitaceae

CAMPANULATAE
276. Campanulaceae
277. Goodeniaceae
(277.) Brunoniaceae
278. Stylidaceae
279. Calyceraceae
280. Compositae

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Toronto 160 Class Brief 5/5/48

Life of Charles Edwin Bessey

Charles E. Bessey, in the best of tradition, was born in a log cabin, in Milton Township, Wayne County, Ohio, May 21, 1845. Adnah Bessey, his father was of French Huegenot stock, and was a teacher, apparently in a country school. Bessey's mother, Margaret, first met his father when she was a student of Adnah, whom she married in 1841.

Bessey received his first education from his father, and in his 17th year, received a licensex to teach school, but turned this down to study in a country school and an academy, preparatory to entering Michigan Agricultural College in July 1866. He started as a major in civil engineering but under the influence of the President of the College, he switched to botany and received his BS Nov. 10, 1869.

After graduation, Bessey worked for a while as an assistant in horticulture in Michigan, but soon accepted an instructorship in botany and horticulture from Iowa State College of Agriculture at Ames. While at Ames, he helped found the Farmers Institute in 1870, and the Iowax Academy of Sciences. In 1875, he became president of this organization, and was re-elected several times.

In 1872, he became a member of AAAS, at the meeting in Dubuque, Iowa. The next summer, he studied under Dr. Asa Gray axxHarvxxx, whom he had met at his first meeting of AAAS.

He received his MS from Michigan Ag. College in 1872, and was promoted to full professorship at Ames. In 1874, he went to the University of California as a temporary Lecturer in Botany.

The University of Iowax conferred the degree of doctor of philosophy upon Exxxbxxxx Bessey, 1879 in recognition of his publications in botany and as a partial reward for what he had accomplished for the state of Iowa.

In 1884, Dr. Bessey became professor of botany at the University of Nebraska, after fifteen years at Ames. He was active in many scientific organizations, among them, the Society for the Promotion of Agricultural

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1893, 1894, 1902 and 1907,
Science, and the Western Society of Naturalists. In 1888, he was ~~xxxxxx~~
vice-president of the botanical section of AAAS. He was also a charter
member of the Botanical Society of America, of which he was president in
1895. That year he was also president of the department of science of the
National Education Association. He was chosden botanical editor of The
American Naturalist in 1880, a position which he held until 1897, when
he switched to a similar position on the staff of Science.

His greatest honor came in 1910-11, when he became president of the
AAAS.

Besides his interest in taxonomy, Dr. Bessey also was a student of
physiology, morphology, paleobotany, and mycology. One of his papers,
"The Diseases of Plants" is well known. He helped write the Hatch Act,
which established federal aid for state agricultural experiment stations.
He also wrote the 1st and second annual report of the Ag. Expt. Sta.
of Nebraska in 1888 and 1889.

Much of Dr. Bessey's time was devoted to a painstaking survey of
the structure and evolution of all plants. At nearly every meeting
frequently
he attended, he presented some phase of this study, so/~~xxxxxxx~~, that
according to Dr. Greenman, his colleagues became fed up with it.

In addition to these many activities, he had the reputation of
being one of the greatest teachers of his time. He was among the first
to use the laboratory technique of botany teaching, and he introduced the
compound microscope both to Ames and Nebraska.

Bessey wrote several texts, among them "The Essentials of Botany",
"Botany for High Schools and Colleges", and "The Essentials of College Botany",
~~and others.~~

~~xxxxxxxxx~~ Along with his other abilities, he was a good college
administrator, and served at intervals as the acting president at Ames,
and as chancellor at Nebraska.

He had three sons, one of whom majored in botany(Ernst A.) and became
a specialist of great renown in the fungi.

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Perhaps the greatest contribution to botany made by Dr. Bessey was his phylogenetic system of taxonomy, and his last work, "The Phylogenetic Taxonomy of Flowering Plants", was one of a series of papers read by invitation at the 25th Anniversary Celebration the Missouri Botanical Garden, October 15, 1914.

Dr. Bessey died in Lincoln, Nebraska on February 25, 1915.

The Besseyan system is quite a departure from the systems we've seen up to this report. The closest parallel is to that of Engler, but the most primitive group is the Ranales, rather than the Apetalous forms, which according to Bessey, are but reduction series of the polypetaly, for example Salicaceae, which he places as an apetalous, declincus Tamariscineae, in the Caryophyllales.

There is no group of Amentiferae, Monochlamydeae, Polypetalae, or Sympetalae, and there has been a great reduction in the number of order,s 32 in all, whereas Engler has 55. Bessey's reputation as a splitter may be somewhat over-looked, since this was the trend in his day. He lists exactly 300 families, (280 according to Kew Index), and the greatest "splitting" was done in the Compositae, or Asterales, in which he made 15 families from the tribes.

The basis of Bessey's phylogenetic system is a group of 28 dicta, or postulates. The first seven of these dicta are general, the next seven refer to general structure of the flowering plants, and the last 14 deal with the flowers of flowering plants.

Before examination of the system, it is necessary to review these "dicta" on which the system is based.

A. General Dicta

1. Evolution is not always upward, but often it involves degradation and degeneration.

2. In general, homogeneous structures (with many and similar parts) are lower, and heterogeneous structures (with fewer and dissimilar parts) are higher.

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3. Evolution does not necessarily involve all organs of the plant equally in any particular period, and one organ may be advancing while another is retrograding.

4. Upward development is sometimes through an increase in complexity, and sometimes by a simplification of an organ or a set of organs.

Used by zoologists for 20 plain why certain crustacea have died out.

5. Evolution has generally been consisten,t ,and when a particular progression or retrogression has set in, it is persisted in to the end of the phylum.

6. In any phylum the holophytic (chorophyll-green) plants precede the colorless (hysterophytic) plants, and the latter are derived from the former.

7. Plant relationships are up and down the genetic lines, and these must constitute the framework of phylogenetic taxonomy.

B. Dicta having Special Reference to the General Structure of the Flowering Plants.

8. The stem structure with collateral vascular bundles arranged in a cylinder is more primitive than that with scattered bundles, and the latter are to be regarded as derived from the former. Presently borne out

9. Woody stems (as of trees) are more primitive than herbaceous stems, and herbs are held to have been derived from trees. Generally ok.

10. The simple, unbranched stem is an earlier type, from which branching stems have been derived. Doubtful, directly opposed to previous statements

11. Historically the arrangement of leaves in pairs on the stem is held to have prededed the spiral arrangement in which the leaves are solitary at the nodes. ok- in Sequoia, even headstone stems. (united leaves probably stem systems. Wenham)

12. Historically simple leaves prededed branched ("compound") leaves. ok

13. Historically leaves were first persistent ("evergreen") and later deciduos.

14. The reticulated venation of leaves is the normal structure, and the parallel venation of some leaves is a special modification derived from it.

C. Dicta having Reference to the Flowers of Flowering Plants.

15. The polymerous flower structure precedes, and the oligomerous structure follows from it, and this is accompanied by a progressive sterilization of stamens. Yes with many parts have homogeneous function.

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16. Petaly is the normal perianth structure, and apetaly is the result of perianth reduction. (aphanisis).

17. The apochlamydeous (dialypetalous) perianth is earlier and the gamochlamydeous (sympetalous) perianth is derived from it by a symphysis of the members of perianth whorls.

18. Actinomorphy is an earlier structure than zygomorphy, and the latter results from a change from a similar to a dissimilar growth of the members of the perianth whorls.

19. Hypogyny is the more primitive structure, and from it epigyny was derived later.

20. Apocarpy is the primitive structure, and from it syncarpy was derived later.

21. Polycarpy is the earlier condition, and oligocarpy was derived from it later.

22. The endospermous seed is primitive and lower, while the seed without endosperm is derived and higher.

23. Consequently, the seed with a small embryo (in endosperm) is more primitive than the seed with a large embryo (in scanty or no endosperm).

24. In earlier (primitive flowers there are many stamens (polystemonous) while in later flowers there are fewer stamens (oligostemonous).

25. The stamens of primitive flowers are separate (apostemonous), while those of derived flowers are often united (synstemonous).

26. The condition of powdery pollen is more primitive than that with coherent or massed pollen.

27. Flowers with both stamens and carpels (monoclinous) precede those in which these occur on separate flowers (diclinous). (hermaphrodite ♀ / dioecious=plant w/♂&♀fls on separate plants / monoecious=plant w/♂&♀fls on 1 plant)

28. In diclinous plants the monoecious condition is the earlier, and the dioecious later.

Polygamy=hermaphrodite + diclinous fls on same plant.
Polygamomonoecious=on 1 plant, the diclinous fls of both sx.
Dioecious=on 1 plant, the diclinous fls of 1 sex only

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In applying these dicta, two classes are named--Oppositifoliae for the dicots, from the opposite cotyledons, as the primitive group, the Alternifoliae, or monocts, with alternate cotyledons (scutellum as 1st cotyledon, and the 1st leaf of the node above as the 2nd) as the derived group.

He points out a similarity of the two classes, as shown by the similarity of modifications in both, the Oppositifoliae showing more details of variation since it is the larger group. The Ranales are the point of origin for the Oppositifoliae, and the Alismatales from the Alternifoliae.

The strobiloid flower structure, in which the axis is elongated, cylindrical, spheroidal, or flattened, bearing on its surface the fertile and sterile sporophylls, prevails in the earlier orders of both classes. This strobiloid form produces the hypogynous flower, and in both classes, shows a progressive modification involving the perianth (actinomorphy to zygomorphy), the stamens (polystemony to oligostemony), the carpels (polycarpy to oligocarpy) and the ovules (multiovulate to rariovulate). In the Oppositifoliae, perianth modifications procede with such regularity as to be able to recognize lower (apopetalous) and higher (sympetalous) groups of orders, but this doesn't hold for the Alternifoliae.

According to Bessey, the Oppositifoliae was the first to emerge from the cycadean phyllum, appearing as the Ranalean complex, and the Alternifoliae arise from this Ranalean complex, the first being the apocarpous Alismatales.

From the Alismatales arise the syncarpous Liliales, with progressive modification to the Arales, Palmales and Graminales. From Liliales by a cotyloid modification the mostly actinomorphic epigynous Iridales are derived, and from these again the zygomorphic epigynous Orchidales. Returning to the Ranales, there are five apopetalous, polycarpellate orders with gradually increasing syncarpy arising, namely Malvales, Geraniales, Guttiferales, Rhoeadales, and Caryophyllales. From the last arise three orders

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or sympetalous, polycarpellate plants, the Ebenales, Ericales and Primulales, and the latter have developed the dicarpellate orders Gentianales, Polemoniales, Scrophulariales and Lamiales, constituting a series which shows diminishing numbers of stamens, carpels and seeds, and increasing zygomorphy. This phyletic sequence from Ranales to Lamiales constitutes the sub-class Strobiloideae, or cone-flowers.

Returning again to the Ranales, we find that they give rise to the simpler, cotyloid, apopetalous, polystemonous, polycarpous, hypogynous Rosales (sub-class Cotyloideae), from which by the early deepening of the cotyloid structure we have the mostly polystemonous, polycarpous, epigynous Myrtales, Loasales and Cactales as a strongly developed side line. The oligostemonous Celastrales continue the main phyletic line with reducing numbers of stamens, carpels and seeds, and a gradual deepening of the cup, to the side-line of the Sapindales, which are eventually epigynous, and the mostly dicarpellate Umbellales. The sympetalous, epigynous Rubiales with reduced calyx, few carpels and few seeds, pass easily into the Campanulales, and the Asterales, the latter with but one seed in the dicarpellary, one-celled, one-seeded, inferior ovary, and with its calyx, when not obsolete, transformed into bracts, spines or bristles to form a "pappus".

According to Bessey, the flowering plants arose from cycadean strobiliferous ancestors, probably of the general type of the Bennettitineae, and as a consequence those anthophyta are considered to be primitive in which the sporophyllas are many and distinct. He split the angiosperm and gymnosperms into three phylla--the Cycadophyta, Strobilophyta (conifers) and Anthophytha.

In this system, the dicotyledons are considered to have had their beginning earlier than the monocotyledons, which must be regarded as having diverged very early from the primitive dicotyledons, and developed into a relatively small lateral branch. The point of divergence of the monocots from the dicots must have been in the order Ranales, probably in the

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neighborhood of the Ranunculaceae. It is not probable that the early (woody) magnoliads or Anonads gave rise to the monocots divergence; it is more probable that this modification arose after the reduction had taken place from the ligneous to the herbaceous Ranales. This is a possible explanation of the marked herbaceousness of monocotyledons as constrasted with the general tendency toward a more ligneous structure in dicotyledons.

In the Ranales, the 24 families included group themselves about three centers, the Magnoliaceae, Annonaceae and the Ranunculaceae. The plants in these centers are typically diplochlamydeous, polycarpellate, hermaphrodite, and actinomorphic, and the modifications in the surrounding families have been such as to result in an achlamydeous structure, which may be monocarpellate, diclinous, and even zygomorphic.

In Caryophyllales, the general arrangement of the families is best understood by placing the Caryophyllaceae centrally at the base; from this, one line runs off to the diplochlamydeous, hermaphrodite Frankeniaceae and Tamaricaceae to the achlamydeous, diclinous Salicaceae, while on the other hand another line passes from the diplochlamydeous, many-ovuled Caryophyllaceae to the apetalous, 1-ovuled Amaranthaceae, Chenopodiaceae and Polygonaceae.

The order Polemoniales is related to the Primulales, and through it to the Caryophyllales.

The characters of Rosales (petals separate, carpels many to few, separate to united, superior to inferior) places it close to the Ranales. The Rosales is another example of Bessey's tendency to split, making families from tribes, especially in the Rosaceae. Casaurinaceae is doubtfully placed here, on the theory that it is a leafless relative of Hamamelidaceae.

The position of the family Proteaceae in the Sapindales is, as Bessey says, "puzzling", and he is doubtful of its affinities.

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In Bessey's arrangement of the Asterales, the Helianthaceae are regarded as the lowest, f om which the two principal phyletic lines have arisen, culminating on the one hand in the Eupatoriaceae, and on the other in the Lactucaceae.

In the Poaceae the hypogynous, tricarpellary monocotyledons reach their culmination, as a highly specialized side line. In grasses the specialization involves plant-body, inflorescence, and flowers. Their nodose, mostly hollow, elongated stems, and long, narrow, tough leaves; the spreading 1-ovuled pistils, producing caryopsis-fruits, are some of the more obvious indications of high specialization, suggesting the possibility that these plants, rather than the orchids, are the highest of the monocotyledons. With the Poaceae the hypogynous monocotyledonous phylum ends. Grasses have not given rise to other groups of plants.

Bessey doesn't consider the Orchidaceae as the culminating family of monocots, since the striking flower structures are "rather easily made entomophylous modifications of the perianth, the most mobile portion of the plant".

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Class: Alternifoliae
Sub-Class: Alternifoliae-Strobiloideae
Order:
Alismatales
1. Alismataceae
2. Butomaceae
3. Triuridaceae
4. Scheuchzeriaceae
5. Typhaceae
6. Sparganiaceae
7. Pandanaceae
8. Aponogetonaceae
9. Potamogetonaceae

Liliales
10. Liliaceae
11. Stemonaceae
12. Pontederiaceae
13. Cyanastraceae
14. Philydraceae
15. Commelinaceae
16. Xyridaceae
17. Mayacaceae
18. Juncaceae
19. Eriocaulanaceae
20. Thurniaceae
21. Rapateaceae
22. Naiadaceae

Arales
23. Cyclanthaceae
24. Araceae
25. Lemnaceae

Palmales
26. Palmaceae

Graminales
27. Restionaceae
28. Centrolepidiaceae
29. Flagellariaceae
30. Cyperaceae
31. Poaceae

Sub-Class: Alternifoliae-Cotyloideae
Order:
Hydrales
32. Vallisneriaceae

Iridales
33. Amaryllidaceae
34. Haemodoraceae
35. Iridaceae
36. Velloziaceae

Iridales (Cont.)
37. Taccaceae
38. Dioscoreaceae
39. Bromeliaceae
40. Musaceae
41. Zingiberaceae
42. Marantaceae

Orchidales
44. Burmanniaceae
45. Orchidaceae

Class: Oppositifoliae
Sub-Class: Oppositifoliae-Strobiloideae-Apopetalae-Polycarpellatae
Order:
Ranales
46. Magnoliaceae
47. Calycanthaceae
48. Monimiaceae
49. Cercidiphyllaceae
50. Trochodendraceae
51. Leitneriacea e
52. Anonaceae
53. Lactoridaceae
54. Gomortegaceae
55. Myristicaceae
56. Saururaceae
57. Piperaceae
58. Lacistemaceae
59. Chloranthaceae
60. Ranunculaceae
61. Lardizabalaceae
62. Berberidaceae
63. Menispermaceae
64. Lauraceae
65. Nelumbaceae
66. Cabombaceae
67. Ceratophyllaceae
68. Dilleniaceae 69
69. Winteranaceae

Malvales
70. Sterculiaceae
71. Malvaceae
72. Bombacaceae
73. Scytopetalaceae
74. Chlaenaceae
75. Gonystylaceae
76. Tiliaceae
77. Elaeocarpaceae
78. Balanopsidaceae
79. Ulmaceae
80. Moraceae
81. Urticaceae

Sarraceniales
82. Sarraceniaceae
83. Nepenthaceae

Geraniales
84. Geraneaceae
85. Oxalidaceae
86. Tropaeolaceae
87. Balsaminaceae
88. Limnanthaceae
89. Linaceae
90. Humiriaceae
91. Erythroxylaceae
92. Zygophyllaceae
93. Cneoraceae
94. Rutaceae
95. Simarubaceae
96. Burseraceae
97. Meliaceae
98. Malpighiaceae
99. Trigoniaceae
100. Vochysiaceae
101. Polygalaceae
102. Tremandraceae
103. Dichapetalaceae
104. Euphorbiaceae
105. Callitrichaceae

Guttiferales
106. Theaceae
107. Cistaceae
108. Guttiferaceae
109. Eucryphiaceae
110. Ochnaceae
111. Dipterocarpaceae
112. Caryocaraceae
113. Quiinaceae
114. Marcgraviaceae
115. Flacourtiaceae
116. Bixaceae
117. Cochlospermaceae
118. Violaceae
119. Malesherbiaceae
120. Turneraceae
121. Passifloraceae
122. Acnariaceae
123. Caricaceae
124. Stachyuraceae
125. Keeberliniaceae

Rhoeadales
126. Papaveraceae
127. Tovariaceae
128. Nymphaeaceae
129. Moringaceae
130. Resedaceae
131. Capparidaceae
132. Brassicaceae

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Caryophyllales
133. Caryophyllaceae
134. Elatinaceae
135. Portulacaceae
136. Aizoaceae
137. Frankeniaceae
138. Tamaricaceae
139. Salicaceae
140. Podostemonaceae
141. Hydrostachydaceae
142. Phytolaccaceae
143. Basellaceae
144. Amaranthaceae
145. Chenopodiaceae
146. Polygonaceae
147. Nyctaginaceae
148. Cynocrambaceae
149. Batidaceae

Super-Order Strobilideae-
Sympetalae-
Polycarpellatae
Order:
Ebenales
150. Sapotaceae
151. Ebenaceae
152. Symplocaceae
153. Styracaceae
154. Fouquieriaceae

Ericales
155. Clethraceae
156. Ericaceae
157. Epacridaceae
158. Diapensiaceae
159. Pirolaceae
160. Lennoaceae

Primulales
161. Primulaceae
162. Plantaginaceae
163. Plumbaginaceae
164. Myrsinaceae
165. Theophrastaceae

Super-Order Strobiloideae-
Sympetalae-
Dicarpellatae
Order
Gentianales
166. Oleaceae
167. Salvadoraceae
168. Loganiaceae
169. Gentianaceae
170. Apocynaceae
171. Asclepiadaceae

Polemoniales
172. Polemoniaceae
173. Convolvulaceae
174. Hydrophyllaceae
175. Borraginaceae
176. Nolan aceae
177. Solanaceae

Scrophulariales
178. Scrophulariaceae
179. Bignoniaceae
180. Pedal iaceae
181. Martyniaceae
182. Orobanchaceae
183. Gesneraceae
184. Columelliaceae
185. Lentibulariaceae
186. Globulariaceae
187. Acanthaceae

Lamiales
188. Myoporaceae
189. Phrymaceae
190. Verbenaceae
191. Lamiaceae

Sub-Class: Oppositifoliae-
Cotyloideae
Super-Order: Cotyloideae-
Apopetalae
Order
Rosales
192. Rosaceae
193. Malaceae
194. Prunaceae
195. Crossosomataceae
196. Connaraceae
197. Mimosaceae
198. Cassiaceae
199. Fabaceae
200. Saxifragaceae
201. Hydrangeaceae
202. Grossulariaceae
203. Crassulaceae
204. Droseraceae
205. Cephalotaceae
206. Pittosporaceae
207. Brunelliaceae
208. Cunoniaceae
209. Myrothamnaceae
210. Bruniaceae
211. Hamamelidaceae
212. Casua rinaceae
213. Eucommiaceae
214. Platanaceae

Myrtales
215. Lythraceae
216. Sonneratiaceae
217. Punicaceae
218. Lecythidaceae
219. Melastomataceae
220. Myrtaceae
221. Combretaceae
222. Rhizophoraceae
223. Oenotheraceae
224. Halorrhagidaceae
225. Hippuridaceae
226. Cynomoriaceae
227. Aristolochiaceae
228. Rafflesiaceae
229. Hydnoraceae

Loasales
230. Loasaceae
231. Cucurbitaceae
232. Begoniaceae
233. Datiscaceae
234. Ancistrocladaceae

Cactales
235. Cactaceae

Celastrales
236. Rhamnaceae
237. Vitaceae
238. Celastraceae
239. Buxaceae
240. Aquifoliaceae
241. Cyrillaceae
242. Pentaphylacaceae
243. Corynocarpaceae
244. Hippocrateaceae
245. Stackhousiaceae
246. Staphyleaceae
247. Geissolomataceae
248. Penaeaceae
249. Oliniaceae
250. Thymelaeaceae
251. Hernandiaceae
252. Elaeagnaceae
253. Myzodendraceae
254. Santalaceae
255. Opiliaceae
256. Grubbiaceae
257. Olacaceae
258. Loranthaceae
259. Balanophoraceae

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Sapindales
260. Sapindaceae
261. Hippocastanaceae
262. Aceraceae
263. Sabiaceae
264. Icacinaceae
265. Melianthaceae
266. Empetraceae
267. Coriariaceae
268. Anacardiaceae
269. Juglandaceae
270. Betulaceae
271. Fagaceae
272. Myricaceae
273. Julianaceae
274. Proteaceae

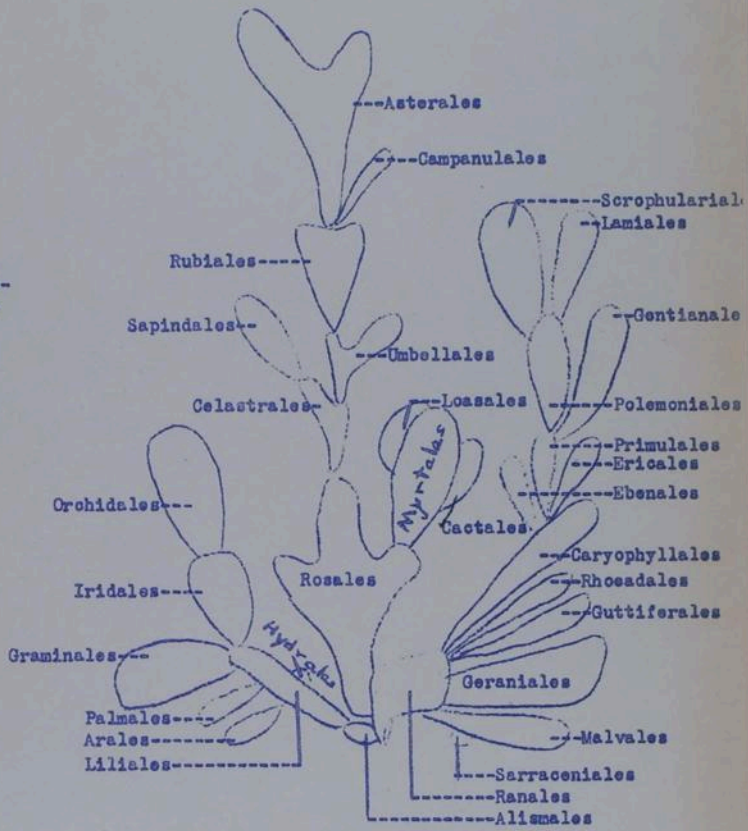
Umbellales
275. Araliaceae
276. Apiaceae
277. Cornaceae

Super-Order: Cotyloideae-Sympetalae

Order
Rubiales
278. Rubiaceae
279. Caprifoliaceae
280. Adoxaceae
281. Valerianaceae
282. Dipsacaceae

Campanulales
283. Campanulaceae
284. Goodeniaceae
285. Stylidiaceae
286. Calyceraceae

Asterales
287. Helianthaceae
288. Ambrosiaceae
289. Heleniaceae
290. Arctotidaceae
291. Calendulaceae
292. Inulaceae
293. Asteraceae
294. Vernoniaceae
295. Eupatoriaceae
296. Anthemidaceae
297. Senecionidaceae
298. Mutisiaceae
299. Lactucaceae
300. Carduaceae



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A. Etter
5/5/48

Order

ORDERS OF ANGIOSPERMS ACCORDING TO THE SYSTEM

OF RICHARD VON WETTSTEIN

I. Class. Dicotyledones
1. Subclass. Choripetalae
A. Monochlamydeae
1. Order. Verticillatae
1. Fam. Casuarinaceae
2. Fagales
2. Betulaceae
3. Fagaceae
3. Myricales
4. Myricaceae
4. Leitneriales
5. Leitneriaceae
5. Juglandales
6. Julianiaceae
7. Juglandaceae
6. Garryales
8. Garryaceae
7. Salicales
9. Salicaceae
8. Batidales
10. Batidaceae
9. Balanopsidales
11. Balanopsidaceae
10. Urticales
12. Moraceae
13. Cannabaceae
14. Ulmaceae
15. Eucommiaceae
16. Rhoipteleaceae
17. Urticaceae
11. Piperales
18. Piperaceae
19. Saururaceae
20. Chloranthaceae
21. Lacistemonaceae
12. Proteales
22. Proteaceae
13. Santalales
23. Santalaceae
24. Grubbiaceae
25. Opiliaceae
26. Octocnemataceae
27. Olacaceae
28. Myzodendraceae
29. Loranthaceae
30. Balanophoraceae
31. Cynomoriaceae
14. Polygonales
32. Polygonaceae
15. Centrospermae
33. Chenopodiaceae
34. Amarantaceae
35. Phytolaccaceae
36. Thelygonaceae
37. Nyctaginaceae
38. Aizoaceae
39. Cactaceae
40. Portulacaceae
41. Basellaceae
42. Caryophyllaceae
16. Tricoccae
43. Euphorbiaceae
44. Daphniphyllaceae
45. Dichapetalaceae
46. Buxaceae
47. Callitrichaceae
17. Hamamelidales
48. Hamamelidaceae
49. Cercidiphyllaceae
50. Eupteleaceae
51. Platanaceae
52. Myrothamnaceae
B. Dialypetalae
18. Polycarpicae - Ranales - Aristolochiales
53. Magnoliaceae
54. Trochodendraceae
55. Lactoridaceae
56. Himantandraceae
57. Eupomatiaceae
58. Anonaceae
59. Myristicaceae
60. Canellaceae
61. Aristolochiaceae
62. Rafflesiaceae
63. Hydnoraceae
64. Calycanthaceae
65. Gomortegaceae
66. Monimiaceae
67. Lauraceae
68. Hernandiaceae
69. Menispermaceae
70. Lardizabalaceae
71. Ranunculaceae
72. Berberidaceae
73. Nymphaeaceae
74. Ceratophyllaceae
75. Nepenthaceae

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Born in 1863 – Died 1931

Prof. at Univ of Vienna –

4 eds of System

late revision 1924 –

Spanish Ed. 1934 –

Copious illustrations assist

Used Engler as foundation

Emphasized primitiveness of Monochlamydeae

Tronco IV Cormophyta

Div. 1 - Archegoniatae

Subdiv. 1. Brophyta

Subdiv. 2. Pteridophyta

Div. 2 - Antophyta

Subdiv 1. Gymnospermae

" 2. Angiospermae

Class 1. Dicotyledoneae

Sub-Class 1 Choripetalae

A. Monochlamydeae

B. Dialpetalae

Sub Class 2 - Sympetalae

Class 2. Monocotyledoneae

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76. Cephalotaceae
77. Sarraceniaceae
19. Rhoeadales
78. Papaveraceae
79. Tovariaceae
80. Capparidaceae
81. Cruciferae
82. Resedaceae
83. Moringaceae
20. Parietales
84. Cistaceae
85. Bixaceae
86. Cochlospermaceae
87. Tamaricaceae
88. Fouquieriaceae
89. Frankeniaceae
90. Elatinaceae
91. Droseraceae
92. Violaceae
93. Flacourtiaceae
94. Stachyuraceae
95. Turneraceae
96. Malesherbiaceae
97. Passifloraceae
98. Achariaceae
99. Caricaceae
100. Loasaceae
101. Begoniaceae
102. Datiscaceae
103. Ancistrocladaceae
21. Guttiferales
104. Dilleniaceae
105. Actinidiaceae
106. Ochnaceae
107. Strasburgeriaceae
108. Eucryphiaceae
109. Caryocaraceae
110. Marcgraviaceae
111. Quiinaceae
112. Theaceae
113. Guttiferae
114. Dipterocarpaceae
22. Rosales
115. Crassulaceae
116. Saxifragaceae
117. Cunoniaceae
118. Brunelliaceae
119. Myrothamnaceae
120. Pittosporaceae
121. Byblidaceae
122. Roridulaceae
123. Bruniaceae
124. Podostemonaceae
125. Hydrostachyaceae
126. Rosaceae
127. Crossosomataceae
128. Chrysobalanaceae
129. Connaraceae
130. Mimosaceae
131. Papilionaceae
23. Myrtales
132. Penaeaceae
133. Geissolomataceae
134. Oliniaceae
135. Thymelaeaceae
136. Elaeagnaceae
137. Lythraceae
138. Heteropyxidaceae
139. Sonneratiaceae
140. Rhizophoraceae
141. Alangiaceae
142. Nyssaceae
143. Lecythidaceae
144. Combretaceae
145. Myrtaceae
146. Punicaceae
147. Melastomataceae
148. Oenotheraceae
149. Halorrhagidaceae
150. Gunneraceae
151. Hippuridaceae
24. Columniferae
152. Malvaceae
153. Bombacaceae
154. Tiliaceae
155. Sterculiaceae
156. Elaeocarpaceae
157. Chlaenaceae
158. Gonystylaceae
159. Scytopetalaceae
25. Gruinales
160. Linaceae
161. Humiriaceae
162. Oxalidaceae
163. Geraniaceae
164. Limnanthaceae
165. Tropaeolaceae
166. Erythroxylaceae
167. Malpighiaceae
168. Zygophyllaceae
169. Cneoraceae
26. Terebinthales
170. Rutaceae
171. Simarubaceae
172. Burseraceae
173. Meliaceae
174. Tremandraceae
175. Polygalaceae
176. Xanthoplyllaceae
177. Trigoniaceae
178. Vochysiaceae
179. Anacardiaceae
180. Sapindaceae

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Botrytales

1. Presence of reduction – primitive.
2. Adaptation to climate, derived.
3. Families with many morph. differences are in process of evolution + young.
4. Stable families with few + unchanging forms are older.
5. Woody → herbaceous
6. Helicoid → cyclic.

Reason for primitiveness of Monochlamydeae is wind pollination, chalazal pollination (pollinat from chalaza)

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181. Akaniaceae
182. Aextoxicaceae
183. Aceraceae
184. Hippocastanaceae
185. Coriariaceae
186. Cyrillaceae
187. Pentaphylacaceae
188. Sabiaceae
189. Melianthaceae
190. Corynocarpaceae
191. Balsaminaceae
27. Celastrales
192. Aquifoliaceae
193. Celastraceae
194. Salvadoraceae
195. Staphyleaceae
196. Hippocrateaceae
197. Stackhousiaceae
198. Icacinaceae
28. Rhamnales
199. Rhamnaceae
200. Vitaceae
29. Umbelliflorae
201. Cornaceae
202. Araliaceae
203. Umbelliferae
2. Subclass. Sympetalae
1. Plumbaginales
204. Plumbaginaceae
2. Primulales
205. Theophrastaceae
206. Primulaceae
207. Androsaceae
208. Myrsinaceae
3. Bicornes
209. Clethraceae
210. Pirolaceae
211. Ericaceae
212. Empetraceae
213. Epacridaceae
214. Diapensiaceae
4. Diospyrales
215. Ebenaceae
216. Hoplestigmataceae
217. Styracaceae
218. Symplocaceae
219. Sapotaceae
5. Tubiflorae
220. Convolvulaceae
221. Cuscutaceae
222. Polemoniaceae
223. Hydrophyllaceae
224. Lennoaceae
225. Boraginaceae
226. Nolanaceae
227. Solanaceae
228. Scrophulariaceae
229. Lentibulariaceae
230. Orobanchaceae
231. Gesneriaceae
232. Bignoniaceae
233. Pedaliaceae
234. Martyniaceae
235. Acanthaceae
236. Verbenaceae
237. Labiatae
238. Globulariaceae
239. Phrymaceae
240. Myoporaceae
241. Plantaginaceae
242. Columelliaceae
6. Contortae
243. Loganiaceae
244. Buddleiaceae
245. Gentianaceae
246. Menyanthaceae
247. Apocynaceae
248. Asclepiadaceae
7. Ligustrales
249. Oleaceae
8. Rubiales
250. Rubiaceae
251. Caprifoliaceae
252. Adoxaceae
253. Valerianaceae
254. Dipsacaceae
255. Calyceraceae
9. Cucurbitales
256. Cucurbitaceae
10. Synandrae
257. Campanulaceae
258. Lobeliaceae
259. Goodeniaceae
260. Stylidiaceae
261. Brunoniaceae
262. Compositae
II. Class. Monocotyledones
1. Helobiae
263. Alismataceae
264. Butomaceae
265. Hydrocharitaceae
266. Scheuchzeriaceae
267. Aponogetonaceae
268. Potamogetonaceae
269. Najadaceae
270. Triuridaceae
2. Liliiflorae
271. Liliaceae
272. Stemonaceae
273. Cyanastraceae
274. Pontederiaceae
275. Haemodoraceae

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276. Philydraceae
277. Amaryllidaceae
278. Velloziaceae
279. Iridaceae
280. Juncaceae
281. Flagellariaceae
282. Rapateaceae
283. Thurniaceae
284. Bromeliaceae
285. Dioscoreaceae
286. Taccaceae
287. Burmanniaceae

3. Enantioblastae
288. Commelinaceae
289. Mayacaceae
290. Xyridaceae
291. Eriocaulaceae
292. Centrolepidaceae
293. Restionaceae

4. Cyperales
294. Cyperaceae

5. Glumiflorae
295. Gramineae

6. Scitamineae
296. Musaceae
297. Zingiberaceae
298. Cannaceae
299. Marantaceae

7. Gynandrae
300. Orchidaceae

8. Spadiciflorae Arales
301. Palmae
302. Cyclanthaceae
303. Araceae
304. Lemnaceae

9. Pandanales
305. Pandanaceae
306. Sparganiaceae
307. Typhaceae

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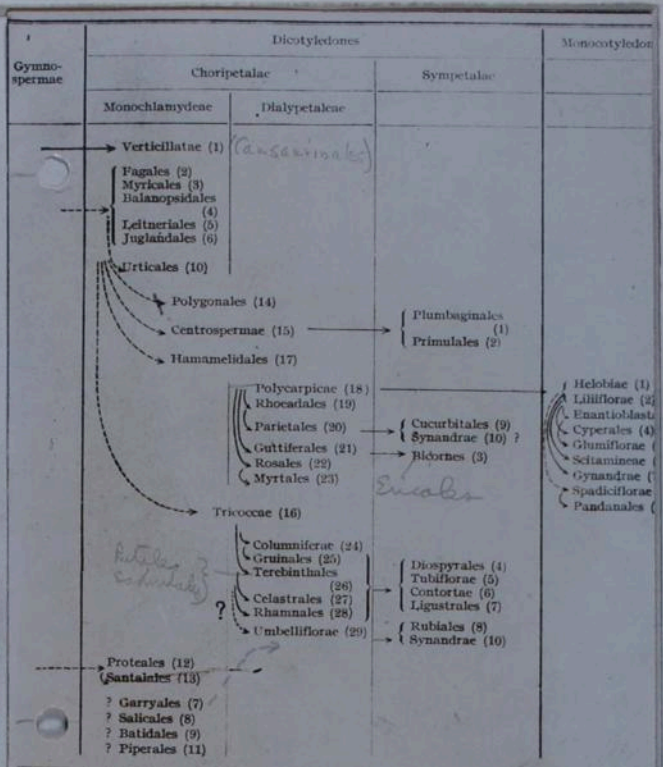

sentación esquemática se ha tenido en cuenta el grado de exactitud o de seguridad de los conocimientos, indicando con líneas encarnadas ininterrumpidas las relaciones que pueden darse como ciertas o como casi seguras, y por líneas de trazos del mismo color las que sólo pueden considerarse probables. Para evitar torcidas interpretaciones pondremos asimismo de relieve que en la comprobación de las relaciones genéticas *no* hay que relacionar precisamente los representantes *actuales* de los diversos tipos. Los números que acompañan a los nombres del cuadro hacen referencia a la numeración de los órdenes en el texto de esta obra.

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Sub plant extract, added immune serum
Closely related - given ppt. same antibody
in even weakest solns. but species not
closely related required conc. solns. for ppt.

Conglutination reaction -
Plant serum added to immune serum + add
beef serum.

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Bot. Arch. 11:105-145.

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L. Pauling - Antibodies + Specific Biological Forces.
Koenigsberg - Bu. Jour Endeavour 7, 43, 1948

Mez - estab. Botanische Archiv for publications of serology.

Concepts - nucleo proteins new basic.
Convergent or parallel development never occurs in serology

1. antigen - protein causing specific antibodies.
2. immune serum -
3. antibodies - cause clumping together of sp. proteins

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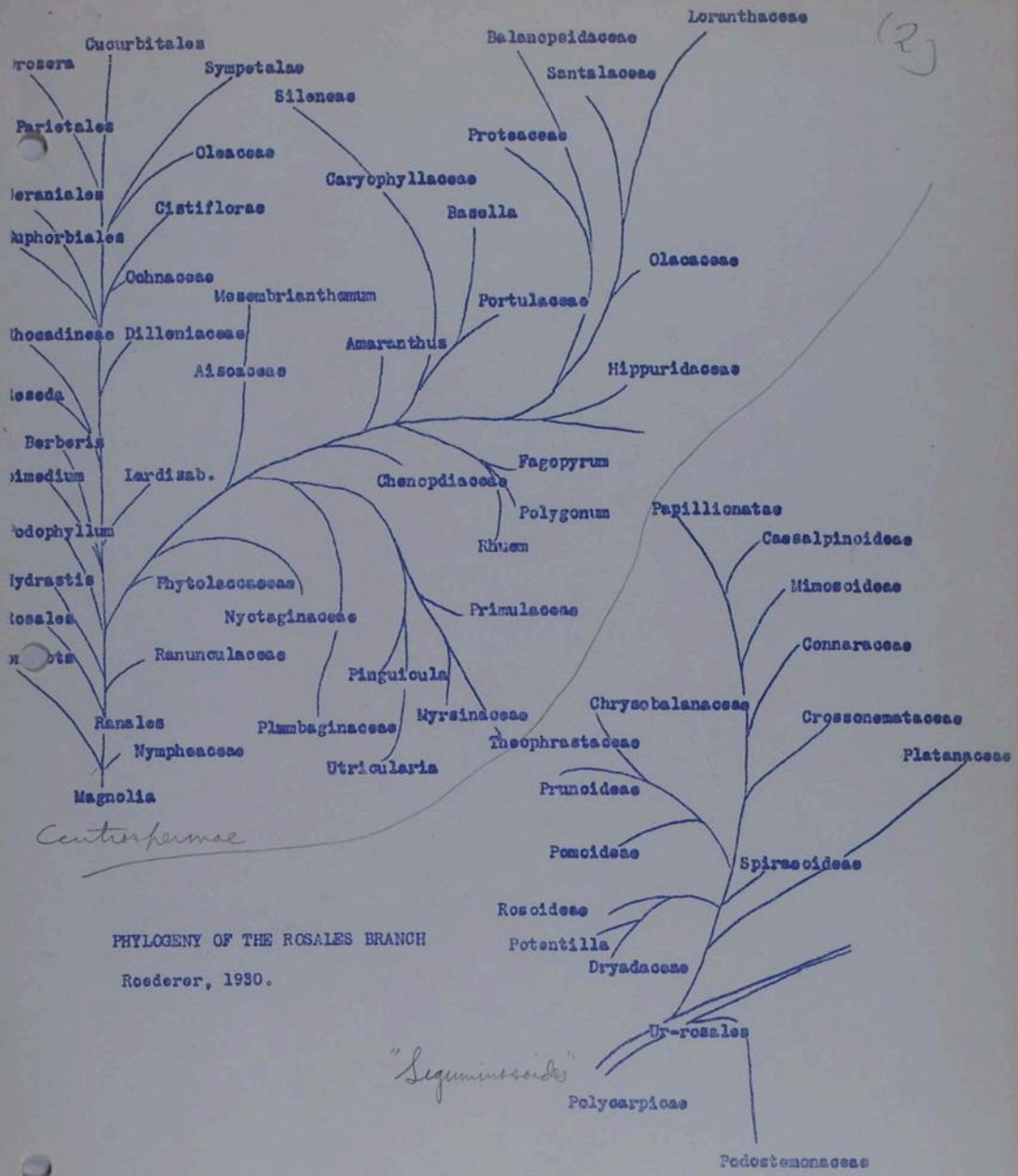
PHYLOGENY OF THE CENTROSPERMAE BRANCH, according to Bitter, 1908.



PHYLOGENY OF THE ROSALES BRANCH

Roederer, 1930.

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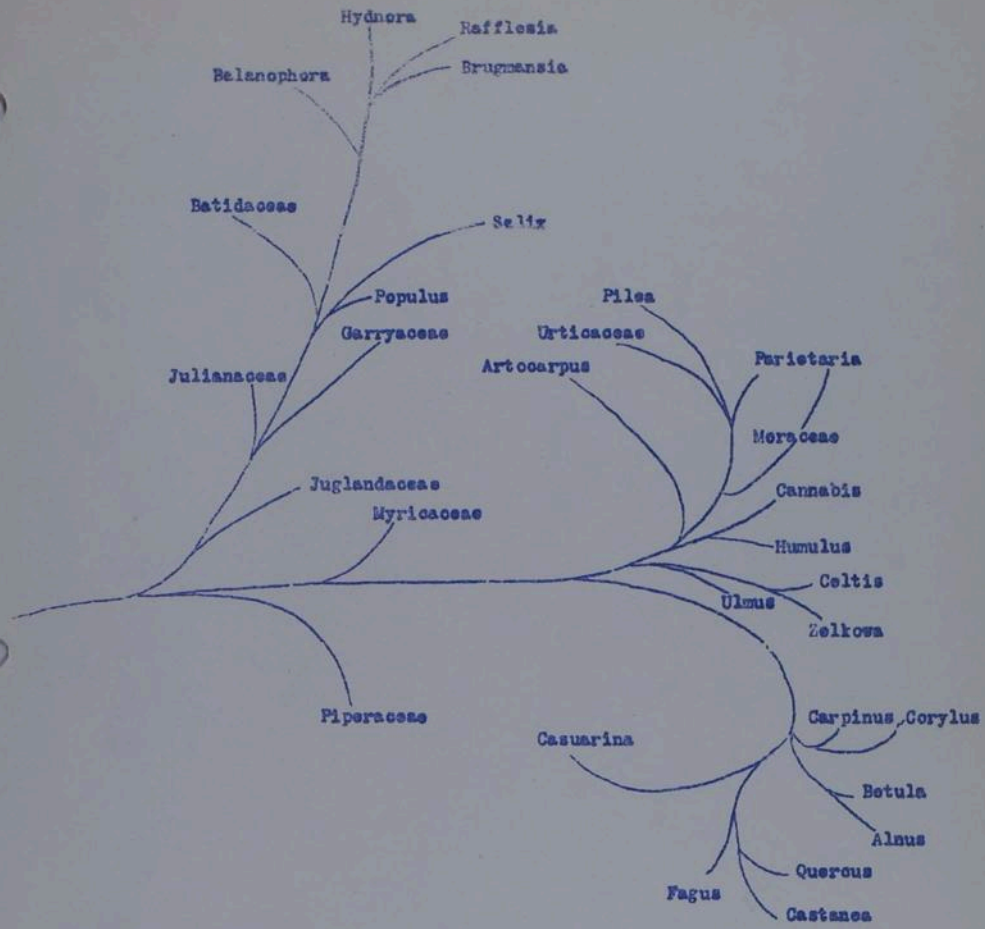
PHYLOGENY OF THE CENTROSPERMAE BRANCH, according to Bitzek, 1928



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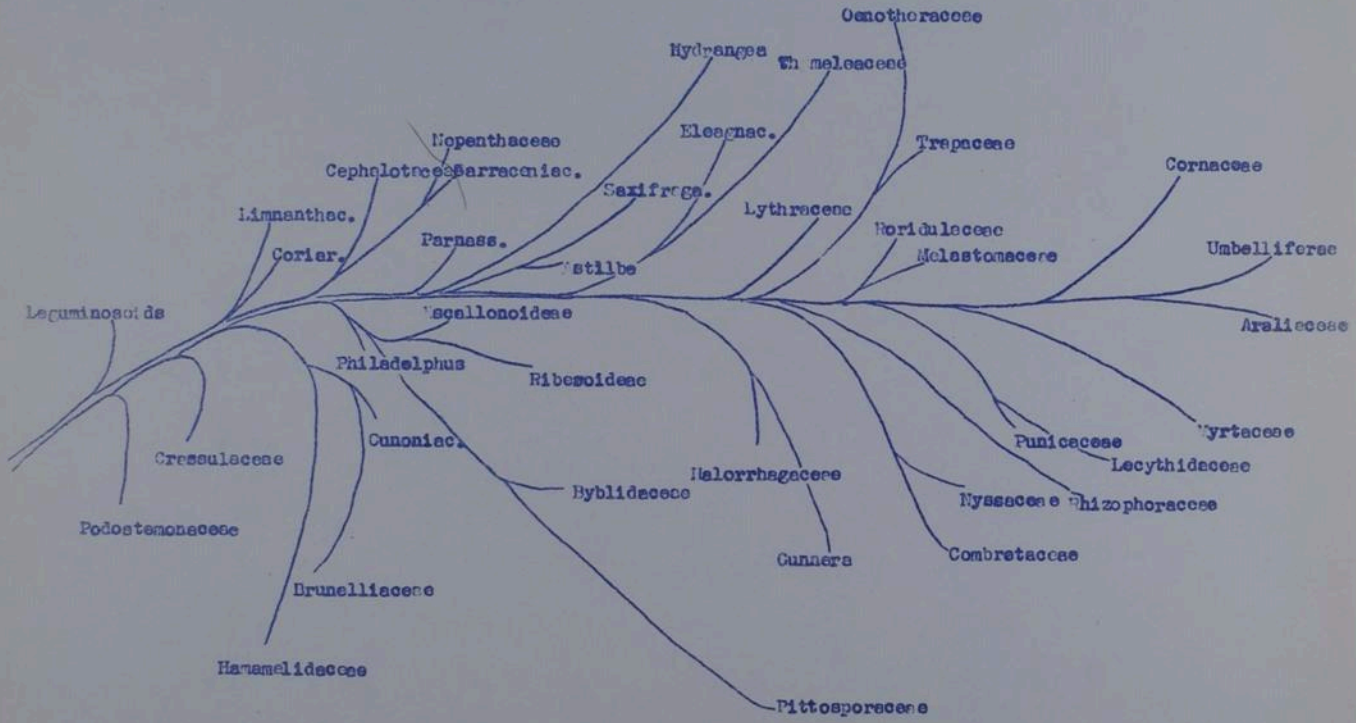
(30)

PHYLOGENY OF THE ROSALES BRANCH, according to Rooderer, 1930



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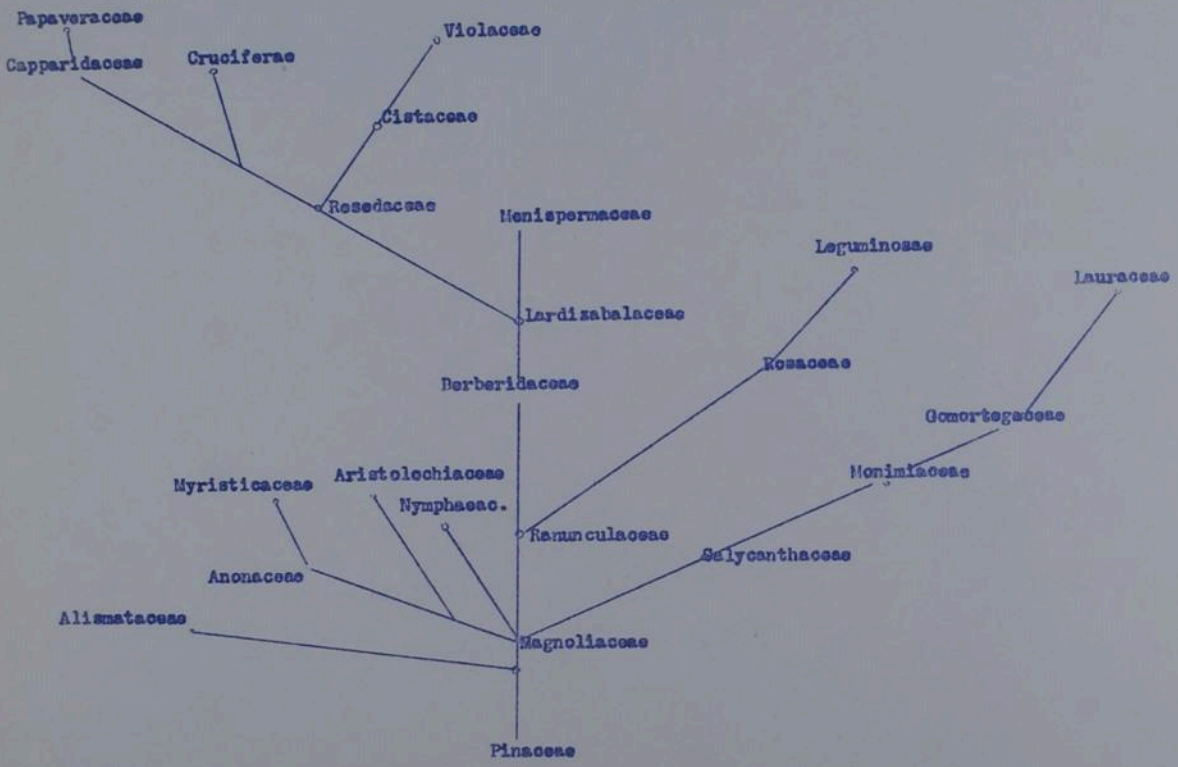
PHYLOGENY OF THE RANALES BRANCH, according to Lange, 1924.



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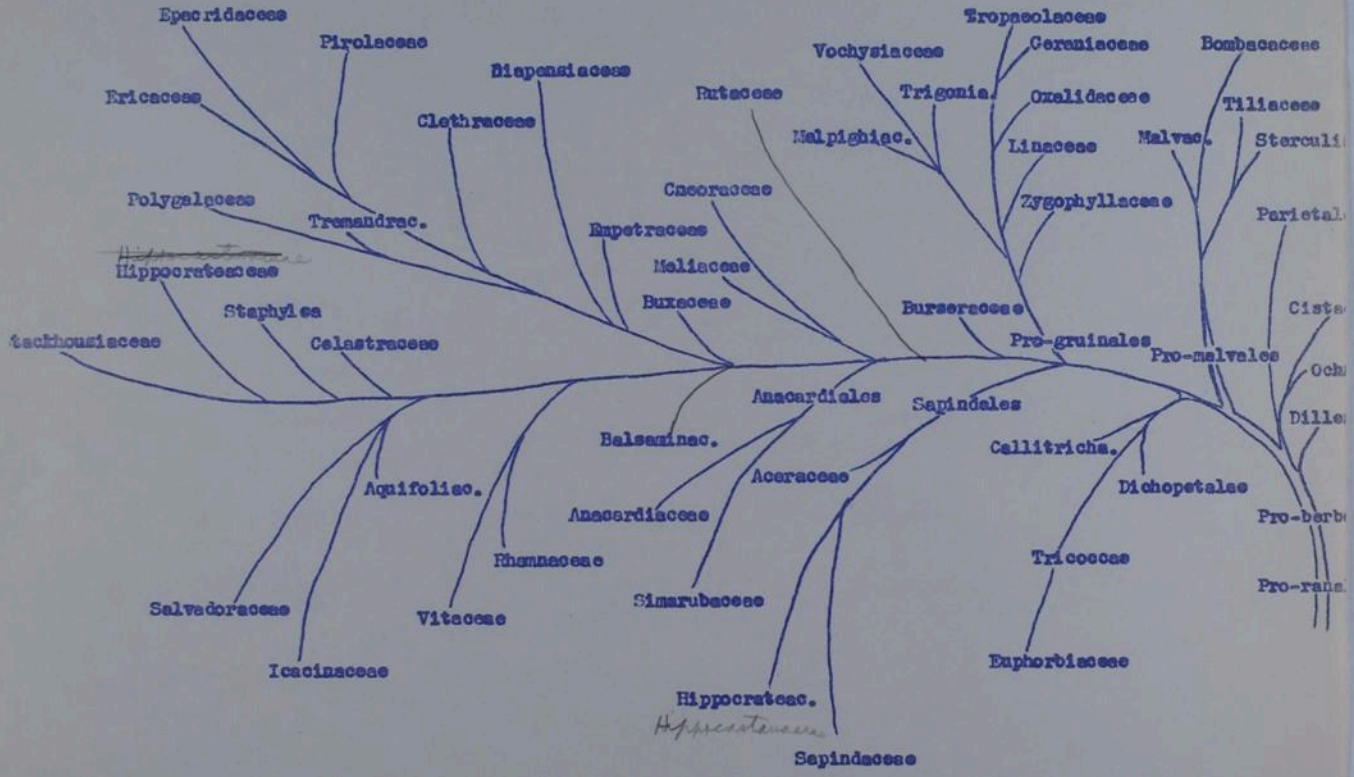
PHYLOGENY OF THE COLUMNIFERAE BRANCH, according to Ruff, 1931



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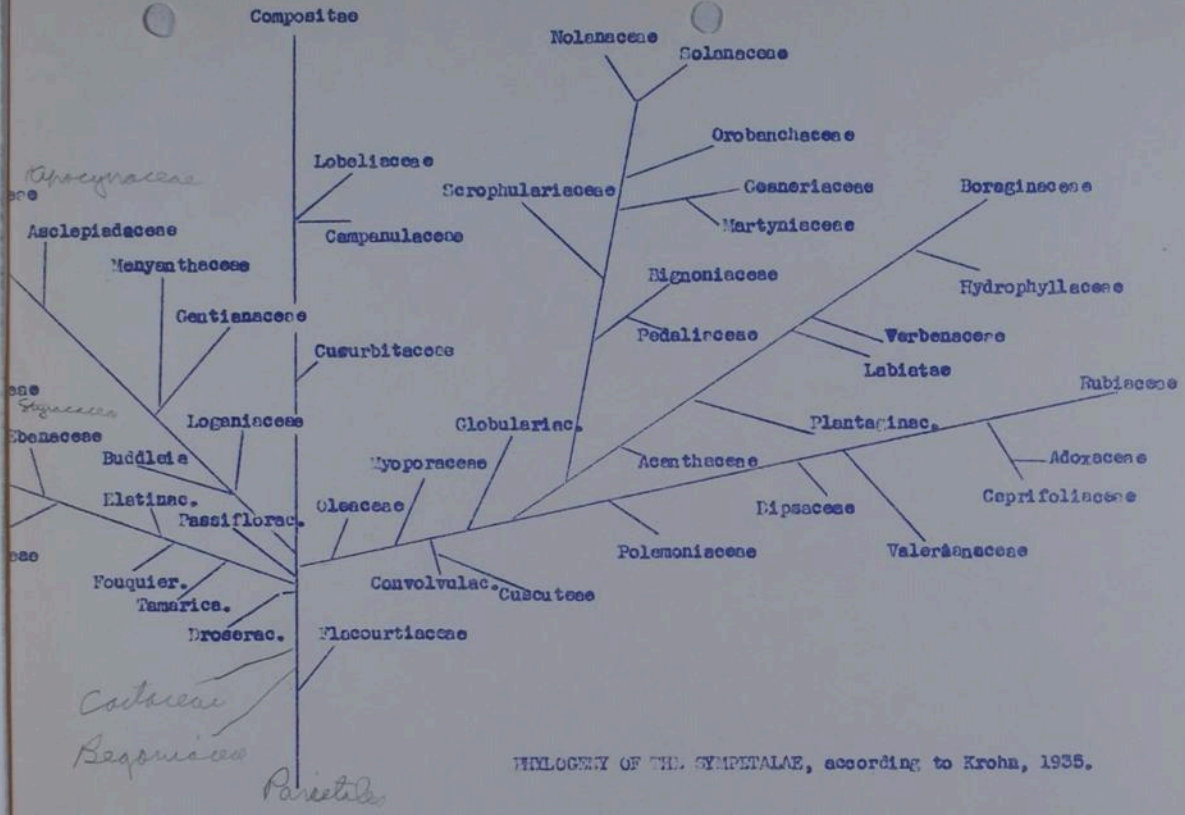

PHYLOGENY OF THE SYMPETALAE, according to Krohn, 1935.

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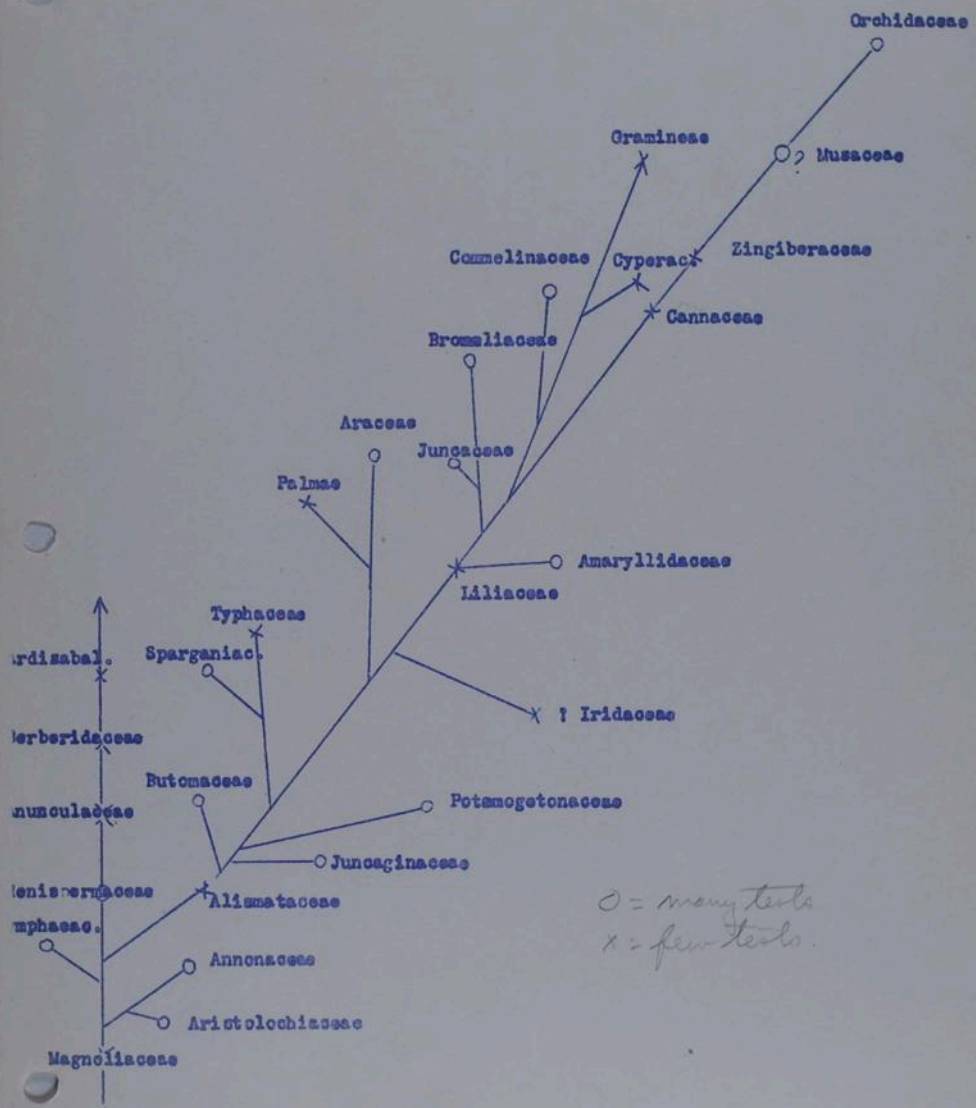
PHYLOGENY OF THE MONOCOTYLEDONES, according to Worsaeck, 1922.



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PHYLOGENY OF THE SYMPETALAE
H. F. Wernham
from New Phytologist, Vol. 10; 1911, Vol. 12; 1912.

Dupont M. Hall
May 14, 1948

1

The Sympetalae are polyphyletic, derived from the Archichlamydeae along 7 distinct lines. These are:

1. Centrospermae → Primulales
2. Geraniales → Ericales
3. Guttiferales — Ebenales
4. Geraniales (Plantaginales) — Contortae — Tubiflorae
5. Calyciflorae — Umbelliflorae — Rubiales — Dipsacales
6. Calyciflorae — Campanulatae
7. Calyciflorae — Passifloralos — Cucurbitales

Wernham's Fundamental Principles

1. He defines a typical flower as an aggregate of sporophylls, delimited by a perianth.
2. Tendencies expressed in the evolution of flowering plants are:
   (1) Economy in production of reproductive parts
   (2) Progressive adaptation to insect visitors
      a. Floral conspcuousness (large individual flowers, excessive branching.
      b. Z ygomorphy (in individual flowers, in certain flowers of dense heads.
      c. Fusion of parts — tube formation (sy mpetaly)
3. The primitive flower is one which exhibits these tendencies the least.
4. Tendencies are very important characteristics in determining relationships and phylogeny of basic groups. Critical constant characters are frequently of little use for this purpose, but are good in delimiting small very closely related groups.

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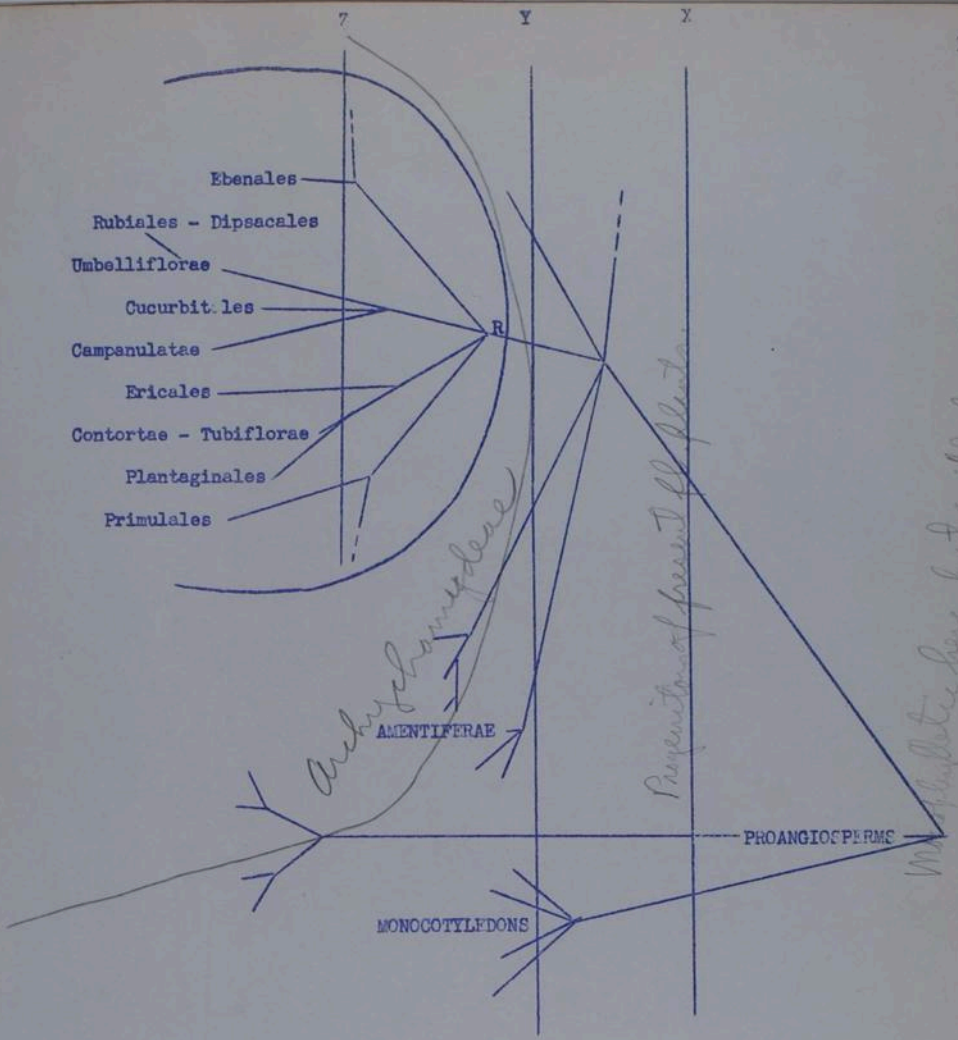

X - boundary between proangiosperms and angiosperms.

Y - line above which are represented all living and fossil monocots and dicots.

Z - all sympetalae are above this line.

R - Ranalian Common Ancestor.

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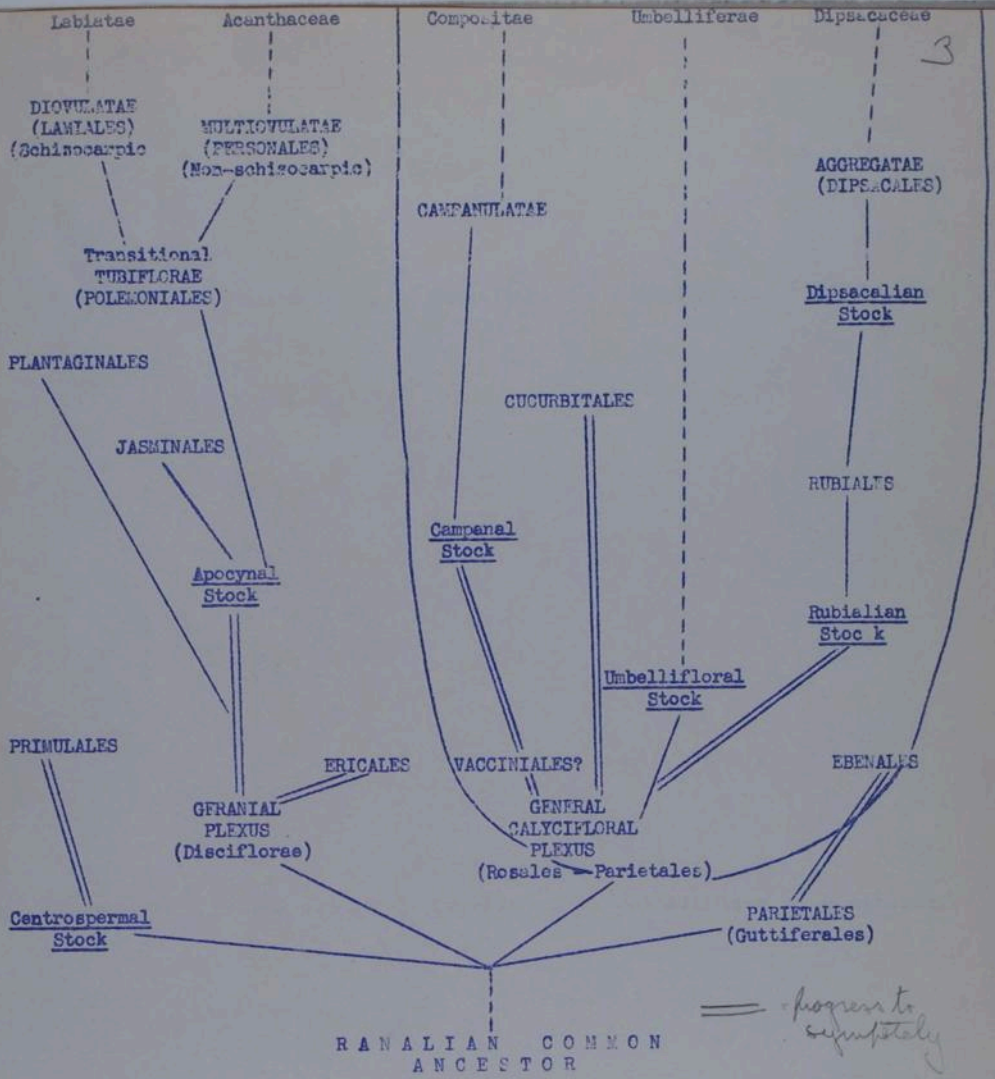

1. Most advanced members of each group are at ends of dashed lines.
2. Orders within ellipse show epigyny.
3. Seven double lines represent progress to sympetaly.

This diagram shows the heptaphyletic origin and affinities of the Sympetalae. See H. F. Wernham on Floral Evolution in New Phytologist, X, XI, 1911, 1912.

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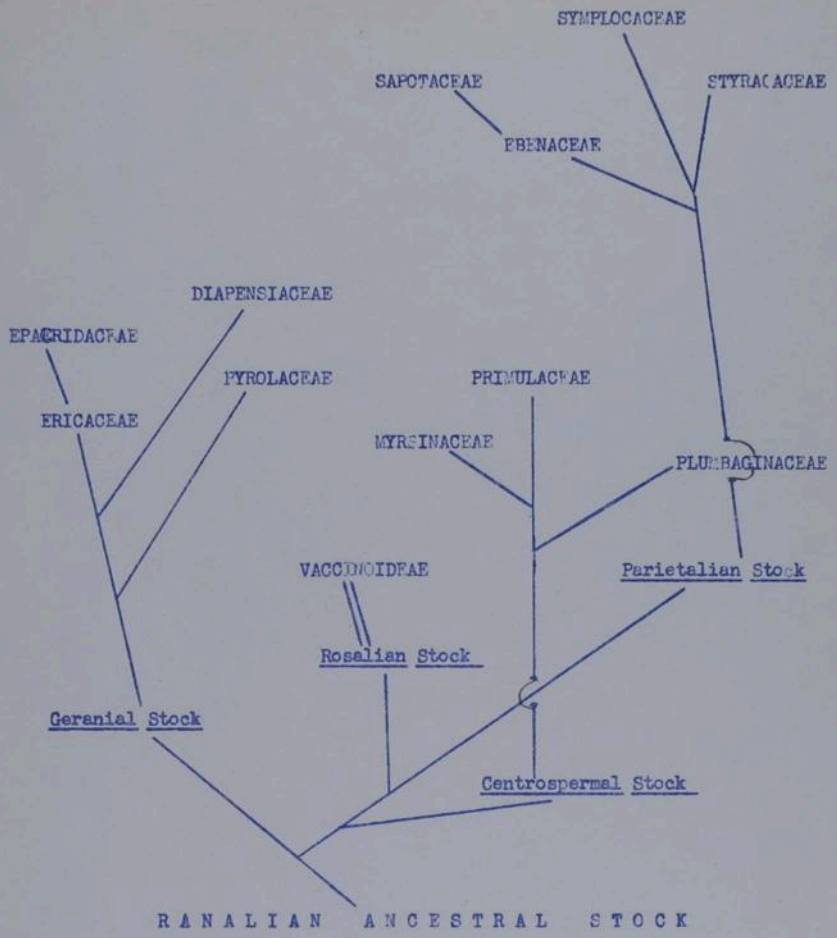

The Pentacyclicae

1. Double line represents epigyny.
2. Relative advancement of families is not indicated.

1. Superpetaly before progress to economy.
2. No aggregation of fls. + no zygomorphy.
3. This grp. is end point – no further devel. from this
4. Habitat of definite limitations (i.e. Ericaceae,

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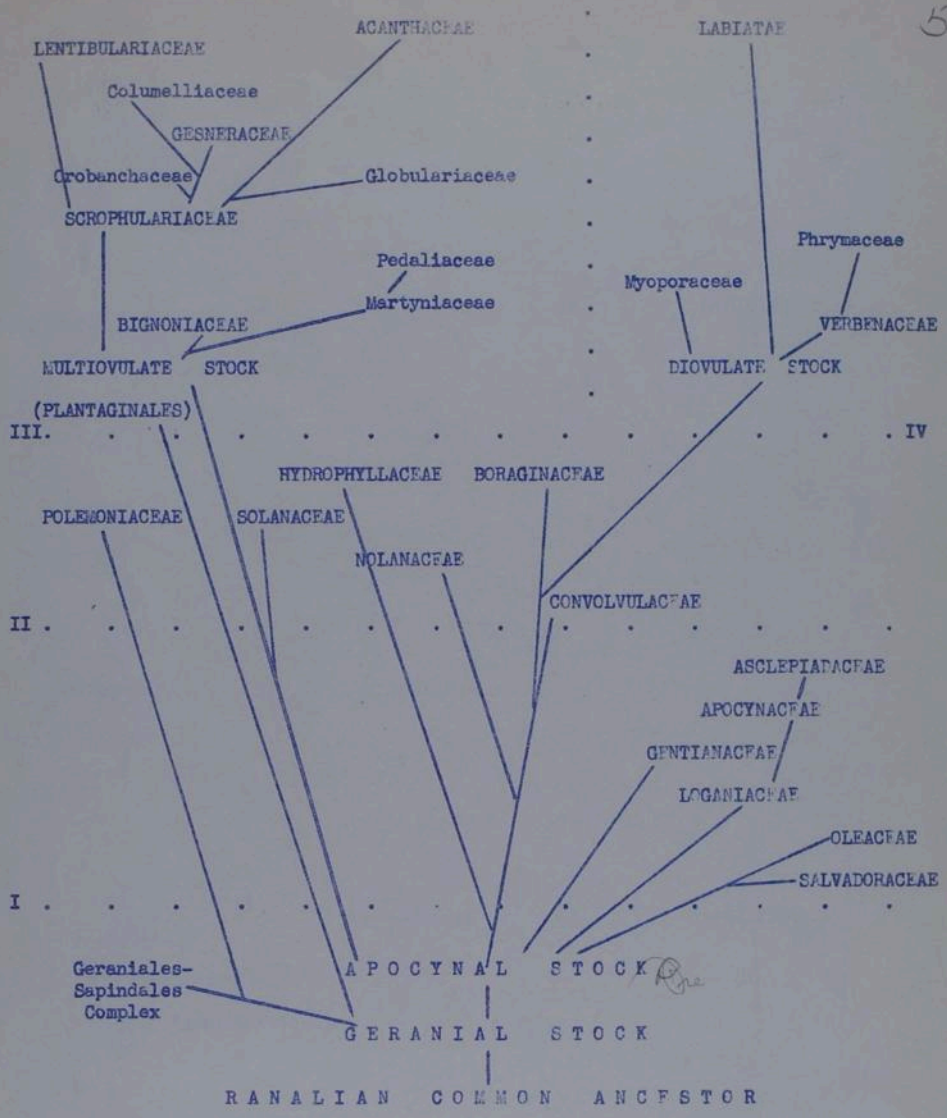

I. Contortae
II. Transitional Group of the Tubifloras
III. Multiovulatae of the Tubifloras
IV. Diovulatae of the Tubifloras

Tetracyclicae
Superae

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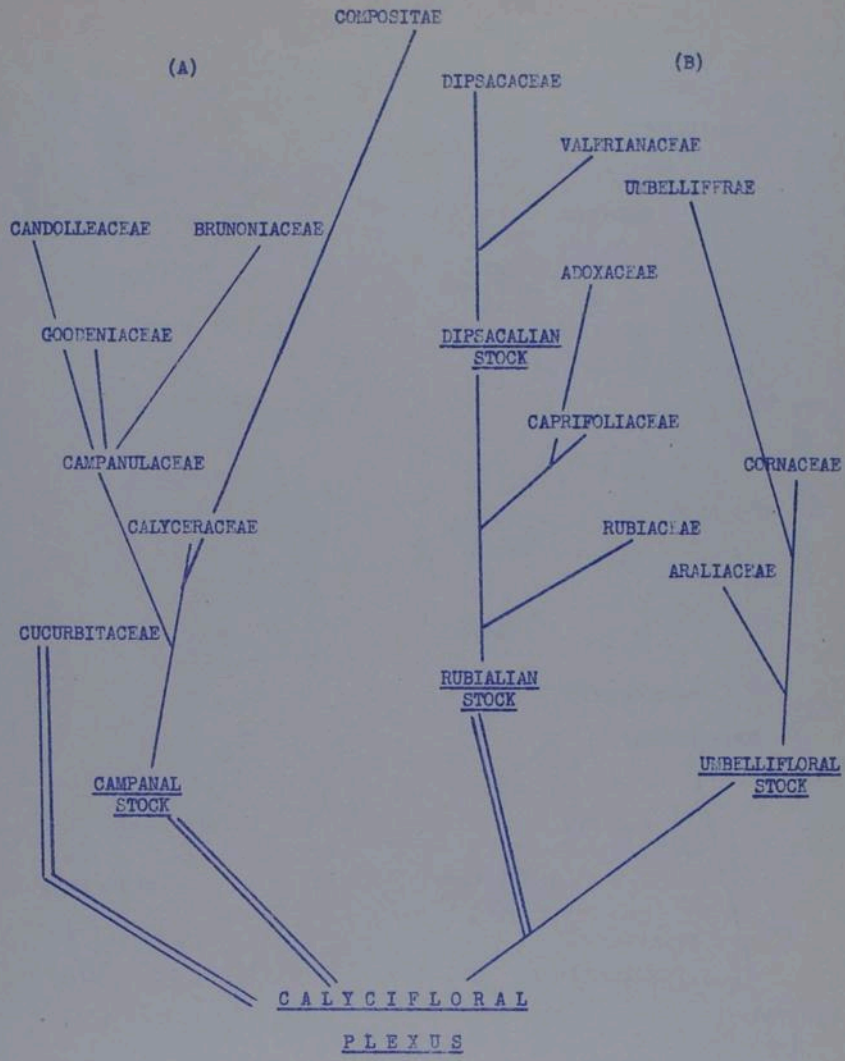

1. Double line shows progress to sympetaly.
2. (A) group exhibits racemose branching.
3. (B) group exhibits cymose branching.

Tetracyclicae
Inferae

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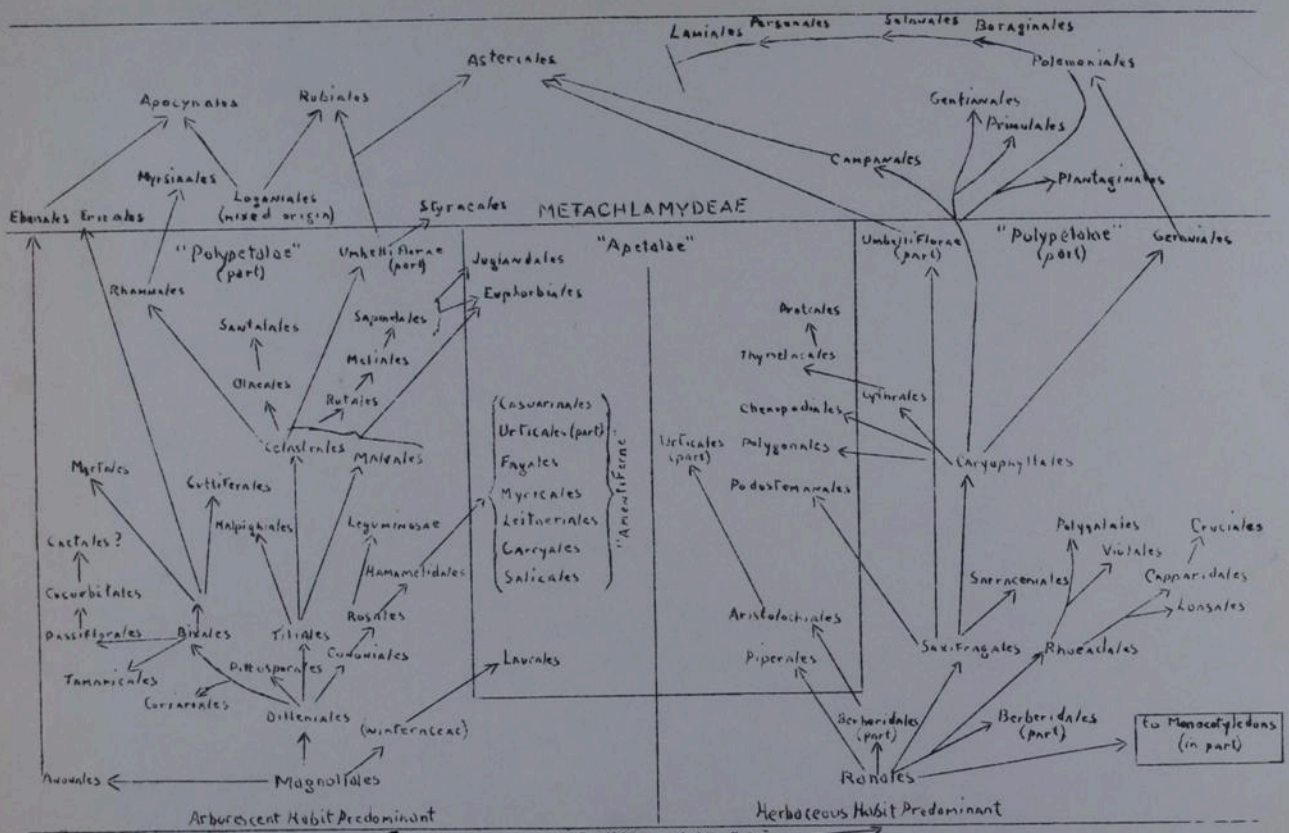
Hutchinson, J - Henry McQuade, 5/7/48



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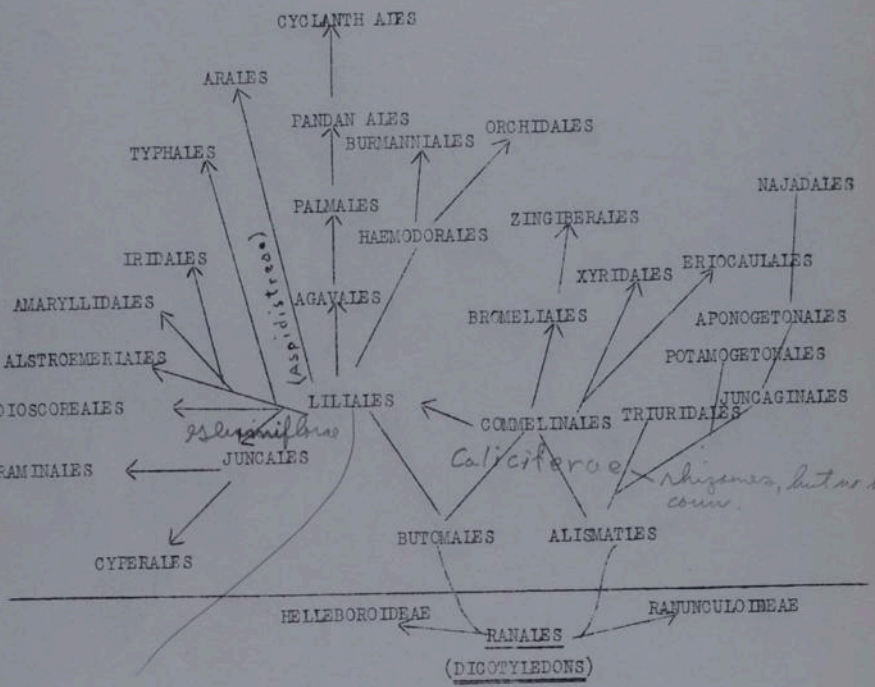
Henry McQuade
15/7/48



Coralliferae
few aquatics, usually terrestrial or epiphytic – perm. root (bulb or corm).

Botanist in Africa – 1946

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Hutchinson - 1882 -

Woody vs herbaceous

Woody - stomates w/ guard cells
Amentiferae - derived, rather than primitive.

herbaceous - w/o guard cells,
at least in primitive families.

Parallel development
Monocots
Aquatic
Coniferae

Climbing

Dicots

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I Telia with sessile teliospores, compacted into layers or columns, and united laterally — Melampsoraceae

Bessey. suppression of special characters –

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Symptatae	Perfect	Dioecious	Monoecious	Bisexual	Regular	Irregular	Sepals	Petals	Disc	Stamens	obdiplostemonous	diplo.	antisepal	antipetal	opening	epipet.	stamens	Ant	Carpels	Ovules	Placenta	Endosperm	Style	Stigma	Fruit
Pentacyclicae Ericales	✓				✓	✓	5-4	5-4	±	5-1	✓				Ai		✓	H	4-5	Many	Ax				
Clethraceae	✓				✓		5	5	–	10	✓				"			H	3	Many	Cent.	+	1	3	Caps
Ericaceae	✓						4-5		+		✓				"			H-E	5-4	1-α	Ax.	+	1	Capitate	B/b
Pyrolaceae	✓				✓				+		✓				"			H	*	α		+	1		Caps
Diapensiaceae	✓				✓		5	5	–	5			Long	✓			✓	H	3	α	Ana	+	1		"
Primulales	✓	✓			✓		5	5		5	✓				"		✓	H		α	Bas Fre.		1		
Theophrastaceae	✓	✓			✓		5	5		5	✓				"			H	5	α	Cent		1		Dr. Be.
Myrsinaceae	✓	✓			✓		4-5			4-5	✓				"			H	–	α	Cent.				Dr Ba.
Primulaceae	✓				✓		5	5		5	✓				"			H	+	α	Cent.				Caps
Plumbaginales	✓				✓		5	5		5	✓				"			H	–							
Plumbaginaceae	✓				✓		5	5		5	✓				"			H	–	1	1	Bas				Cir. Caps
Ebenales	✓	✓			✓							✓			"			HPE	+	α			+			
Sapotaceae	✓				✓		2 or 4 rows 4-8	4-8		2-3 rows					"			H	+	4-8	1	½		1		Be.
Ebenaceae	✓	☐	✓		✓		3-7	3-7		3-7					"			H	+in 4Fl.	2-6	1-2 Basal		+ Cent.	2-8		Be.
Styracaceae	✓				✓		5-1	5-4		8-10								HP		3-5	1-fou Ana.		1		Dr.
Symplocaceae	✓				✓		5	3+1		α								E		5					Dr
Tetracyclicae Oleales	✓	✓			✓		4	4		2								H		2	1 Basal				
Oleaceae	✓	✓		✓	✓		4-5 0-5	4-5 0-5		2						✓		H		2	2 Ana		±	1	Caps Ba
Contortae	✓				✓		4-5	4-5	+	4-5							✓	H		2	2 Ax Par.	+	1		
Loganiaceae	✓				✓		4-5	4-5	–	4-5								H		2			+	1	2	Caps Be
Gentianaceae	✓				✓		4-5	4-5		4-5								H		2	1					Caps
Apocynaceae	✓				✓		5	5	+	5							✓	H-P		2	Basal	Ax	Thickened 1			Fol.
Asclepiadaceae	✓				✓		5	5		5								H		2	Basal		Apocarpous			Fol.

Comments

4 merous or alternate, opposite, superposed, free or epipetal. Stamens usually free & hypogynous.

Petals free, stamens obdiplostemonous

Anther values free, frequently appendaged

Incomplete septation of ovary

Stamens epipetalous

Stamens 5 antipetalous, filaments united.

Ovules numerous in placentae. Black lines on 100 over petals.

Always herbaceous

Per. Herb, in epidermal H2O or Chalk-glands.

Woody plants, Haplo-diplo-triplostemonous. Petals sometimes imbricate or basally appendaged. Outer whorl of stamens usually staminodial.

Usually dioecious, corolla persistent.

Filaments united

Stamens numerous on receptacle, or in number of 5. Filaments ± united

Reg. Stamens 2. W/O antipetalous whorl

W/antipetalous whorl. Disc pres. Usually Colorful

An interpetiolar ring for stipules

Herb, (earth) fovea in corolla. Anthers spirally twisted

Corolla throat appendaged, Style thickened, Disc Pres.

Corona, gynostegium, pollen tetrads or pollinia

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	Perfect	Dioecious	Monoecious	Polygamous	Regular	Irregular	Sepals	Petals	Disc	Stamens	obdiplostemonous	diplostemonous	antipetalous	antisepalous	Epipetalous staminodes	Axis	Carpels	Ovules	Placenta	Endosperm	Style	Stigma	Fruit.	Comments.
Convolvulales																								
Convolvulaceae	✓	①			✓		5(4)	⑤	+	5·4						H	②	2	bic	+	1		Cap	Disc pres., endocarp. sclerenchymatous, pericarp. & testa fused
Tubiflorae																								
Sub-Polemoniineae																								
Polemoniaceae	✓				✓		②	⑤	⑤	+	5					H	⑤	[3-6]	1-∞	Sec.	1		Loculicidal Caps	
Sub-Boraginineae	✓				✓											H	②	[4]	d-2				Schizo-carpic Nutlets	Fls. in scorpioid cymes
Hydrophyllaceae	✓				✓		⑤	⑤		5						H	1-2	d-2		+	1-2		Loculicidal Caps	Corolla usually scorpioid infl. Corolla bell-like, stamens on corolla alt. w/ petals
Boraginaceae	✓				✓		④	⑤	⑤	+	5					H	②	[4]	1	bas.	-	1	Schizocarpic, 4 nutlets	Style gynobasic, ovary 2-celled, dividing into 4 by false septa
Sub-order Verbenineae																								
Verbenaceae	✓			②	⑤	✓	5-5	5-4		4						1-3	H	②	[5]	bas.	±	1	Drupe or Schizocarp	Didynamous stamens, ov. 2 Style terminal.
Labiatae	✓					✓	2-lip	*	+	4						±	H	②	1	bas.			Schizocarpic, 4 nutlets	Style gynobasic * Corolla bilabiate, stamens 4, didynamous, part 4-carpel.
Sub-order Solanineae																								
Nolanaceae	✓				✓		⑤	⑤		5						H	⑤	[∞]		+			Schizocarpic	Stamens 5-carp. Pist. 5-carp, divided into 5-30 mesocarp
Solanaceae	✓			②	✓		⑤	⑤	+	5	anthers 2-celled, opening by slits or pores				+	H	②(5)	d	Ax.	+	1	2-lob Caps	Berry	Corolla plicate, sometimes convolute. Glandular
Scrophulariaceae	✓				✓		4-5	5	+	4						±	H	②	[∞]	Ax.	+	1	1	Caps	Corolla 2-lipped, 1 anterior stamen hot glandular
Orobanchaceae	✓				✓		2-5	5		4						H	②	[∞]	d	Par.	+	1	Caps	Parasitic herbs, stamens like Corolla
Gesneriaceae	✓				✓		⑤	5	+	4						H-P	①	[∞]	d	Par.	±		Loculicidal Caps	Pistil Hy-Par., 1-celled. Corolla usually bilabiate
Martiniaceae	✓				✓		⑤	⑤	∪	4						H-P	1	[∞]	[∞]	Par.	±		Caps	Fruit a horned caps, becoming 4-celled by false septa
Bignoniaceae	✓				✓		⑤	⑤	+	4	Pd	Anthers 2-celled, separate			±	H	②	[∞]	d	Par.	-	1	Caps	dehiscing by 2 valves from central septum
Lentibulariaceae	✓				✓		⑤	⑤		2	Stamen anterior, 1 celled					H	②	[∞]	d	Free Cent.	Stigma sessile		Caps	2-lipped corolla. Aspect of Scrophulariaceae. Insectivorous
Acanthaceae	✓				✓		5-3-3	⑤	+	4-2 tog.	Thecae inserted at different levels.				±	H	②	2-∞	Par.		2-lob	Valvate Caps	2-lipped, unequally bilobed. Retinacula.
Plantaginaceae	✓			✓			4	4		4-2				✓		H	②	d-1	Cent.	+		Circ(Pix) Caps	4-Merous, Reg., Cent. Placenta, like Primulales
Inferae — Inferior ovary																								
Rubiales	✓			✓	✓		4-5			4-5	Stamens opposite corolla lobes					E-P	②	2-3	d-1	Apo.				
Rubiaceae	✓			✓	②		4	④	⑦	4	anthers 2-celled					E	②	[1]			+	1(2)	Caps Ber.	Pist. 4-merous, 2-carpels, 2-celled, 1 ovule in each cell, usually 2 ovules aborted
Caprifoliaceae	✓			✓	✓		⑤	⑤		5-1						E	⑤	[1]			+Fla.	2	Ber. Dr.	Anthers 2-celled, basifixed, versatile, sometimes Capitulum
Valerianaceae	✓		✓		✓			⑤		1-4						E	3	1				1	2-3	Ach.	Calyx an Epi. ring, pappus-like. Corolla sometimes
Dipsacaceae	✓				✓			④		4						E	②	1				1	1-2	Ach.	Fl. enveloped by persis. epicalyx, pappus-like. Corolla 2-lobed.
Campanulales	✓		✓		✓	✓	5	⑤		5						E-P	2-5				+Fla.	1	Caps	Calyx often persistent, corolla valvate, stamens free, style with collecting hairs, stigmas 2-5, fleshy, appendiculate on inside
Campanulaceae	✓		✓		✓											E-P	5							
Compositae	✓		✓		✓		-	5		5	Stamens united by anthers					E	②	[1]	bas.			2	Cypsella	Flowers in heads, subtended by involucre of phyllaries. Heads sessile, head surrounded by involucre of phyllaries. Fl. 1-2 kinds, ray & disc. Corolla 5-lobed, stamens free

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Monocots	Perfect	Dioecious	Monoecious	Polygamous	Regular	Irregular	Sepals	Petals	Disc	Stamens	Staminode	Pistil	Carpels	Ovules	Placenta	Endosperm	Style	Stigma	Fruit	Comments
Helobieae (Alismatales)	✓		✓		✓	⊕	Valved or double			1-∞		H	1-∞			-				Embryo large, w/prominent hypocotyl. Aquatics or Marsh
Alismaceae	✓		✓		✓	?	3	3		3-5		H	∞	1-∞	Ax.				Ach. Foll.	Calyx green or petaloid, laticiferous. "Monocot" Buttercups.
Hydrocharitaceae			✓		✓	⊕	3	3	Inner whorl	3-in 1-5 whorls		E	(2-5) ∞	Axile Parietal	Par.	-			Capsule or fleshy	A prominent spathe associated w/ovary (sometimes of 2 coalesced).
Scheuchzeriaceae	✓		⊕		✓		3	3		6		H	6	1-2	Basal				Subsq. accrsc.	Sepals & petaloid, 3 stamens & w/basal adnexae.
Potamogetonaceae	⊕		✓		✓		small & 4-1 tepals			4-1	Antherless scales	H	4-1	1	Basal Ant.				Dr. Fruit	Aquatics, submerged inflorescence, racemose, or flabellate.
Najadaceae			✓				Inclosed in a sheath			1	Enclosed in a sheath	H	1	1	Ana			2-3	Berry	Fl. ♂ & ♀ maybe inclosed in a spathe (bottle-shaped).
Triuridaceae			✓		✓		Perianth Simple 3-9 Parted			3-6	Sessile	H	∞	1			3 Styles Hasal			Mycorrhizal herbs. ♂ fl. w/ 3-6 sessile anthers united at base.
Liliales	✓		⊕		✓		3	3		<6>		H-E	3	3	Axile	+				Perianth double, usually petaloid, or of sepals & petals
Liliaceae	✓		⊕		✓		(3-4-5) 3	3	Extrorse or introrse	6		H	(2-∞) 3	3	Axile Ana	oily Albu	1		Caps. Ber.	Fruit usually petaloid, free or partly united, from bulbs, rhizomes, tubers or tuberous roots or corms.
Amaryllidaceae	✓				✓	⊕	3	3	Epipetalous	6		E	3		Axile				Caps.	Perianth sometimes accompanied by fancy corona
Iridaceae	✓				✓	⊕	2-3 more or less united			3		E	3	Appr. ∞	Axile	oily Albu	1		Caps.	Style often w/petaloid branches, stamens 3
Juncaceae	✓				✓		2-3 more or less united			3+3		H	3		Axile Parietal	Starchy	1	3 Rarely 6	Caps.	Fruit usually membranaceous, scarious, leathery, rarely petaloid.
Dioscoreaceae	⊕	✓			✓		6	Brietly Sep.		6		E	3		Axile				Caps. Ber.	Vegetable tendrils by petiole. Mostly 3, Dioscorea 5-7
Burmanniaceae	✓				✓	⊕	2-3 more or less united			6-3	Enlarged connective	E	3			-			Caps.	Stamens perhaps connected, Saprophytes w/o chlorophyll
Farinosae	✓				✓		3-3 more or less united			3-3		HPE	3		Axile Parietal					Ovules & fruit often, endosperm mealy, embryo curving
Bromeliaceae	✓				✓	⊕	3	3		6		H-E	3	∞	Axile			1	3 Caps.	Tank by persist calyx. Usually acaulescent herbs.
Pontederiaceae	✓				✓		6-3 partly united			6-3	Inserted to & adnate to perianth tube	H	3	∞	Axile	+			Caps. Achs.	Herb. w/ floats, leaf sheath often w/ air bladders
Commelinaceae	✓				✓	✓	3	3		6	all fertile or one ♂	H	3-2	2	Axile Parietal				Caps. Ber.	Filaments hairy, monilliform hairs, prominent mucilaginous
Xyridaceae	✓				✓		3	3				H	3	∞	Axile Central				Caps.	Small herbs with radical grass-like leaves, mostly racemose, scapose
Eriocaulaceae			✓		✓	✓	2-3 more or less united			6-2		H	3-2	1	Basal	+			Caps.	Involucrate heads at base of inflorescence, flowers in numbers, scarious

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Monochlamydeae

1. Salicales 1.
   Salicaceae
2. Hamales
   Hamaceae
3. Juglandales
   Myricaceae
   Juglandaceae
4. Julianales
   Julianaceae
5. Fagales 2.
   Betulaceae
   Fagaceae
6. Casuarinales
   Casuarinaceae
6a. Leitneriales 3.
   Leitneriaceae
7. Urticales
   Ulmaceae
   Urticaceae
   Moraceae
   Cannabinaceae
8. Proteales
   Proteaceae
9. Santalales 4.
   Olacaceae
   Santalaceae
   Loranthaceae
   Balanophoraceae
10. Aristolochiales
   Aristolochiaceae
   Rafflesiaceae
11. Polygonales 5.
   Polygonaceae
12. Piperales
   Piperaceae
   Saururaceae
13. Centrospermae
   Chenopodiaceae
   Amarantaceae 6.
   Nyctaginaceae
13. Centrospermae (cont - p.6)
   Phytolaccaceae 6.
   Aizoaceae
   Portulacaceae 7.
   Caryophyllaceae

Polypetalae

1. Ranales 7
   Magnoliaceae
   Annonaceae 8
   Myristicaceae
   Calycanthaceae
   Monimiaceae
   Lauraceae
   Ranunculaceae 9.
   Berberidaceae
   Menispermaceae
   Nymphaeaceae 10
   Ceratophyllaceae
2. Rhoeadales 10
   Papaveraceae
   Capparidaceae 11
   Cruciferaceae
   Resedaceae
   Moringaceae
3. Sarraceniales 12
   Sarraceniaceae
   Nepenthaceae
   Droseraceae
4. Parietales 12
   Cistaceae
   Bixaceae 13
   Tamaricaceae
   Frankeniaceae
   Violaceae
   Flacourtiaceae
   Passifloraceae 14
   Caricaceae
   Loasaceae

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Polypetalae

5. Peponiferae 14
   Cucurbitaceae
   Begoniaceae 15
6. Guttiferales 15
   Dilleniaceae
   Ochnaceae 16
   × Marcgraviaceae
   Theaceae
   Guttiferae
7. Malvales 17
   Tiliaceae
   Malvaceae
   Bombaceae 18
   Sterculiaceae
8. Tricoccae 18
   Euphorbiaceae
   Buxaceae 19
   Callitrichaceae
9. Geraniales 19
   Geraniaceae
   × Oxalidaceae
   Balsaminaceae 20
   Tropaeolaceae
   Linaceae
   Zygophyllaceae 21
   × Malpighiaceae
10. Rutales 21
    Rutaceae
    Simarubaceae 22
    Burseraceae
    Meliaceae
11. Sapindales 22
    Anacardiaceae
    Sapindaceae 23
    Aceraceae
    Hippocastanaceae
    Polygalaceae
    ~~Celastraceae~~

1
12. Celastrales 24
    Celastraceae
    × Aquifoliaceae
    × Staphyleaceae
    Empetraceae
13. Rhamnales 25
    Rhamnaceae
    Vitaceae
14. Rosales 25
    × Crassulaceae
    Saxifragaceae 26
    × Cunoniaceae
    Pittosporaceae
    × Podostemonaceae
    Hamamelidaceae 27
    Platanaceae
    Rosaceae
    Connaraceae 28
    Leguminosae
15. Myrtiflorae 29
    Thymelaeaceae
    × Elaeagnaceae
    × Lythraceae 30
    Punicaceae
    Rhizophoraceae
    × Combretaceae 31
    × Lecythidaceae
    Myrtaceae
    Melastomaceae 32
    × × × Onagraceae
    × Haloragaceae 33
    × Hippuridaceae
16. Opuntiales 33
    Cactaceae
17. Umbelliflorae 34
    Araliaceae
    Umbelliferae
    Cornaceae 35

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Sympetalae 35
Pentacyclicae
1. Ericales
1. Clethraceae
2. Ericaceae
3. Pyrolaceae 36
4. Diapensiaceae
2. Primulales
X 1. Theophrastaceae
X 2. Myrsinaceae 37
3. Primulaceae
3. Plumbaginales
1. Plumbaginaceae
4. Ebenales 38
X 1. Sapotaceae
X 2. Ebenaceae
X 3. Styracaceae
X 4. Symplocaceae 39
Tetracyclicae
Superae
1. Oleales
1. Oleaceae
2. Contortae 40
X 1. Loganiaceae
X 2. Gentianaceae
3. Apocynaceae
4. Asclepiadaceae 41
3. Convolvulales 42
1. Convolvulaceae
4. Tubiflorae
Polemoniineae
1. Polemoniaceae
Boraginineae 43
2. Hydrophyllaceae
3. Boraginaceae
Verbeninineae 44
4. Verbenaceae
5. Labiatae
Solaninineae 45
6. Nolanaceae
7. Solanaceae
X 8. Scrophulariaceae 46
X 9. Orobanchaceae
X 10. Gesneriaceae 47
X 11. Martyniaceae
X 12. Bignoniaceae
X 13. Sentibulariaceae 48
14. Acanthaceae
15. Plantaginaceae 49
Inferae
1. Rubiales
1. Rubiaceae
2. Caprifoliaceae 50
X 3. Valerianaceae
X 4. Dipsacaceae
2. Campanulales 51
1. Campanulaceae
2. Compositae

Monocots.

1. Helobieae 52
1. Alismaceae
2. Hydrocharitaceae 53
3. Scheuchzeriaceae
4. Potamogetonaceae
5. Naiadaceae 54
6. Triuridaceae
2. Liliales
1. Liliaceae
2. Amaryllidaceae 55
3. Iridaceae
4. Juncaceae 56
3. Dioscoreaceae
4. Burmanniaceae
3. Farinosae 57
1. Bromeliaceae
2. Pontederiaceae
3. Commelinaceae
4. Xyridaceae 58
5. Eriocaulaceae
4. Glumiflorae

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2. Cyperaceae 59
5. Scitamineae 60
1. Musaceae
2. Zingiberaceae
3. Cannaceae
4. Marantaceae
6. Microspermae 61
1. Orchidaceae
7. Arales 62
1. Palmaceae
2. Cyclanthaceae
3. Araceae
4. Lemnaceae 63
8. Pandanales
1. Pandanaceae
2. Sparganiaceae
3. Typhaceae 64.

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2. Indeterminate inflores.

1. Racemes - simple, no branching.
2. Panicles - branched raceme
3. Spikes - fls. sessile.

3. Mixed inflorescence - compound inflores. called a thyrse. Main axis is indeterminate, but secondary branches determinate. Thyrse from Isseel, means a bunch of grapes.

If peduncle suppressed + pedicels remain, result is an umbel -

If both peduncle + pedicel suppressed, a head is produced.

If a single fl. bears bracts, the bracts are good indications that the fl. is reduced inflorescence.

Vernation types.

1. Simplest - conduplicate - leaf folded like pages of a book
2. Plicate, (pleated)
3. Circinate - the leaf is conduplicate - circinnate
4. Conduplicate - convolute
5. Contorted

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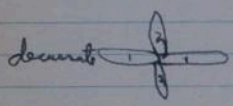
Discussion of inflorescence

1. Simple or compound (as Fagaceae)

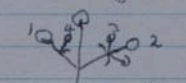
2. In a compound (Fagaceae) inflorescence, 3 fls subtended by a bract, each fl. by a bracteol (bracteole).

Simple or compd. not too important.
Most important is the time of flowering
Determinate + indeterminate -
Cyme is unit of determinate infl. - a type called a dichasium is basic
The phyllotaxy (method of leaf bearing) may be decussate, or distichous, or spiral. Simplest cyme is an opposite decussate dichasium. Plants with whorled leaves may have a trichasium. Plants with more than 3 bracteoles are pleiochasium.

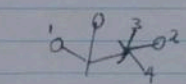


Cyme modifications -
1. When one member of a dichasium is aborting, repeats whole blooming pattern -

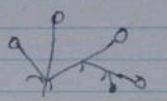
(Cymule - branch of a cyme) (diminutive).



By further abortion, flowering time further repeat.



Abortion occurs on one side or other consistently. So that by further abortion



Scorpioid ~~Helicoid~~ cyme developed

Alternate abortion makes a helicoid, if in decussate plants from top looks like this

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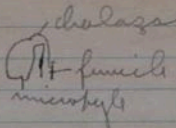
2. anatropous, the micropyle pointing toward the origin of the funicle

Epitropous - bent toward the ofsf.
Apotropous - " " " base
Pleurotropous - " " " side.



3. Campylotropous funicle

Monochlamydeae - sometimes called Amentiferae or Amentaceae first by Linnaeus. Ferae - means bearing.

Salicaceae - buds of Salix have 2 valvate bud scales, occasionally 1 or 2 or more buds. - Insect pollinated.

Populus - dioecious - broad leaves 2 glands at base of midrib - aspens + cottonwoods
little oil produced - much oil produced

axis of catkin is simple -
Fls in axils of lacerated bracts.
Wind pollinated -
Large elaborate stigmas
Ovary surrounded by a disc - possibly a reduced perianth
Stamens many borne on a disc -

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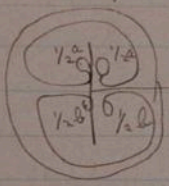
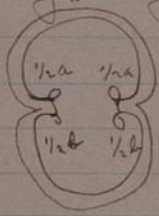
♀ - stigmas



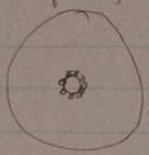
easiest separation along 2 outer layers of epidermis. There are axile placentae.

A bicarpellary ♀ stigmas ovary may be one-celled.



This type has parietal placentae. In this one, no epidermis will be seen because of the dissolution of central partition or septa.

Central placentation - only way to tell no of cells is to look at no of stigmas, or the no. of vascular strands.



Types of ovules: critical organ to examine for determination of type is the funicle -

1. ovule straight. ♀ ovules tropous
long axis of funicle same as that of ovule.

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Comments on outline; page 1

1. Cotyledons - if 2, whether united or separate only of genetic significance if polycotyledonous, not particularly important.

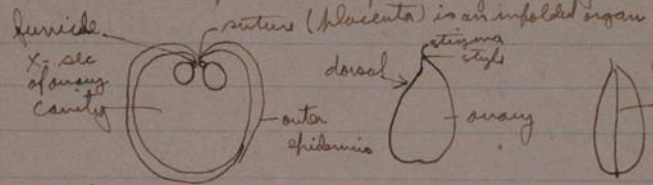
Terms of DC

{ Exogenous - dicots in old lit - because of open vasc. bundles, the cambium close to surface
{ Endogenous - monocots " " " " closed " " DC thought that growth was from within.

Monochlamydeae - hadre "sepals" no separate petals or sepals. Centrospermae as fulcrum order to next group. Pollination often endotrophic (pollen tube goes up the chalaza). Seeds often w/ 1 integument.

The lowest common denominator of the ovary is the ovule.

The buttercup consists of a single cavity in the ovary



Carpel is component part of pistil.

The funicle of nutmeg is interesting. The funicle may be coiled, or variously produced around the ovule - In the nutmeg, the funicle is called the aril. Mace is another spice from the funicle.

Axile placenta derived from the infolding of a single carpel - the most primitive.

The bicarpellary ovary is the cohesion of 2 single carpels.

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+ stamens were developed from leaves

3. Tendencies of all organs to not work in a solid phalanx.

17. Indication that syngamy is derived from polygamy is that usually there will be separate vascular strands going to the corolla.

Teratology - study of freaks.
Atavism - reversion from freak to type.

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(5)

Engler's biggest mistake was to assume that the cone-like fruits of Amentiferae were closest to the gymnosperms. Thought that since monocots had usually fewer parts than dicots, were older + simpler so should come first.

From Jussieu on, the disputes have not been where a genus should go, but the larger groups are in dispute as to position.

J. Hutchinson - came up from position as gardener at Kew. 1926 Published his classification of families of plants.

The 3 surviving systems are those of DC, B+H and Engler.

Guiding principles of Bessey, Hutchinson, et al.
The main spring of taxonomy is to depict evolution.
Phylogeny is the apparent course of evolution.
The systems of Bessey + Hutchinson are both very close to Jussieu, although the former were making a conscious effort to depict evolution, but Jussieu was not.

The Dicta of Bessey -

2. Sterilization of parts is in a centrifugal direction, the inner parts maintaining function longest, as in stamens.
Goethe thought just the opposite that petals

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1813- August Peran De Candole - based a system largely on Jussieau - "Theorie Elementaire". Interested in morphology in analyzing the relationships - the floral morph which gave the definitions -
Alphonse, A P's son, continued this analysis

1862-1883 - Bentham + Hooker - Genera Plantarum - a system of convenience - the natural.
Up to this point, not interested in evolutionary tendencies, but merely an interest in a "natural" grouping.

1860-1933 Engler - most influential systematist of his period (from 1880-1910) on His publications
1. Syllabus der Pflanzenfamilien - 11 volumes - divides all groups of plants into orders, families + mentions most economically important genera. Had collaborators, rather than depending on his own knowledge.
Placed plants in evolutionary sequence.
Englerian system adopted in most U S herbaria because he was a great teacher.

Minor prophets -
1915 Charles E. Bessey - couldn't, like Linnaeus, couldn't get his ideas over - system became relation to Bentham + Hooks

1901 Rudolph von Wettstein - a Viennese - Handbook, 4 editions resembles Engler - last time men reversed Engler in placing dicots as older -

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(3)

In 1735 - Sis Systema Naturae - embodied his sexual system of plants - based on no., position etc of stamens, recognizing 23 entities - 24 including 1 which he called cryptogamia because he couldn't count the stamens (i.e. figs).

In 1753 - Species Plantarum - embodying the system established in 1735.

1751 - Philosophia Botanica - L. confessed that Syst. Nat. wasn't so hot, + merely an expedient, prophesying that later study would be into natural relations - enumerating 63 natural orders of fl plants + 4 cryptogamia, recognizing Filices, Musci, Algae (including lichens), Fungi. In these 63 orders, recognized the palms, orchids etc. using the familiar endings aceae, ae, but his Compositi is a little aberrant.
L. did not define his orders.

A.L. Jussieu 1789 - Genera Plantarum Secundum Ordines Naturalis Deposita - adopted many natural orders previously recognized. Defined his orders, with distinguishing features, using Ray's system of cotyledons, further divided into position of ovary - called the father of the natural system.

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In 16th century, with awakening of all learning, study of plants returned. In western Europe, a group of botanists, herbalists, started studying their own plants they collected. They were still largely interested in medicinal value, but started bringing plants together.

Cesalpino 1583 was one of earliest, wrote a treatise on the Umbelliferae -

German herbalists -

Otto Brunfels
Leonard Fuchs
Bock

Caspar Bauhin - 1st binary names; the no of genus concept

French

l'Obel & J.P. Tournefort - last herbalist - 1st recognized genus in 1699.

Italy - Cesalpino - first monographer

England

William Turner - a minister

John Ray - greatest Eng. herbalist. In 1699 reduced equation to 3 - ~~reducing~~ looking inside seeds - found the embryo, dividing into (1) acotyledonae (no seed leaves), 1 seed leaf (2) monocotyledonae, 2 seed leaves, (3) dicotyledonae. As early as 1699, the thing which we consider normal & naturally was 1st introduced.

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(1)

Taxonomy - like math, a reduction of equations to an irreducible minimum - examining diff. + similarities to bringing things to an understandable body of facts - taking into account the naturalness of relationships. family, genus, sp.

Darwin + others consider taxonomy as the closest method of demonstration of evolution.

Taxonomist most interested in gross morphology in the sense of organography, with greater refinements when necessary, i.e. anatomy as in Malpighiaceae in which genera are largely separated by the stelar structures.

Taxonomic tools - physiology, ecology, geography, geology

The humanistic relations - the laws of plant names - The names of plants themselves is etymology - The literature of taxonomy is a humanity derivative.

-aceae means "ish" or -like as e.g. Rosaceae means "rosish".

History - names of plants are as old as language - useful + non-useful. To 16th century interest was w/refer. to plants useful to man, particularly medicinal. Theophrastus was exception, interested in plants from philosophical view point - classed into trees, shrubs, + herbs.

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DICOTYLEDONES: Flowers 5-4-merous or reduced; cauline stele annular, open; leaf venation reticulate; radicle developing a primary root; cotyledons 2.

Apetalae

MONOCHLAMYDEAE: Flowers frequently reduced and unisexual, naked or with undifferentiated perianth (except some Centrospermae).

Order 1. Salicales.

Family 1. Salicaceae: Flowers dioecious, in catkins, without perianth but with subtending gland or disc; staminate flowers with 2 or more stamens; pistillate flowers with superior 2-carpellate 1-celled ovary, placentation parietal; fruit a capsule; seed comose, with scanty endosperm. Trees and shrubs: leaves alternate, simple, stipulate.

Salix -
Populus

Order 2. Garryales.

Family 1. Garryaceae: Flowers dioecious, in simple catkins, clustered by 2s and 3s; staminate flowers pedicellate with 4 petals, 4 alternate stamens, and a vestigial pistil; pistillate flowers naked and sessile with a superior, 2-carpellate, 1-celled pistil with 2 pendulous ovules; fruit a 1-2-seeded berry. Shrubs: leaves opposite, simple, entire, exstipulate.

Carrya

Order 3. Juglandales: Flowers unisexual, in catkins, naked or monochlamydeous; staminate flowers with few or several stamens; pistillate flowers with a 2-carpellate, 1-celled ovary having 1 orthotropous ovule. Trees or shrubs with alternate, exstipulate, simple or compound, aromatic leaves.

Family 1. Myricaceae: Flowers monoecious or dioecious, naked; pistil supported by 2 bracteoles adnate to fruit; fruit a small drupe usually secreting wax. Leaves simple or pinnately divided.

Myrica
Comptonia - (Sweet fern)

Family 2. Juglandaceae: Flowers monoecious, naked or monochlamydeous. Bracts, bracteoles, and perianth free or adnate to ovary; fruit a "drupe" or nut with 2-4 partial septa. Leaves pinnate.

Juglans -
Carya

Order 4. Julianiales.

Family 1. Julianiaceae: Flowers dioecious; staminate flowers in catkins or in simple or branched racemes, with 3-9-parted perianth and alternating stamens; pistillate flowers naked, 3-4 in a close involucre, ovary 3-carpellary,

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anthesis - maturity of stigmas or stamens.

Casuarinaceae. striking resemblance to Ephedra. By some a link to the Gymnosperms. ♂ inflorescences grades into stem w/o striking separation. Perianth only in staminate flo. Sites of perianth lobes concrescent in bud. Act anthesis, stamen pushes off the perianth.

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1-celled with 1 arillate ovule; fruit samaroid, compound, adnate to the persistent enclosing involucre. Trees and shrubs, resinous; leaves alternate, pinnate, exstipulate.

Juliania - a samara like fruit.

Order 5. Fagales: Flowers unisexual, usually in compound catkins, the pistillate reduced; staminate flowers usually adnate to the bracts, naked or monochlamydeous; pistillate flowers naked or monochlamydeous; supported by bract and bracteoles, the pistil 2-3 (-6)-carpellate with similar cells each with 1-2 ovules, inferior; fruit a 1-seeded nut or samara associated with persistent bracts and bracteoles, seed without endosperm. Trees and shrubs; leaves simple, alternate, with deciduous stipules.

Stamens cleft - thecae are sphaeric

Family 1. Betulaceae: Flowers monoecious in catkin-like, compound inflorescences, the pistillate often reduced; perianth of small scales, when present, varying in number and degree of union; pistillate flowers adherent to their bract, with 2-12 stamens; pistillate flowers with 2-celled pistil with 2 styles, each cell with 1 pendulous anatropous ovules with 1 integument; fruit with 1 seed, usually enveloped by the accrescent bract.

Chalazogamic
Predominantly dimerous
stamens cleft
staminate
Cotyledons very large, contain oil

Corylus - Hazelnut
Ostrya - hop hornbeam
Carpinus - bract + pistil herbaceous
Betula - Scotch's liquor
Alnus - has woody
Ostreoboria - Asian

Dominican Plicate (Platy)
deciduous
4 Plant from Johnston
persistent
micellus tends to produce a no. of embryo sacs
linden
has vascular tissue
ovules
fl 7 pistillate fl. in a cyme, the central fl. abortive.

Family 2. Fagaceae: Flowers monoecious, rarely dioecious, the staminate usually in catkins, the pistillate usually few, sometimes solitary; staminate flowers often with scale-like perianth, with varying stamens; pistillate flowers usually with a 3-celled (rarely 6-celled) pistil with 2 pendulous anatropous ovules with 2 integuments in each cell; fruit 1-seeded, invested at maturity by a bracteate cupule.

Predominantly trimerous
3 carpellate
placenta axillary

monoecious
dioecious
Quercus - cup deciduous acorn fruit - has 1 acorn - 1 pistil
Castanea " covers " - has several fruits
Fagus
Nothofagus - Restricted to S hemisphere

Order 6. Casaurinales.

Family 1. Casaurinaceae: Flowers monoecious, extremely simple; staminate flowers in whorls in clustered twiggy spikes at ends of young stems, with 1 more or less cleft stamen and a caducous 2-leaved perianth with 2 bracteoles; pistillate flowers capitate on short side branches, naked but with 2 bracteoles, the pistil 2-carpellate, 2-celled but 1 abortive, the second usually with 2 ovules, one abortive; fruit a woody samara enclosed by the woody bracteoles. Trees and shrubs with green fluted stems and whorled scale-leaved.

Pendulous anatropous ovule.

Casuarina - 40-50 sp - Austral - Asian + Oceania

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Tendency toward isomery in Urticales is significant. The gynoecium is most likely to be heteromerous, whereas sepals, petals + stamens tend toward isomery.

Position of stamens- (1) opposite stamens - antisepalous

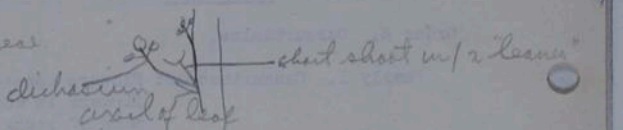
petal
or calyx lobe

(2) stamens opp. petals - antipetalous

Ulmus - may have 1 fertil + 1 sterile cell in ovary. Thin covering (by closure of sterile cell) axile placentation.

Stipules in Urticales may take place of bud scales - They are caducous in Urticaceae, tend to be persistent - Position variable - good method of sorting genera -

Inflorescence of Urticaceae



Sepal of same perfect laterals usually staminate, lowest are sterile

polygamo-dioecious;

In Urticaceae, cystoliths + fibers are common

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Cannabinaceae - Pls pentamerous.

See Hooker - Account of Breadfruit in Curtis Botanical Magazine -

Addisonia - con icones (the only one in this country) published by NY Bot. Gard.

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Ulmaceae

1. Ulmus - fr a samara - fls in small cymes, sessile, perianth usually 4 lobed - wind pollinated.

2. Celtis - fr a berry - wide distrib. Afr Asia Eur + Am. - 9° catkins, ♀ fls solitary or very few in axils of leaves

Urticaceae

1. Boehmeria nivea - source of ramie - fum bast fibers.

Moraceae (mulberries) - latex occurs usually as articulated - ducts (single cells which coalesce) latex canals - single cells w/o coalescence

Dorstenia - contra-yerba

Morus - fruit a small nut - perianth lobes accrescent forming the "fruit" an aggregate - inflorescence racemiform.

Fruit of Ficus is a syconium - the peduncle is fleshy (not the receptacle). Perianth makes a fleshy pulp on interior of syconium.

Broussonetia - paper mulberry has a capitate pistillate inflorescence

Maclura pomifera - osage orange - infl. a head. Peduncle small in center -

Artocarpus incisa - trees up to a meter in diameter, trees up to 20 ft - from Eastern Asia. Staminate inflorescence up to a yard long, covered completely with fls. Pistillate inflorescence is large, capitate. Flowers on surface, the peduncle very large -

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stigma a single invaluable structure.

Unknown whether unisexual or bisexual among

Order 6a. Leitneriales.

Family 1. Leitneriaceae: Flowers dioecious, naked, in catkins; pistil 1-carpellate with 1 ovule; fruit a drupe. Shrubs with alternate, simple, exstipulate leaves.

Cretaceous coastline plants disjunct distrib. from Sa. to SE. Mo. no intermediate stations.

Leitneria

Order 7. Urticales: Flowers generally unisexual, small, regular, and mono- (dioecious) chlamydeous or rarely naked; petals 2-7, greenish and more or less united; stamens 4-5, opposite; pistil superior, 1-2-carpellate, usually 1-celled, 1-ovulate; fruit a nut, drupe, or samara. Herbs, shrubs, or trees; leaves usually simple, alternate, and stipulate; usually cymose inflorescences.

(1-7) (5) (one perianth leaf)

Stipules coalescent (found only with the bud?)

monoecious Important

Family 1. Ulmaceae: Flowers often bisexual; stamens erect in bud; styles 2; ovule pendulous and anatropous; endosperm usually absent. Trees and shrubs without latex; leaves often oblique, stipules deciduous.

Ulmaceae Celtidaceae

Represented by 2 subfamilies: Ulmus bisexual fl., fruit a samara. Celtis unisex "

Filaments, with anthers inverted. Center.

Family 2. Urticaceae: Flowers usually 2-merous; stamens inflexed in bud; style 1; ovule erect, orthotropous; endosperm oily. Herbs, rarely woody, often with stinging hairs; leaves stipulate.

Urtica - Boehmeria

Monoecious, unisexual

Family 3. Moraceae: Flowers 2-merous; stamens inflexed or straight in bud; styles 2; ovule pendulous; endosperm present. Trees or shrubs, rarely herbs, with latex; leaves stipulate, often lobed.

Cecropia - succulent leaf

Morus
Ficus - "Fruit" = syconium = inflorescence, fruit has a stadia - 1 stamen
Artocarpus bread fruit
Dorstenia - Contrayerba - flowers in syconium -

Family 4. Cannabinaceae: Flowers dioecious, 5-merous; stamens erect in bud; styles 2; ovule pendulous; endosperm scanty. Aromatic herbs with more or less divided, stipulate leaves.

Cannabis - sativus - hemp, hashish, Marijuana.
Humulus - Inflorescence

Order 8. Proteales. Lupulus - the hop vine from Eurasia.

Family 1. Proteaceae: Flowers bisexual or unisexual, cyclic, 4-merous, regular or irregular; perianth petaloid; stamens opposite and usually united to petals; pistil superior, 1-carpellate; ovules 1-many; fruit a follicle or indehiscent; seed without endosperm. Usually woody plants; leaves alternate, exstipulate, entire or pinnately divided.

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4. Balanophoraceae - complete parasites - Helosis - looks like a Coprinus or Agaricus - color + all - w/ flowers scattered all over the "pileus" - all root parasites.

Aristolochiales -

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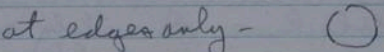
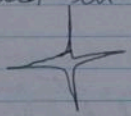
Aestivation

1. Valvate - united at edges only - 

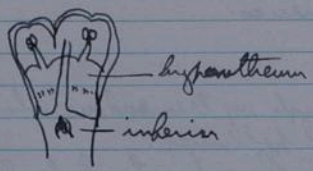
2. Imbricate all within or all without.

3. contorted - twisted.

4. Pliate - petal is imbricate, valvate or contorted, but folded in half-



Commandra



Receptacle - a region where the traces depart to various floral organs - it is not a recognizable "organ".

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Santalales - according to Wettstein + Hutchinson this order + Aristolochiales are widely separated. Actually these show similar tendencies towards parasitism.

Santalum album - sandal wood of commerce - ingredient of incense.

Structure of ovule of Santalales is interesting - have no integument, and in some, no nucellus. Immediately within the pericarp of the fruit is found the endosperm (this indicates that it is a seed).

Parasites (vascular) parasitize host usually by a rhizome modification, or others by roots. The "haustoria" of dodder are adventitious roots.

1. Olacaceae - petals green color.
2. Opiliaceae - tropical America.
3. Stilbiaceae - African.
4. Santalaceae: pallida
   Commandra - 6" - 1' ft high w/ tremendous rhizome system. inferior ovary - insect pollinated.

Calyculus - "a little calyx" - actually a bract - looks like a cup outside the perianth proper.

Characters of Santalaceae - single perianth 4 - 5 merous - all root parasites - no calyculus.

Loranthaceae - all stem parasites - perianth usually double, 2- or 3-merous.

Subfamilies based on presence or absence of the calyculus
1 Viscoideae - no calyculus.
   V. album - English mistletoe
2. Loranthoideae - calyculus present.
   Mistletoe - genus Viscum - old world -
   New world mistletoe is Phoradendron
   Arceuthobium - the only flowering plant which parasitizes the gymnosperm.
   Psittacanthus (parrot flower) - tropical genus, with handsome orange, scarlet, 6" flowers.
No differentiation of ovules - 1 ovule in placenta.
Phoradendron - largest genus - separated on architectural characters of leaves.

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Banksia - racheme condensed into a spike, fr. fruit woody. adherent calyx

Protea
Grevillea - silk oak - from Australia, a tree 25 m.

Order 9. Santalales: Flowers bisexual or unisexual, cyclic, regular, rarely irregular; perianth sometimes petaloid; stamens opposite petals; pistil inferior, 2-3(-1)-carpellate, usually 1-celled; fruit 1-seeded, nut, drupe, or berrylike; endosperm present. Herbs or woody plants, often more or less parasitic; leaves simple, alternate or opposite, sometimes lacking.

Placentation central

Family 1. Olacaceae: Autotrophic woody plants; ovules naked.

Reduction valvate in Comandra

Family 2. Santalaceae: Hemiparasitic woody or herbaceous plants; perianth single, 4-5-merous, without a calyculus; ovules naked.

Hypanthium

(Quinka fruit no integument

stamens opp. the petals of albumen

Santalum - sandalwood - a tree. mostly root parasites
Comandra - horned toad flax - a dusk associated with perianth

Cymose inflorescence

Family 3. Loranthaceae: Hemiparasitic shrubs; perianth usually double and 2-3-merous, with or without a calyculus; ovules undifferentiated.

stamens opp. perianth

embryo sac formed in placenta.

Phoradendron
Viscum
Loranthus
Arceuthobium - most reduced; on pines.

no diff. between fruit

Family 4. Balanophoraceae: Complete parasites; flowers naked or with a simple 3-4-merous perianth; ovules naked or undifferentiated.

Plants are aphoganous (no seed) fuse the embryo from endosperm. Root parasites.

Balanophora
Helosis

generally 3 merous

Order 10. Aristolochiales: Flowers bisexual or unisexual, cyclic, regular or irregular; perianth simple, united or free, petaloid or fleshy; stamens as many as perianth segments or more, free or united with the style; ovary inferior, 4-6-celled with axile placentas or 1-celled with parietal placentas; ovules numerous, with 2 integuments; fruit a capsule or berry; seeds with endosperm. Herbs or woody climbers with alternate exstipulate leaves, or leafless parasites.

Placenta axile or parietal. gynostemium

because of prevailing 3-merey, Hutchinson + Wettstein place in magnoliaceae

Family 1. Aristolochiaceae: Autotrophic plants; flowers bisexual; stamens free or united with style, 6-36; ovary 4-6-celled.

chiefly vines

Aristolochia - duteliman pipe vine. Perianth irreg. - stamens united.
Asarum - wild ginger - corolla reg. stamens separate

Family 2. Rafflesiaceae: Complete parasites; flowers unisexual; stamens indefinite, united to the style. Column or elevated style

Stem or root parasites

Rafflesia - in Malaya - root parasite - largest flower in plant kingdom
Apodanthes - America stem "

The whole tissue of plant lives within the cambium of the host. Sl. staminate or pistillate

Families 3. Hydnoraceae - Complete parasite, fls bisexual, stamens 3-4 many - alike, united in a ring adnate to base of perianth

Genus Hydnora

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Ephemeral - one day bloom or part of a day.

π A tubular corolla with reflexed lobes is salverform

Anthocarp = an achene with a persistent (accrescent?) perianth member.

Achene - indehiscent, dry, one-celled, one seeded, in which the testa is free from the pericarp.

What appears to be a calyx in Mirabilis is actually an involucre, with sometimes 3 flowers within.

Tendency of Phytolaccaceae + Aizoaceae is towards numerous parts, particularly in stamens - in which more than one part (stamen) is found where one would normally be expected - called Pleiomerism.

Stegnosperma - dicotyledons

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Asymmetrical polydesmy - causes flattened type of stems
occurs in Leguminosae + Malpighiaceae.

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1. Central placentation of ovules links the 3 orders here

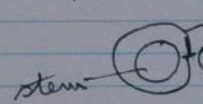
Geniculate – bent + swollen stems (at the nodes)
characters of Polygonaceae
Polygonaceae generally with a perianth while
Perigyny – a general tendency in these orders

A nut – a one seeded indehiscent fruit – dry + hard.
the testa is adnate to the pericarp.

The orthotropous ovule of Polygonaceae keeps it out of Centrospermae (campylotropous).

Polygonum fagopyrum (a genus sometimes called Fagopyrum esculentum (esculentum means edible).
sativum also means edible.

Ochreas are intrapetiolar stipules (between petiole + stem).
there are two fused stipules



The ochrea provide good specific separation.

Piperales – perisperm – the accrescent nucellus, which is used as a storage organ, in some cases rather than the endosperm.
Source of black pepper is chiefly from the bleaching pericarp, but also in perisperm.

Piperaceae – anomalous stele allies this family to Centrospermae as in Beta – the rings in the beet.
Polyderm – instead of 1 cylinder of procambium laid down, several cylinders of procambia. In young stems, may be one cylinder of procambium, and as plant ages, new procambia are laid down in the cortex.
This phenomena has been the main reason for calling the Piperaceae the transitional family from monocots to dicots.

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Order 11. Polygonales. - often in Centrospermae (Engler)

Family 1. Polygonaceae: Flowers usually bisexual, small, regular, 3(-2)-merous; perianth undifferentiated or rarely differentiated; stamens usually 6-9, rarely fewer; pistil superior, 3(-2)-carpellate, 1-celled; ovule 1, erect, orthotropous; fruit a 3- or 2-sided nut; seed with a more or less excentric, frequently coiled, embryo and mealy endosperm. Herbs, rarely shrubs or trees; leaves simple, usually alternate, with an ochreate stipule. - contain organic acids (smartweed)

Polygonum - Fagopyrum buckwheat - subg. areat not a grass.
Rumex - the docks - "R. acetosella - "sheep's sorrel"
Rheum - rhubarb.
Coccoloba - dioecious, the sea grape.

Order 12. Piperales: Flowers generally bisexual, minute, naked, in spikes; stamens 1-10; carpels free or united, 1-4; ovules orthotropous, usually solitary; seed usually large, containing a small embryo at the tip of the endosperm, perisperm frequently present. Herbs or shrubs, rarely trees, frequently climbing; leaves entire, stipulate or exstipulate, with oil cells.

Family 1. Piperaceae: Flowers usually in fleshy spikes; ovary 1-celled; ovule 1; seed with endosperm and perisperm. Stem with more than 1 ring of vascular bundles. - reason for Engler placing these in Monochlamydeae.

Piper
Peperomia

Family 2. Saururaceae: Carpels 3-4, free or united; ovules 2 or more; stem with 1 ring of vascular bundles.

Saururus cernuus (nodding inflorescence) - the lizard's tail.

Order 13. Centrospermae: Flowers bisexual or unisexual, regular, usually 5-merous; perianth simple or double, the inner petaloid; stamens in 1-2 series, rarely many; pistil usually 1-5-carpellate, usually 1-celled with central placentation, superior or rarely inferior; ovules 1-many, campylotropous or rarely anatropous; fruit usually a capsule or nut, rarely a berry; embryo large, curved round a perisperm. Herbs, rarely shrubs or trees; leaves alternate or opposite, simple, usually exstipulate.

Family 1. Chenopodiaceae: Flowers small, monochlamydeous, unisexual or bisexual; perianth 5-2-merous, usually herbaceous; stamens opposite and isomerous or fewer; pistil 2-carpellate, 1-celled; ovule 1, basal; fruit a utricle or nut enclosed by the persistent perianth. Herbs, rarely shrubs, usually with anomalous stele; leaves alternate, exstipulate.

Stamens largely free.

utricle - dehiscent or indehiscent; dry, inflated, bladder like accrescent perianth.

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Halogeton glomeratus - sheep poisoning - (Utah)

Chenopodium - contain hairs filled carry water.
Beta - ovary partially inferior sugar beets - seeds held together.
Spinacia sp. oleracea.
Salicornia - curious seedling plant - axis becomes fleshy.

β-xanthin - a pigment found only in Beta - not other plants

Family 2. Amarantaceae: Flowers similar to Chenopodiaceae, but perianth scarious; pistil 1-3-carpellate; ovules 1-several. Herbs or shrubs, usually with anomalous stele; leaves opposite or alternate. Staminal filaments united into tube at base, with lacunae projecting between

inflorescence a thyrse

bisexual — Amarantus
Celosia - cockscomb
Gomphrena - cult. bachelor buttons.

Vegetative - mostly stem

Family 3. Nyctaginaceae: Flowers frequently showy, bisexual, rarely unisexual, monochlamydeous; perianth tubular or funiform, petaloid, plicate, the lower portion persisting and adhering to the fruit; stamens usually 5 and alternate, rarely more or fewer, the filaments often unequal; pistil 1-carpellate; ovule 1, basal; fruit an achene (anthocarp); cotyledons unequal, 1 occasionally suppressed. Herbs or shrubs, occasionally climbing, stele anomalous; leaves usually opposite, often unequal, simple, exstipulate.

last character

fruit anthocarp

Bracts are showy — Mirabilis - jalapa - 4 o'clock (Oxybaphus is segregate of Mirabilis genus)
Bougainvillea spectabilis
Abronia - sand verbena - herbs
Pisonia - tree or shrub, monoecious

Family 4. Phytolaccaceae: Flowers inconspicuous, bisexual or unisexual, 5-4-merous; perianth monochlamydeous, free or united at base, persistent; stamens various, isomerous and opposite or alternate, or numerous; pistil 1-10-carpellate, free or united; ovule 1 in each ovary cell; fruit a schizocarp, berry, or nutlet. Herbs, shrubs, or trees, rarely climbing; leaves simple, usually alternate and exstipulate.

usually petaloid

Staminodes frequently present

good character

Phytolacca
Limeum - africa - frequently w/petals Strikingly petaloid

Family 5. Aizoaceae: Flowers bisexual, typically monochlamydeous, cyclic; perianth 4-5-merous; stamens 5(-3)-many, the outer often petaloid; pistil 2-many-carpellate, superior or inferior, 2-many-celled; ovules many, anatropous or campylotropous; fruit a capsule. Herbs or undershrubs, usually succulent, with anomalous stele; leaves opposite or alternate, exstipulate.

Xerophytes + Halophytes

numerous

Plants chiefly of Mediterranean, Africa, + western U.S.

Mesembryanthemum -
Mollugo - carpetweed.
Sesuvium
Tetragonia New Zealand spinach

Reduction of flower - great development in Aizoaceae.

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Dianthus sp are characterized by cæspitose habit, stoloniferous, jointed stems, leaves narrow, lanceolate, ensiform (sword shaped) + more or less succulent, with a glaucous bloom. Grow best on well-drained soils well limed - (gypsophyllous)

Silenoideae - petals clawed + notched, often w/ a crest (liferous) which is a scale which is interpeted as of stipular origin, particularly so since stipules are characteristic in the family. Often these crests occur on sepals as well as petals. This gives a possible derivation for petals + sepals as changed foliar organs.
Central placenta -

Alsinoideae - free central placenta - probably derived from lateral septal of a 3-carpellate ovary, the septae of which have been dissolved.

Dianthus barbatus - Sweet William
" caryophyllus - carnation.

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Types of fruits -

See Holman + Robbins -

1. Main divisions - simple fruits + pseudocarps -
   A Simple (true fruits) - from a single flower + from pistil only -
      Dry
      Dehiscent
         1. Follicle - produced from a single carpel - dehiscent in a septicidal manner (25) (always has more than one seed) (milkweed)
         2 Legume - loculicidal + septicidal dehiscent.
         3. Capsule - composed of 2 + more syncarps - w/ valvate or loculicidal, or by poricidal dehiscent or circumcisile. Often capsule is indehiscent.

B. Pseudocarps - of one or more fls, w/ more than pistil.

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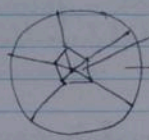
Ovule development
1. Nucellus first developed
2. Next is inner integument, then outer

From the straight spirals we find what a petal is.
In Helleboroideae, the nectaries are the outside members of the staminal straight spiral.

As the stamens of the outer whorl become more + more laminated. The thecae of the anthers apparently take part in this lamination. The Berberis petals evidence this structure in their development.
The spurred petals of Aquilegia are similarly derived.

The gynoecium of Aquilegia is interesting (usually 5 carpels)
There are 5 hyaline scales alternating with the carpels
(Scales are reduced carpellodes).
The fruit of Aegela is a bladdery structure 5 fused carpels



Berberidaceae - cyclic arrangement derived from the straight spiral.

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This group of Ranales is largely herbaceous, without oil cells

Ranunculaceae - almost same as Magnoliaceae, but herbs
When perianth is simple, generally accompanied by nectaries.
Generally speaking ex-stipulate
Jussieau - careful study of family - found similarities with monocots + this group. In a few of Ranunculaceae there are scattered vasc. bundles, largely without endodermis
Tendency of cotyledons to fuse into a tube at the base; continuing into blade.
Plumule has tendency to break out of side of cotyledonary tube, such as coleoptile + plumule of dicots. monocots -
Frequent trimery
Juss. thought Alismaceae of monocots most similar.
Development of floral envelope - perianth simple, w/ nectaries, the nectaries develop between sepals + androecium.

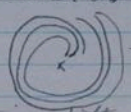
Fruit character used in separating subfamilies

1. Helleboroideae - follicles or berries (as Actaea) the more primitive. Simple petaloid perianths w/ nectaries.
2. Anemonoideae - achenes - genera w/ distinctly dibblamydeous perianth.
3. Paeonoideae - follicles here - sometimes in Dilleniaceae have a fleshy follicle, the outer integument longer than inner integument.

Helleboroideae - spiral arrangement - in which spirals continue the cycle started in the bracts
13 Staminal spirals.

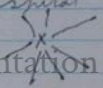
b = bract
s = sepal

Spiral of stamens of Ranunc. is a true spiral or straight spiral. There are not just one spiral, but several as



- this is a true spiral

A straight spiral caused by extension of the true spiral



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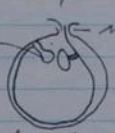
Ranales (cont).

Degeneria vitiensis - has an open carpel -



Papillate hairs of stigma provide a nutrient soln. for pollen grain development.

Stigma receptive even inside of ovary - not a stigma as such - 3 strands enter ovary - (the papillate hairs line the ovary ???)

Hallier - thought Magnoliales ~~thought it~~ were best possible springboard for Angiosperms - derived from lic-sporangiate Bennettitales, the cones of which are unique in their lic-sporangiate cones - the Bennettitales probably derived from the pinnate megasporophylls of Cycas. The Bennettitales had a similar strobilus, surrounded by a compound staminate ~~or~~ and microsporophylls

Since Hallier, intermediate genera, i.e. Pteridosperms with cupules (genus Caytonia) have been found. Capules are very close to carpels -.

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Ranales - keystone of phyletic systems
1. Convex floral axis
2. Infinite nos. of parts -
3. ~~Num~~ Free carpels
Hutchinson makes 3 or 4 orders (sensu stricto).
Aristolochiales allied? particularly Magnoliales.
~~Wettstein~~ Rendle calls the order Polycarpicaceae

Ranales divided into 2 series
1. First 6 families are woody (as a rule) having oil cells of parenchyma - aromatic.
2. next 5 families largely herbaceous, w/ no oil cells.

Magnoliaceae - convex or elongate floral axis
Usually has 3 spiral whorles, instead of 2 - 3 spirals each of which is 3-merous. The parts of these whorles difficult to distinguish.
Stipules usually present.
75 Genera ±
Illicium
Degenera
Segregate families
Winteraceae - Illicium, Drimys - single carpel apple, no stipules
Schizandraceae - staminodes +, no stipules.
Hemetandraceae - perianth does n't open.
Trocodendraceae -
Cercidophyllaceae - see example in greenhouse -
Degeneriaceae ~~st~~ vitiensis (Fiji Islands) -

Magnolia - 2 centers of distrib - 1 in subtropical America + 2 S.E. Asia. American spp. bloom after leaves, Asiatic bloom before the leaves.
Liriodendron - generally E. U.S. and eastern China (same sp.)
Fossils occur in Greenland + Europe Explains discontinuous distribution of Magnolia -

Drimys - no vessels in xylem. Very light wood.
The phloem has distinct angiospermous aspect - that is with sieve tubes + companion cells. There are no companion cells in phloem of gymnosperms. (Jeffrey) the wood
Vessels [illegible] will occur in

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Family 6. Portulacaceae: Flowers small or showy, bisexual, dichlamydeous; sepals 2, free; petals 4-5; stamens 5 and antepetalous, rarely more; pistil 3-carpellate, 1-celled, superior rarely subinferior; ovules 2-many; fruit a capsule. Herbs, rarely small shrubs, usually succulent; leaves simple, usually with scarious stipules.

Portulaca
Claytonia
Talinum

Family 7. Caryophyllaceae: Flowers usually bisexual, rarely unisexual, dichlamydeous, 5-4-merous; sepals free or united, persistent; petals often clawed and notched; stamens 8-10, or fewer; receptacle sometimes elongated below stamens; pistil 2-5-carpellate, 1-celled; ovules usually many rarely few or 1; fruit a valvate capsule, rarely a berry. Herbs or undershrubs; leaves usually narrow, opposite, rarely alternate, exstipulate or stipulate; inflorescence cymose.

Dianthus
Stellaria
Cerastium
Saponaria
Silene
Lychnis
Paronychia
Arenaria

POLYPETALAE: Flowers usually bisexual, unisexual only in derived forms. Perianth dichlamydeous, except in derived forms, the sepals and petals typically free.

Order 1. Ranales: Flowers spiral, spirocyclic, or cyclic, regular, or zygomorphic in derived forms; floral axis convex, frequently much elongated, rarely concave and more or less united with the pistil in derived forms; perianth usually either petaloid or with both calyx and corolla; stamens usually numerous; carpels numerous to solitary, usually free; seeds usually with copious endosperm, sometimes also with perisperm.

Family 1. Magnoliaceae: Flowers bisexual or sometimes unisexual, regular, hypogynous, spiral or spirocyclic; floral axis convex or elongated; perianth more or less dichlamydeous; stamens usually numerous; carpels usually numerous and free, rarely united; ovules anatropous with 2 integuments; fruit a follicle, winged nut, or berry; seeds with a small embryo enclosed in copious endosperm. Woody plants with oil cells in the parenchyma; leaves alternate, entire or rarely lobed, often stipulate.

Magnolia
Liriodendron
Drimys

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Family 2. Annonaceae: Essentially as in Magnoliaceae, but flowers typically 3-merous; stamens with very short filaments and apically produced connective; endosperm ruminated; leaves exstipulate.

Annona squamosa (custard apple or sour sop), cherimola
Asimina

Family 3. Myristicaceae: Much as in Annonaceae, but flowers inconspicuous, dioecious, cyclic; perianth lobes united below; staminate flowers with 3-18 stamens united by their filaments; pistillate flowers with 1 carpel and 1 basal ovule; fruit a fleshy capsule containing an arillate seed with ruminated endosperm.

Myristica fragrans - nutmeg

Family 4. Calycanthaceae: Flowers bisexual, perigynous; perianth of numerous petaloid tepals; stamens 10-20; carpels 20, free, included within a hypanthium; ovules 2, anatropous, with 2 integuments; fruit an achene, enclosed collectively within the persistent hypanthium; embryo large, endosperm very scanty. Shrubs with oil cells in the parenchyma; leaves opposite, entire.

Calycanthus - S. Appalachians

Family 5. Monimiaceae: Flowers usually unisexual, perigynous; perianth sometimes wanting except for the hypanthium, monochlamydeous or somewhat differentiated; stamens numerous or few, the dehiscence sometimes valvular; carpels usually numerous, free; ovule 1; fruit an achene, enclosed collectively within the persistent hypanthium; embryo small, enclosed within copious non-ruminated endosperm. Shrubs and trees, rarely climbing, with oil cells in the parenchyma; leaves leathery, usually opposite, simple, exstipulate.

Monimia

Family 6. Lauraceae: Flowers bisexual or sometimes unisexual, regular, usually 3-merous, somewhat perigynous; perianth monochlamydeous or poorly differentitated, more or less united at the base; stamens usually in 4 whorls, valvular, the inner frequently staminodial and glandular; pistil 3-carpellary, 1-called; ovule 1, pendulous; fruit a berry, rarely a drupe, more or less enclosed by the persistent hypanthium; embryo large, endosperm lacking or scanty. Woody plants with oil cells in the parenchyma; leaves alternate, simple, entire, exstipulate; rarely leafless parasites.

Sassafras
Cassytha - a large vine - parasite.
Laurus - nobilis - laurel,
Benzoin (spice bush) - S. E. early in spring
Persea - americana - avocado

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Cassytha - parasitic genus -

Cinnamomum
Persea - avocado
Nectandra - greenheart - outstanding tropical hardwood tree (very heavy)

Family 7. Ranunculaceae: Flowers bisexual, rarely unisexual, spiral or spirocyclic, rarely cyclic, regular or irregular, hypogynous; perianth simple and petaloid or distinctly dichlamydeous, frequently accompanied by nectaries; stamens generally indefinite and free; carpels indefinite to few or solitary, rarely united; ovules numerous to few, with 1 or 2 integuments; fruit a follicle or achene, rarely a berry; seeds with a small embryo enclosed by copious oily endosperm. Herbs, rarely somewhat woody, without oil cells; leaves usually alternate and more or less divided blades, sometimes stipulate. (Thalictrum has stipules)

Fruit a true achene

Palmately divided leaves — Helleborus - X-mas rose - bloom in cold weather.
Caltha - Marsh marigold - boggy + marshy places - mint + white
Isopyrum -
Actaea - Baneberry
D. ajacis — Delphinium + Consolida - cosmopolite
Aconitum - Monks-hood
Nigella - "saffron" in this family 5 carpels united, fr a capsule.
Anemone - has no calyx.
anemonoides — Clematis - mostly tropical genus in S.A.
Myosurus - mouse tail
Has shiny petals — Ranunculus — dichlamydeous
Thalictrum - Rue - dioecious
Paeonia — only woody member family.

Family 8. Berberidaceae: Flowers bisexual, usually cyclic, regular, hypogynous, 3-2-merous; perianth of 2-4 whorls, usually dichlamydeous, often accompanied by nectaries; stamens usually in 2 whorls, rarely more, the anthers usually with valvate dehiscence; carpel usually solitary; ovules numerous to few, the integuments 2, the outer longer than the inner; fruit a berry or capsule, rarely an achene; seed with copious endosperm and usually small straight embryo, frequently arillate. Perennial herbs or shrubs without oil cells; leaves simple or compound, exstipulate.

an unrelated family - somewhat associated with Lauraceae.
aril in placenta.

Pearl placenta in Ranunculaceae (Paeonioideae)
Hydrastis - several carpels.
anthers w/ slits
" valvate — Podophyllum - may apple - closer to Paeonia
Berberis — barberry - only woody Genus

Family 9. Menispermaceae: Flowers small and dioecious, cyclic, 3-2-merous, usually regular; petals smaller than the sepals and sometimes lacking; stamens sometimes united; carpels usually 3 or more, rarely 1, free, superior; ovule 1, pendulous, with 2 integuments; fruit a drupe; seeds with endosperm, sometimes ruminate, or exalbuminous, the embryo often bent.

Vines -

*

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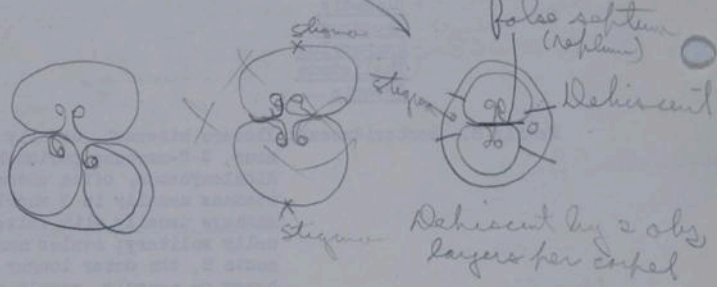
Structure of carpel of Rhoeadales



The carpel = a foliage leaf rolled so that sides or edges meet, and the stigma is formed from the midrib.

Amicarpellary — stigma

"Commissural" stigmas stigma

False septa do not delimit the carpels — does not contain vascular

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Nelumbo- leaves & fls. above water.
Nymphea- " only float.

Rhoegadales-
Position of stigmas -

Seeds campylotropous, embryos somewhat curved.

Tendencies -
1. Stamens indef in Papaverace + Cruciferae as Ranales.
2. Unlike Ranales in 2-merry + syncarpy
3. Ovaries falsely many celled.

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Menispermaceae — Generally lianas without oil cells; leaves alternate, simple, frequently lobed.

Menispermum
Cissampelos

Lardizabalaceae — a vine Akebia (cinnamon vine)

aril in funiculus

Family 10. Nymphaeaceae: Flowers bisexual, regular, hypogynous to perigynous, acyclic to cyclic; perianth segments free, 6 to indefinite, usually dichlamydeous, the petals often grading to the 6-many stamens; carpels 3-many, free, rarely united; ovules 1-many, with 2 integuments; fruit a nut or indehiscent capsule; seeds often arillate, usually with both perisperm and endosperm, the embryo with fleshy cotyledons. Water- or marsh plants; leaves usually floating or submerged.

sometimes united

vinp. chara.

Cabomba — Water lily miniature
Nelumbo — Water - 1-cell below only - white - yellow; pink-Eurasian.
Nymphaea
Castalia — hardy water-lilies — choice. - gradation of stamens.
Victoria — leaves in center rise above water.

Elongation of axis of many in Castalia

carpels cohere laterally

Nuphar - carpels united

Family 11. Ceratophyllaceae: Flowers unisexual, inconspicuous; ~~pistillate~~ staminate flowers with perianth of about 12 narrow lobes united at the base and 12-16 2-3-horned stamens; pistillate flowers with similar perianth and 1 carpel containing 1 pendulous ovule; fruit a spurred nut; seed with a large embryo and scanty endosperm. Rootless submerged aquatic herbs with whorls of simple, much-dissected leaves.

Ceratophyllum = horned leaf.

Ceratophyllum (means horned)

Mediterranean Europe is center of origin

Order 2. Rhoeadales: Flowers bisexual, hypogynous, 2-, or rarely 3-merous, regular or irregular; stamens 4-many; pistil 2-many-carpellate, 1-celled, the placentation parietal, often 2-celled by a false septum (replum), stigmas often commissural; fruit a capsule, berry, or nut; seeds usually small and exalbuminous, the embryo usually large and filling the cavity. Herbs, shrubs, or trees, often laticiferous.

Mostly herbaceous
Oil producing
The predominantly 4-merous
In a few cases, petals lacking

Family 1. Papaveraceae: Flowers regular or irregular; sepals 2 or 3, imbricate, usually caducous; petals 4-6, sometimes more, usually in 2 whorls, often crumpled in the bud, deciduous, rarely absent; stamens usually indefinite, rarely 4 or 2; carpels 2-many, usually 1-celled, rarely falsely 2-celled; ovules usually many, rarely few or 1, anatropous or campylotropous; fruit usually a capsule dehiscing by pores or valves, rarely indehiscent; seeds globose or ovoid, the embryo small in an oily endosperm. Herbs, sometimes somewhat woody below, rarely shrubs, usually with colored or colorless latex; leaves alternate, simple, usually lobed or divided.

Generally polypetalous.

Bocconia cordata - petals absent.

This is only family w/ endosperm (except Resedaceae)

median transverse zygomorphy

Hunnemannia

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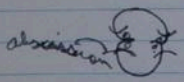
Capparidaceae

Cruciferae - commissural stigmas.

John Lindley - The Vegetable Kingdom - since abscission on both sides of placentas, there were 4 carpels by a reduction from a regularly 4 carpellate ovary.



Edith Ruth Saunders agreed in 1924 - thought that all ovaries composed of fertile + sterile carpels - The solid carpels being fertile + the hollow (valves) carpels are sterile.

This is principal of carpel polymorphism.

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Papaveraceae largely N hemis.

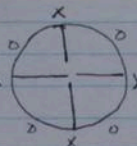
Papaveroideae - many stamens

Hypecoideae - 4 stamens

Fumarioideae - zygomorphy is lateral, not median - only 2 stamens anthers w/ 3 thecae. No latex cells, but have oil cells.

Placentation parietal -

x = actual position
o = expected position of the stigmas



placenta almost meet in the centers giving the aspect of a 4-carpellate ovary.

The commissural stigmas correspond to the commissures of the carpels, and consequently are directly above the placenta.
Commissural stigmas in Cruciferae also

Stigma of Papaver is imbriculiform -

In Papaveraceae, those w/ siliqua have the top of the replum open, in Cruciferae, the replum is joined at the top + closed by a diaphragm

Seeds of poppies are caruncular, the aril being an enlarged funicle with oil cells.

One lateral petal of Corydalis is saccate, providing the lateral zygomorphy.
The stamen opposite the spurred petal has at the base of the filament an outgrowth enclosed in secretory.
D. C. considered the 3 petaled stamens of Corydalis to be derived from 2 normal 2-theca stamens. Not borne out.
As I say found that the 3 petaled stamens are produced by 2 vascular strands, and that the 3 petaled business is reminiscent of the Hypecoideae

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Papaver
Argemone
Eschscholtzia
Bocconia
Corydalis
Dicentra

Family 2. Capparidaceae: Flowers more or less irregular; sepals 4; petals 4, frequently unequal, rarely lacking; stamens 4-many, frequently borne on an androgynophore; pistil 2-carpellary, usually borne upon a gynophore which is often accompanied by a nectariferous disc; ovules many and campylotropous; fruit usually a silique, rarely a berry, drupe, or nut; seeds exalbuminous with a large, folded embryo. Herbs, shrubs, or trees, frequently glandular or scaley; leaves simple or palmately compound, entire or variously divided, usually stipulate, alternate.

Cleome
Polanisia
Capparis

Family 3. Cruciferae: Flowers regular; sepals 4; petals 4, diagonal; stamens 6 (tetradynamous); pistil 2-carpellary, 2-celled by a false septum; ovules usually numerous, anatropous or campylotropous; stigmas usually commissural; fruit usually a silique; embryo filling the seed. Herbs, rarely shrubs; leaves alternate, simple, exstipulate, usually pinnately lobed or divided; inflorescence ebracteate.

Arabis
Matthiola
Barbarea
Erysimum
Brassica
Draba
Lunaria
Camelina
Capsella
Lepidium
Iberia
Isatis
Cakile
Raphanus

Family 4. Resedaceae: Flowers bisexual or rarely unisexual, irregular; sepals and petals usually 4-8; stamens 3-40, borne upon a glandular, excentric androgynophore; pistil open apically, 2-6-carpellate, 1-celled; ovules many; fruit an open capsule; seeds small, completely filled by the curved embryo. Mostly herbs; leaves alternate, simple, with small glandular stipules; inflorescence sometimes ebracteate.

Reseda

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Parietales - Plants as a whole which have become adapted to xerophytic systems - chiefly of the Mediterranean Basin.

Stamens indefinite, basipetal (home so that upper stamens develop before the lower, or acropetal, or ~~centrifugal~~ centripetal). The weak meristem stops development at the top first). Called intercalary meristem

Frequently only the base of placenta is simuliferous.

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Order 3. Sarraceniales: Flowers bisexual or unisexual, regular, hypogynous; perianth usually dichlamydeous; pistil 3-5-carpellary with parietal or axile placentation and indefinite ovules. Herbs or shrubby climbers; leaves usually alternate and entire, more or less modified for insectivory.

Family 1. Sarraceniaceae: Flowers bisexual, regular, typically 5-merous; sepals and petals usually 5; stamens numerous; pistil 4-5 celled with numerous ovules on axile placentae; stigma large and umbraculiform, with 5 small inferior stigmas; fruit a valvate capsule; seeds small, with copious endosperm and a small embryo. Marsh herbs with radical pitcher leaves.

Sarracenia
Darlingtonia
Heliamphora

Family 2. Nepenthaceae: Flowers dioecious, regular, typically 4-merous; perianth of 2 2-merous whorls; stamens variable, united into a column; pistil 4-celled with numerous ovules on axile placentae; fruit a leathery, valvate capsule; seed minute. Shrubby climbers with alternate, entire leaves modified as both tendrils and pitchers.

Nepenthes

Family 3. Droseraceae: Flowers bisexual, regular, typically 5-merous; sepals and petals 5; stamens 5-20; pistil 3-5-carpellary, 1-celled, with parietal or rarely central placentation; fruit a capsule, rarely indehiscent. Small herbs, typically more or less aquatic or bog-inhabiting, with leaves modified as spring-traps.

Drosera
Dionaea

Order 4. Parietales: Flowers regular or irregular, usually bisexual, usually hypogynous, rarely perigynous or epigynous; perianth dichlamydeous, 5-merous; stamens 5-many; pistil usually 3-carpellate, 1-celled with parietal placentation; ovule usually with 2 integuments. Herbs or woody plants; leaves with opposite or alternate, usually stipulate leaves.

Family 1. Cistaceae: Flowers essentially regular, bisexual, hypogynous; sepals 5, the 2 outermost usually smaller than the inner and rarely absent; petals 5, sometimes 3, caducous; stamens indefinite, basipetal upon a somewhat elongate floral axis; pistil 3-10-carpellary, 1-celled; ovules 2-many orthotropous, rarely anatropous; fruit a leathery or woody, loculicidal capsule; seeds small, the embryo usually coiled in a mealy or cartilaginous endosperm.

Lechea
Helianthemum

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Theories of stem production -

1. Phyllom theory - assumed that leaf bases united forming stem + head is leaf

2. Leaf-skin theory (Miss Saunders) - from study of Ranunculaceae - mass of growth from petiole downward.

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Family 2. Bixaceae: Flowers regular, bisexual, hypogynous; sepals and petals 5; stamens indefinite; pistil 2-carpellary; ovules anatropous; fruit a loculicidal capsule; seeds with a fleshy red testa. Trees; leaves alternate, simple, palmately nerved.

Bixa orellana - anatto - yellow dye, coloring for margarine

Family 3. Tamaricaceae: Flowers bisexual, regular, hypogynous; perianth 5-4-merous; stamens 4-10; pistil 3-5-carpellate, 1-celled; styles free; ovules few or many, anatropous, on basal or parietal placentas; fruit a capsule; seeds hairy, with or without endosperm; shrubs, sometimes herbs; leaves alternate, exstipulate, usually narrow and sheath-like.

Tamarix gallica - salt cedar

Family 4. Frankeniaceae: Flowers bisexual, regular, hypogynous, subtended by 2 pairs of decussate bracteoles; sepals 4-7, each bearing a basal ligular scale; stamens 6, the filaments united at the base; pistil usually 3-carpellate, 1-celled; styles united; ovules many, anatropous, borne on the lower half of parietal placentas; fruit a capsule included within the persistent calyx; seeds with mealy endosperm surrounding the straight, axial embryo.

Frankenia

Family 5. Violaceae: Flowers bisexual, regular or irregular, hypogynous, subtended by 2 bracteoles; sepals 5; petals 5, free or united at the base, the posterior 1 spurred in irregular flowers; stamens 5, adnate to the base of the petals, usually with an enlarged connective; pistil usually 3-, sometimes 2-5-carpellate, 1-celled; fruit a capsule or berry; seed with straight embryo and oily endosperm, sometimes arillate. Herbs, shrubs, or small trees with alternate or opposite, simple, stipulate leaves.

Viola
Hybanthus
Rinorea - woody - good sized forest trees

Family 6. Flacourtiaceae: Flowers bisexual, rarely unisexual, regular, hypogynous, rarely perigynous, usually cyclic; sepals 2-15, free or rarely united below; petals 2-15, rarely absent, occasionally more numerous, free, occasionally grading to the stamens; stamens usually indefinite, sometimes united into bundles, the anthers frequently acuminate or appendaged; hypogynous disc or nectaries usually present; pistil 2-10-carpellate, usually 1-celled, sometimes completely or incompletely chambered; fruit a capsule or berry, 1-many-seeded; seed albuminous, the embryo straight, with large flat cotyledons, often arillate. Trees and shrubs; leaves alternate, simple, usually with caducous stipules.

Tropical

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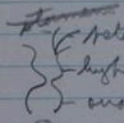
Peponiferae - ovules, cotyledons, stem and leaves peculiar
frequent staminate or pistillate. Perianth
sometimes reduced to calyx only (Begoniaceae)
Sympetaly is a frequent tendency.
Usually w/ parietal placenta often have prolonged
placenta which produce effect of 3-carpels.
Tendency of epigyny, sympetaly, unisexuality
3 carpellate link flora families together.



Cucurbitaceae - petals incompletely united.
Anthers usually 2-celled. Stamens
frequently united in pairs, w/ 1 stamen
left out.
Occasionally anthers are completely
united by the filaments and thecae
have fused to form a sort of garland (the
thecae fused end to end.

2-celled
♂ ∞

Pollen is largest of all dicots!

Tendrils

Axillary axis
(○ +
tendril (branched).

Might be interpreted as bracteoles of flr,
or as a misplaced leaf, or better, as one
stipule. Not a leaf because venation
of leaf is orbate or palmate, and a tendril looks
like a mid-rib.

* → Here, Malvales have similar tendency of having
the same sort of palmate venation

Hairs of Cucurbits are multicellular
like Malvales?

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Flacourtia - Small small flowers
Oncoba - pretty flowers
Casearia -

Family 7. Passifloraceae: Flowers bisexual, rarely unisexual, regular, hypogynous; sepals 5, rarely 3-8, united at the base into a campanulate hypanthium; petals 5, rarely 3-8 or absent, bearing a complex, fimbriate corona at the mouth of the hypanthium; stamens 5, borne upon a more or less elongate androgynophore; pistil 3-, rarely 4-carpellate, 1-celled; ovules several or numerous, anatropous; fruit a capsule or berry; seeds arillate, albuminous. Herbaceous or woody climbers; leaves alternate, more or less lobed, stipulate, with axillary tendrils. The tendril is the central flower of a dichasium, which has been reduced

Passiflora - granadilla, passion-fruit

Family 8. Caricaceae: Flowers unisexual, rarely bisexual, monoecious or dioecious; regular, hypogynous; sepals 5, free or somewhat united at the base; petals 5, united into a tube at the base; stamens 10, usually in 2 unequal series, epipetalous; ovary 3-5-carpellate, 1-celled; ovules numerous, anatropous; fruit a berry; seeds with a soft outer testa, the embryo large, in oily endosperm. Trees with thick, succulent stems, laticiferous throughout; leaves spiral, long-stalked, palmately or pinnately divided or compound, exstipulate.

Carica papaya - long-stalked leaf

Family 9. Loasaceae: Flowers bisexual, regular, epigynous or perigynous; sepals usually 5; petals 5; stamens numerous, frequently grading to the petals; pistil 3-7-carpellate, inferior or subinferior, 1-celled; ovules usually many, seldom 1, with 1 integument; fruit a capsule; seed albuminous. Herbs or shrubs, sometimes climbing, the whole plant usually bearing hooked or stinging hairs or thorns; leaves alternate or opposite, entire or divided, exstipulate.

Mentzelia
Loasa

Order 5. Peponiferae: Flowers usually unisexual, regular, epigynous; perianth dichlamydeous, usually 5-merous; stamens 5-numerous, rarely 4, united or free; pistil 3-carpellate, 1-3-celled, the placentas parietal or axile; ovules numerous, with a large persistent nucellus and 2 integuments; endosperm absent or scanty. Mostly tropical herbaceous plants, often climbing.

Family 1. Cucurbitaceae: Flowers usually diclinous, regular; perianth usually borne with the stamens upon an epigynous prolongation of the hypanthium; sepals usually 5, more or less united at the base; corolla usually 5-merous, mostly sympetalous; stamens usually 5, usually more or less

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Guttiferales - based on character of producing oil or wax, not on a genus particularly.
Petals + calyx closely imbricated ???
Parallel character of being free + indefinite.
Stamens produced centrifugally - as Parietales (Cistaceae)
Seeds ordinarily with an aril.
Sepals persistent.
→ Paeonia - often in Dilleniaceae because of stamen development, and buds covered w/ wax or resin.
+ woody habit of some.

Dilleniaceae - leaves extremely scabrous - good identifying character.
Curatella - called sand paper tree.

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fused into a column, the anther cells commonly sinuous and more or less confluent, the pollen mostly very large; pistil 3-carpellate, 1-celled, the parietal placentas thick, bifid, bearing many ovules; fruit a berry or pepo, rarely dehiscent; seeds without endosperm, embryo straight, with large oily cotyledons. Usually climbing herbaceous annuals, more or less succulent; leaves alternate, subtended by tendrils as a rule, large and often palmately lobed or divided.

Cucurbita - large fruits
Cucumis - citron
Citrullus
Momordica - a vine
Luffa - sponge gound

Family 2. Begoniaceae: Flowers unisexual, monoecious, epigynous, usually somewhat irregular; perianth usually monochlamydeous, petaloid, rarely an inner whorl of petals present, the tepals usually free; staminate flower usually with 2-4-parted perianth and numerous stamens with the filaments more or less united into a tube; pistillate flower usually with 2-5-parted perianth, the pistil inferior, unequally 1-3-winged, usually 2-3-, rarely 4-6-carpellate, mostly with as many cells bearing the very numerous anatropous ovules on elaborate axile placentas, rarely 1-celled with parietal placentation; fruit usually a capsule; seeds minute, exalbuminous, the poorly developed embryo rich in oil. Succulent herbs, occasionally tuberous, epiphytic, or root climbers; leaves distichous, usually asymmetrical, palmately nerved, entire or variously divided, stipulate.

Begonia

Order 6. Cuttiferales: Flowers usually bisexual, regular, rarely irregular, hypogynous, perianth dichlamydeous, usually free, often 5-merous, but variable in number; stamens usually numerous, rarely 10 or fewer, free or variously united; pistil 2-several-carpellate, rarely 1 carpel, free or united, placentation axile; ovules usually anatropous, with 2 integuments; endosperm oily or proteinaceous when present, never starchy.

Family 1. Dilleniaceae: Flowers bisexual, regular or rarely irregular, hypogynous, dichlamydeous; sepals 5, rarely 3-many, often accrescent; petals 5, fugaceous; stamens indefinite, rarely 10 or fewer, free or variously united at the base, sometimes staminodial; carpels 1-many, free or more or less completely united, but the styles usually free; ovules 1-many in each carpel, anatropous, the raphe always ventral; fruit a capsule, rarely indehiscent or a berry; seeds usually few or solitary, conspicuously arillate, with a copious endosperm and a usually very small embryo. Trees or shrubs, sometimes lianes, rarely herbs; leaves alternate, simple, entire, with or without stipules.

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Dillenia
Hibbertia

Family 2. Ochnaceae: Flowers bisexual, regular, or the androecium excentric, hypogynous; sepals 5-10, free or united at the base, often leathery, imbricated; petals 5-10, free, contorted; stamens usually numerous, occasionally 5-10, sometimes staminodial or excentric, generally with short filaments, the long anthers mostly opening by pores; carpels 3-15, free or united but always with a common style, frequently borne upon an elongated, accrescent floral axis, placentation axile or rarely parietal; ovules 1-numerous, anatropous, the raphe always ventral; fruit usually a capsule, sometimes indehiscent, commonly a cluster of drupes on the accrescent floral axis; seeds large and without endosperm, or small, usually winged, and albuminous; trees and shrubs, very rarely herbs, with leaf-traces in the cortex; leaves alternate, stipulate, usually leathery and entire.

Ochna
Ouratea
Sauvagesia

Family 3. Marcgraviaceae: Flowers bisexual, regular, hypogynous; sepals 4-5, free; petals 4-5, free or more or less united, sometimes falling in a cap at anthesis; stamens 3-many, united below; pistil 2-many-carpellate, 1-celled at anthesis, later becoming partitioned by the placentas; ovules numerous, anatropous, with 2 integuments; fruit a capsule, sometimes indehiscent; seeds without an aril, albuminous. Mostly woody root-climbers; leaves alternate, simple, leathery, sometimes dimorphic; inflorescences pendulous, with colored hood- or pitcher-shaped nectariferous bracts.

Marcgravia

Family 4. Theaceae: Flowers bisexual, regular, hypogynous; sepals 5-7, free, persistent; petals 5-7, free or united at the base, imbricate; stamens usually numerous, free, united into a tube, or in 5 bundles adnate to the base of the petals; pistil 3-many-carpellate with axile placentation, the styles free or more or less coherent; ovules usually numerous, anatropous; fruit a loculicidal capsule, sometimes indehiscent; seeds without an aril, with little or no endosperm and a large embryo. Trees and shrubs with sclereids in the tissues of stem and leaves; leaves alternate, simple, exstipulate, usually leathery.

Thea
Camellia

Family 5. Guttiferae: Flowers bisexual or unisexual, regular, hypogynous, with variable number and arrangement of parts; sepals

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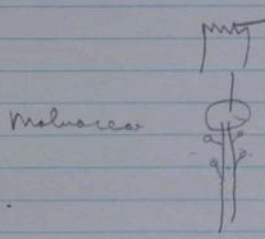
Malvales- Union of stamens allies to Gutiferales
Two groups of fruits 1- schizocarp, 2- capsule.
Multicellular hairs + type of fruit allies
to Loiaceae



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usually 2-6, free; petals usually 2-6, free; stamens usually numerous, often more or less united, particularly in groups; pistil usually 3-5-, sometimes 2-many-carpellate, with as many cells; ovules 1-many in each cell, amphitropous or anatropous; stigmas as many as the carpels, usually sessile and radiate; fruit a capsule, often septifragal, or fleshy and indehiscent; seeds usually large, completely filled by the straight embryo. Trees and shrubs, rarely herbs, with resin or oil in schizogenous canals; leaves opposite or whorled, simple, entire, usually exstipulate.

Hypericum - has definite stipes - leaves beloved punctate.
Clusia - stamens ∞ petals, 4-5, stigmas disc, unisexual fls
Mammea - a drupe fruit of delicate flavor.
Garcinia - mangosteen or mangosteens. source of resin gamboge"

Order 7. Malvales (Columniferae): Flowers bisexual, very rarely unisexual, regular or rarely irregular, hypogynous, cyclic; sepals 5, free or united, valvate; petals 5, rarely absent, free, often contorted; stamens usually in 2-5-merous whorls, sometimes multiplied or 1 whorl reduced to staminodes or absent, usually united into a tube, sometimes free or united into bundles; pistil 2-many-carpellate, placentation axile; ovules 1-many, anatropous, with 2 integuments; fruit various. Herbs, shrubs, or trees with alternate, simple, stipulate leaves; stellate hairs very frequent, and mucilage cells or ducts in the cortex and pith.

Family 1. Tiliaceae: Flowers bisexual, regular; sepals 5, sometimes united; petals 5, free, imbricate; stamens usually numerous, rarely 5-10, free or united only at the base, sometimes borne on an androgynophore, the anthers 2-celled; pistil 2-many carpellate, the cells 1-many ~~carpellate~~; ovule fruit dehiscent or indehiscent; seeds with fleshy endosperm and large embryo.

Tilia - basswood because used prepared for basket.
Corchorus - cult. trop. Am. shrub - "jute" fibers.

Family 2. Malvaceae: Flowers bisexual, regular, proterandrous; sepals 5, usually subtended by a paracalyx, free or united at the base; petals 5, usually contorted; stamens united into a tube, sometimes staminodial, usually indefinite through multiplication, the anthers reniform, 1-celled, the pollen large and echinulate; pistil 1-many-carpellate with axile placentation; ovules 1-several, anatropous; fruits usually a capsule or schizocarp, rarely fleshy and indehiscent; seeds with scanty endosperm and embryo with large convolute cotyledons. Herbs or shrubs, rarely trees; leaves alternate, simple, usually palmately lobed, stipulate.

Althaea
Hibiscus
Gossypium
Malva
Abutilon

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Turneraceae - the ventral scale relates to order Geraniales.

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Family 3. Bombacaceae: Much as Malvaceae, but predominantly trees with greatly thickened trunks; anthers 1-2-celled, the pollen smooth; petals frequently hairy; pistil 2-5-carpellate.

X

Bombax
Ceiba
Adansonia

Family 4. Sterculiaceae: Flowers bisexual or unisexual, regular or irregular; sepals 5, free or united; petals 5, sometimes absent; stamens in 2-5-merous whorls, more or less united at the base, the outer frequently staminodial, the anthers 2-celled; pistil 5-carpellate, sometimes borne with the stamens upon an androgynophore; ovules 2-many, anatropous; fruit a capsule, schizocarp, or berry; seed with fleshy endosperm and embryo with flat, folded, or rolled cotyledons.

→

Sterculia
Theobroma
Cola

Order 8. Tricoccae: Flowers unisexual, rarely bisexual, hypogynous, usually regular; perianth monochlamydeous or dichlamydeous; sometimes absent; stamens equal and opposite to the perianth segments; pistil 3-carpellary, 3-celled, rarely 2-many-carpellate and -celled, each cell with 1-2 pendulous anatropous ovules with ventral, rarely dorsal raphe. Trees, shrubs, and herbs, sometimes climbing, frequently with stellate hairs or scales.

Family. Euphorbiaceae: Flowers unisexual, mooecious or dioecious, of diverse structure; perianth absent, simple and calycine, or of both calyx and corolla; staminate flowers with as many stamens as perianth lobes, more or fewer, sometimes 1, sometimes compound and branching; pistillate flowers usually 3-carpellate with 1 ovule in each cell, seldom more or fewer cells or 2 ovules, with ventral raphe, in each; stigmas mostly 3 and dichotomous; fruit mostly a 3-parted schizocarp, seldom a berry or drupe; seeds usually with a micropylar caruncle. Trees, shrubs, or herbs, frequently laticiferous, occasionally succulent and cactoid; leaves alternate, opposite, or whorled, simple or compound, usually with stipules; inflorescence frequently a cyathus.

→

Conquist relates to Rosales, + derived from Celastrales.

Ricinus
Hevea
Euphorbia
Croton
Acalypha
Jatropha
Manihot
Phyllanthus

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with Liz 3/3/70

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Englar united Geraniales w/ Tricoccae because of orientation of ovule (elevated raphe). Actually the Tricoccae should be considered as a reduction series of the Geraniales + should be treated after Geraniales — none of Geraniales are unisexual

Diplostemenous - 2 whorls of stamens, the outer alternating with the petals -
Obdiplostemenous — the outer whorl of stamens opposite the petals (antipetalous)

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Family 2. Buxaceae: Much as in Euphorbiaceae, but the ovules with dorsal raphe, and the capsule loculicidal. Evergreen perennial herbs, shrubs, and trees.

Buxus sempervirens
Pachysandra - small ground cover

Family 3. Callitrichaceae: Flowers unisexual, monoecious, hypogynous, extremely reduced; perianth absent, the flowers supported by 2 small bracteoles; staminate flower with 1 stamen; pistillate flower with a 2-carpellary pistil, each cell with 2 anatropous ovules with a ventral raphe; fruit a cluster of 4 nutlets through false septation of the ovary. Slender terrestrial or aquatic herbs, sometimes with stellate hairs; leaves opposite.

Callitriche autumnalis

Order 9. Geraniales: Flowers bisexual, regular, sometimes irregular, hypogynous, cyclic, basically 5-merous; sepals 5, free or sometimes united at the base, imbricate; petals 5, free, imbricate, sometimes contorted; stamens typically in 2 5-merous obdiplostemonous series, sometimes more numerous, free or the filaments united at the base; carpels usually 5, often 3, with axile placentation; ovules 1 many, pendulous and anatropous with the micropyle directed outward, 2 integuments; Endosperm present or absent. Generally herbaceous plants, sometimes woody or climbing.

Family 1. Geraniaceae: Flowers regular, rarely irregular; sepals 5, free or rarely united, imbricate; petals 5, free, imbricate, rarely unequal; stamens 10-15, the inner longest, the outer sometimes staminodial; carpels usually 5, 5-celled, with a common style or beak, each cell with 1-2, rarely more, ovules; fruit an elastically dehiscent schizocarp, or a capsule; seeds not arillate, with a straight or curved embryo, endosperm scanty or absent. Herbs, sometimes woody below, frequently aromatic; leaves simple, opposite or alternate, usually stipulate.

Geranium - regular
Pelargonium - irregular petals (African)
Erodium - E. Hemisphere

Family 2. Oxalidaceae: Flowers bisexual, regular, hypogynous; sepals 5, free; petals 5, free, stamens 10, in 2 unequal series, the filaments united at the base; pistil 5-carpellate, the styles free; fruit a capsule dehiscing

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loculicidally, rarely fleshy and indehiscent; seeds with a fleshy aril, the embryo straight, embedded in fleshy endosperm; herbs, rarely undershrubs or small trees, with oxalic acid; leaves alternate, often compound, and usually exstipulate.

Byophytum - paripinnate leaves

Roots with corm or tubers

Oxalis

Averrhoa - tree (fruit) fruit fleshy & succulent. edible -

cf. carambola

Family 3. Balsaminaceae: Flowers bisexual, irregular, hypogynous; sepals 5, the posterior spurred, petaloid; petals 5, unequal, the anterior largest, the lateral more or less united in pairs; stamens 5, with short filaments, the anthers coherent and covering the pistil; ovary 5-celled, each cell with 1 row of pendulous anatropous ovules; fruit an elastically loculicidal capsule; seeds exalbuminous. Succulent, usually annual herbs; leaves alternate, opposite, or ternate, simple, stipules absent or represented by glands.

The inner series of stame - obsolete

Paller grain fruit

I. sultans - African (Woodson notes on life cycles.

African largely

Impatiens noli-tangere - touch me-not

Family 4. Tropaeolaceae: Flowers bisexual, irregular, hypogynous; sepals 5, petaloid, the posterior and 2 adjacent lateral uniting to form a dorsal spur; petals 5, the 3 anterior clawed and ciliate; stamens 8, free; pistil 3-celled, each with 1 pendulous anatropous ovule; fruit a fleshy schizocarp; seed filled by the large embryo. Succulent annual or perennial herbs; leaves scattered, simple, peltate, usually exstipulate, the petioles often serving as tendrils for support. New World.

Actually the spur is from receptacular tissue

Median stamen of both whorls lost to produce the 4-merous stamens.

Some Peruvian sp produce edible tubers

Tropaeolum

Family 5. Linaceae: Flowers bisexual, regular, hypogynous; sepals 5, rarely 4, free; petals 5, rarely 4, free; stamens 5-4, alternating with as many subulate staminodes and the filaments united at the base; pistil 5-4-carpellary, often divided by false septas, each carpel with 2 pendulous anatropous ovules, the styles free; fruit a septicidal capsule, rarely a drupe; seeds with fleshy, oily endosperm. Herbs or small shrubs; leaves basically alternate, simple, entire, stipulate or exstipulate.

subulate - needle-shaped or awl shaped.

4 inner stamens become staminodes

Linum flax

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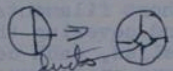
Secretory systems

1. Non-articulated cells - single, branched, multinucleate cells producing latex.

2. Articulated ducts - formed by fusion of separate cells, the point of fusion being evidently "jointed".
   Lysigenous

3. Schizogenous ducts - intercellular spaces, rather than cells themselves, formed by 2 or more divisions of the cells.



4. Traumatic ducts - are like the lysigenous, or infrequently schizogenous ducts.

Disc may be staminodes or carpellodes, w/ nectary, but in Rutales, the structure is something of a gynophore. Frequently the Rutales, together w/ Sicoideae, are merged with the Geraniales (particularly by E+P).

Rutaceae frequently have almost separate carpels, joined only at the base

"Simple" leaves frequently actually a reduced compound leaf - terminal leaflet

joint winged rachis = petiole.

Oxalis

petals valvate, stamens distinct

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bi.

Family 6. Zygophyllaceae: Flowers ~~bi~~sexual, regular, hypogynous; sepals and petals 5, free; stamens 10-15, free, usually with basal appendages; pistil 5-4 celled, each with 1-several ovules in each; style angular or furrowed, with a terminal stigma; fruit a loculicidal or septicidal capsule or schizocarp, rarely a berry or drupe; endosperm present or absent. Herbs or shrubs; leaves opposite or alternate, usually paripinnate.

Guiacum - Tribulus - Covillea -

Family 7. Malpighiaceae: Flowers generally bisexual, more or less irregular, hypogynous to somewhat perigynous; sepals 5, usually bearing conspicuous external glands; petals 5, generally with a claw and a fringed or toothed margin, regular or obliquely irregular; stamens usually 10, equal or sometimes staminodial or aborted, the filaments usually united below; pistil 3-(Rarely 2-5-)carpellate, placed obliquely, each cell with a single pendulous ovule; fruit usually a schizocarp, sometimes winged, sometimes a nut or drupe; seed exalbuminous. Usually woody lianas, sometimes small trees or shrubs, usually rather densely covered with 1-celled, variously branched hairs; leaves usually opposite, simple, and entire, often with glands at the base or on the petiole, stipulate; flower-stalks jointed, usually with a pair of bracteoles below the joint.

Malpighia coccigyra
Banisteria

Disciflorae of Bentham. + the next 3 orders

Order 10. Rutales: Similar to Geraniales, but with a hyopgynous disc; chiefly woody plants with oil cells in the parenchyma.

Family 1. Rutaceae: Flowers bisexual, rarely unisexual, regular or somewhat irregular; sepals and petals 4-5; stamens obdiplostemonous, sometimes equal to the petals, rarely indefinite; pistil usually 4-5-carpellate, rarely fewer or more, often free below and united above, usually with 1-2 ovules on axile placentas; fruit various; seeds with a large embryo, with or without endosperm. Herbs, shrubs or trees; leaves alternate or opposite, simple or compound, glandular-punctate, exstipulate.

Citrus
Ruta - Rue -
Dictamnus -
Ptelea

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Amaryllidaceae -

1. Botanical review - Ricketts
2. Annals of the Missouri - Woodson - 1935

~~Sabastedan~~
Sabastian vegetative anatomy for separation of families

Family 2. Simarubaceae: Similar to Rutaceae, but flowers usually unisexual, and oil cells absent; staminal filaments frequently accompanied by small scales; pistil often borne upon a gynophore. Chiefly trees with alternate, pinnate leaves.

Ailanthus
Quassia amara - Surinam quassia wood

Family 3. Burseraceae: Similar to Rutaceae, but flowers chiefly unisexual, and lysigynous resin canals predominating. Shrubs and trees; leaves glandular-punctate, alternate, pinnate.

Boswellia - frankincense
Commiphora - source of myrrh
Bursera - torch wood

Family 4. Meliaceae: Flowers bisexual or polygamous, regular; calyx and corolla 4-5-merous; stamens 8-10, petaloid tube frequently bearing teeth or petaloid lobes between the anthers; pistil usually 2-5-celled bearing 1-2 (rarely more) ovules on axile placentas; fruit a capsule, beery, or drupe; seeds often winged, with or without endosperm. Mostly trees and shrubs with alternate, pinnately compound, exstipulate leaves.

timber trees

Swietenia
Cedrela - manufacture of cigar boxes
Melia - chinaberry

Order 11. Sapindales; Flowers bisexual or unisexual, usually more or less irregular, hypogynous, usually 5-merous, sometimes 4-merous; stamens typically obdiplostemonous, sometimes reduced, frequently anisomerous or unequal; pistil usually 2-3-carpellate, frequently only 1 cell fertile frequently with a glandular disc; ovules 1-2 in each carpel, pendulous with a dorsal raphe or ascending with a ventral raphe as a rule; fruit various, often 1-seeded, the embryo large, usually without endosperm. Trees or shrubs, frequently lianas, rarely herbs (Polygalaceae); leaves alternate or opposite, simple or compound.

Family 1, Anacardiaceae: Flowers usually bisexual, sometimes unisexual; perianth regular or slightly irregular, usually 5-merous, the sepals and petals frequently somewhat united at the base; stamens 5-10, sometimes anisomerous, sometimes only 1 fertile; pistil usually 3-, rarely 5-carpellate, often but 1 cell ovuliferous; ovules 1 in each fertile cell, pendulous with a dorsal raphe; disc usually manifest; fruit a capsule, samara, or drupe, 1-seeded. Trees and shrubs with schizogenous resin

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obliquely irregular - ~~(⊕)~~ ⊕ plane of symmetry not passing thru axis.

The inflorescence of Sapindaceae are scorpioid thyses.

The principals of teratology - Masters negatives

situation known as polydesmy

Conditions of sexuality in flowers and inflorescences.

1. Dichlinous, hermaphrodite, bisexual, perfect.
2. Monoclinous - polygamous (bi or unisexual on same or different plants.

Polygamo-monoecious (on same plant)
Andro- monoecious (♂ or ♀)
Gyno- " (♀ or ♂)
Polygamo- dioecious (on different pls)
andro - dioecious (♂/♀)
gyno- dioecious (♀/♀)

monoecious + dioecious - strictly monoclinous plants
Polygamous - m/f or other sex on a plant (plural) and hermaphrodite fls.)
androgynous ♂/♀ on same inflorescence

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Rhus cotinus - the smoke tree
" verniciflua - the Chinese lacquer

canals; leaves alternate, imparipinnate, exstipulate.

R. verniciflua - source of Chinese lacquer - paints & varnishes

Rhus
Anacardium occidentale - cashew nut
Mangifera indica - mango
Pistacia vera - the nut
Schinus molle - Chinese pepper tree.

Family 2. Sapindaceae: Flowers unisexual, regular or obliquely irregular, 5-merous or sometimes 4-merous; sepals usually free; petals usually free, often with scales or hair-tufts within; stamens usually in 2 5-merous whorls, often reduced to 8 or fewer; pistil usually 3-celled, each cell usually with 1 ascending ovule with a ventral raphe; disc usually present; fruit a capsule, nut, berry, or drupe, frequently a winged schizocarp, 1-seeded; seed without endosperm, often arillate. Trees or shrubs, frequently climbing by tendrils, often resinous; leaves alternate, usually compound, often with transparent punctate or linear resin sacs.

type family of Order

Radelkoffer - German authority

anomalous stele - stele broken up into meristeles.

State out as a sepal or petal

Secondary meristem from pericycle functioning as promeristem

Tendrils consisting leaves, fls. part of the inflorescence

Teratology - study of one organ looking or functioning as another organ.

Mimetin (M) - thrown back to more primitive form.

Genus Koelreuteria - Chinese varnish tree

Sapindus - soapberry - carpels dehiscent ventrally
Litchi
Paullinia
Serjania

Blighia - akee - poisonous tropical

Family 3. Aceraceae: Flowers regular, unisexual, sometimes polygamous; sepals 5, free; petals 5 or absent, free; stamens 5-10, usually 8; pistil 2-celled, each with 2 superposed ovules with a dorsal raphe; disc usually manifest; fruit a schizocarp of 2 1-seeded samaras; seed without endosperm. Trees or shrubs; leaves opposite, usually simple and palmately lobed, rarely 3-foliolate or 5-foliolate

Seeds plicate in bud

A. pseudo-platanus - the English sycamore

Acer

Negundo - Box Elder - Cornfl Leaf

Family 4. Hippocastanaceae: Flowers unisexual or bisexual, irregular; sepals 5, united or free; petals 5-4, the 2 upper larger, the median of the 3 lower sometimes absent; stamens 8-5; pistil 3-celled, each with 2 superposed ovules; disc manifest or obsolete; fruit a capsule, usually 1-seeded; seed large, without endosperm. Trees and shrubs; leaves opposite, digitately compound.

Horse chestnut

Seeds plicate in bud

Horse chestnut - study, evolution on the bud scales.

Aesculus - N Hemisphere
Buckeye

Family 5. Polygalaceae: Flowers bisexual, irregular; sepals 5, usually free, the inner often large and petaloid; petals 5-3, the 2 upper and 1 lower usually present, the latter forming a keel and usually with fimbriate appendages, more or less united with the staminal tube; stamens 8, united in a

Engler - plein Pflanzenfam.

Chodat - authority - says the family of no close relation. Pollen grains characteristic of family

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staminal column; pistil 2-celled, each with 1 pendulous ovule with ventral raphe; fruit usually a loculicidal capsule, rarely a berry; seed with or without endosperm, often arillate. Herbs, shrubs, or small trees, sometimes lianas, often laticiferous; leaves alternate, opposite, or whorled, simple, entire, usually exstipulate.

Pollen grains ellipsoid with pits at the ends

Monnina - woody w/ a long Polygala - means "much milk" the milkwort.
Securidaca - woody liana - fruit a samaroid schizocarp.
Sapindales - Eugen

Sapindales - 2 cycles of stamens
Reduction of parts - 1 cycle of stamens
Seed - hypogynous - ~~epigynous~~
Sedum terminal 4 - many + fusion of petals + sepals.
ovules w/ dorsal or ventral raphe.

Order 12. Celastrales: Flowers bisexual or unisexual by abortion, regular, hypogynous, cyclic, usually 4-5-merous; sepals and petals free or united at the base; stamens 4-5, antesepalous, usually associated with a disc; pistil 2-5 celled, each with 1-several anatropous ovules; seed usually albuminous. Chiefly woody plants with simple, sometimes compound, leaves.

Family 1. Celastraceae: Flowers more frequently bisexual; disc present; pistil 4-5-celled; ovules 1-2 in each cell, mostly erect; fruit a samara, drupe, or berry; seeds mostly arillata. Woody plants with opposite or alternate, simple, stipulate leaves.

Pedicels usually jointed - <

vine, all leaves Celastrus - bittersweet - C. scandens.
Evonymus - Wahoo (E. atropurpureus)

Family 2. Aquifoliaceae: Flowers more frequently unisexual; disc absent; pistil 2-4-celled as a rule; ovules 1-2 in each cell, pendulous; fruit a drupe. Woody plants with alternate, usually coriaceous, simple, exstipulate leaves.

Monoecious or dioecious.
several stones in fruit
"pyrenes".
Paraguay tea - Yerba mate
Pistillate inflorescence shown

evergreen - ~~deciduous~~ - opaca
deciduous - verticillata
Ilex - centered in trop. S. Am.
aquifolium - European of superior shrub.

Family 3. Staphyleaceae: Similar to Celastraceae, but with pinnate leaves.

Staphylea - bladdernut

Family 4. Empetraceae: Flowers unisexual by abortion, 2-3-merous; petals and sepals free; disc absent; pistil 2-9-celled, each with a single erect ovule with 1 integument; fruit a multilocular drupe. Heath-like shrubs with linear, exstipulate leaves.

Wettstein - early sympetaly near Ericaceae

Empetrum nigrum - only N. sp. small undershrub - in Alaska, Greenland + high mts. of N. Engl. + Rockies
circumboreal. fruit edible.

Crativa - Fla

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Rosales. - family characters not clear. Apocarpy prevalent considered primitive

Trends in class – Ranales - spiral
Geraniales
Rosales. - cyclic.

Rosales may be as primitive as Ranales, w/exception of epigyny - from standpoint of leaf, stipulate condition is primitive - stip. is evidence of primitive compound leaf.

Woody habit scattered.

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Order 13. Rhamnales: Flowers as in Celastrales, but frequently perigynous, rarely epigynous; stamens antepetalous; disc present. Shrubs or trees, often lianas, with simple or palmately compound leaves.

Family 1. Rhamnaceae: Buckthorn family. Flowers bisexual, sometimes unisexual by abortion, regular, 5-(rarely 4-) merous, perigynous or epigynous, rarely apetalous; pistil usually 3-(rarely 1-2-) celled, each with 1 erect anatropous ovule with 2 integuments; fruit a drupe, schizocarp, or samara; seed sometimes arillate, with scanty endosperm. Shrubs or trees, sometimes climbing; leaves simple, with small stipules.

Rhamnus cathartica, caroliniana
Ceanothus - Jersey tea
Zizyphus Lotus - Lotus bush

Family 2. Vitaceae: Flowers bisexual, sometimes unisexual, regular, 5-4-merous, hypogynous; petals often cohering at the tips and falling as a cap at anthesis; pistil usually 2-celled; fruit a berry; Tendril-climbing shrubs, rarely erect; leaves alternate, stipulate, simple and entire or palmately divided, or palmately compound.

Tendrils are extra-axillary. (Interpetiolar as terminal, and stem is sympodial): Tendril is a reduced inflorescence.

Vitis labrusca - "Fox grape"; Va. Creeper
Ampelopsis (Parthenocissus) veitchii - Boston ivy
Cissus

Order 14. Rosales: Flowers bisexual, rarely unisexual by abortion, usually cyclic, regular to irregular, hypogynous to epigynous, usually perigynous through development of a hypanthium, usually 5-merous; sepals and petals generally free; stamens as many as the petals, more, or fewer, free or sometimes united; carpels as many as the petals but usually fewer; free or united, but the styles generally free; ovules few or numerous, borne on (axile), rarely parietal, (placentas), usually anatropous, integuments 2, rarely 1. Plants of diverse habit; leaves simple or compound, with or without stipules.

Stamens usually 2-cyclic + obdiplostemonous

( ) both genus + name genus

(Not typical of family)

Family 1. Crassulaceae: Flowers bisexual, regular, usually 5-merous, but sometimes 3-30-merous, hypogynous as a rule; petals usually free, sometimes united; carpels isomerous with petals, free or united below, usually with scale-like appendages at the base; ovules usually numerous in 2 rows on the placenta, rarely few or 1; Fruit usually

Free petals - apopetaly
Fused - gamopetaly

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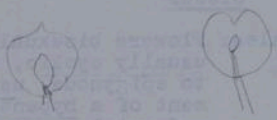
Woody or herbaceous as primitive - See Jeffrey + Tower
Bailey + Sinnot



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Pleiomery - mult. of 5 parts.

follicular; seeds minute, endosperm scanty or absent. Succulent herbs or small trees; leaves alternate or whorled, exstipulate, usually simple.
Chiefly desert plants.

Crassula - Jade tree
Sedum - includes Live-for-ever
Sempervivum - Hen + Chicken - reproduce by stolons.
Bryophyllum - tropical weed
Echeveria

Family 2. Saxifragaceae: Flowers bisexual, typically dichlamydeous, regular or irregular, hypogynous, perigynous, or epigynous; perianth 5-(rarely 4-) merous; stamens 5-10, rarely 4-8, free, sometimes replaced by staminodes; pistil usually 2-carpellate, rarely 2-5 carpellate, 1-5-celled, sometimes with a glandular disc, the placentas usually axile, sometimes parietal, large and swollen, bearing several rows of anatropous, sometimes having but 1 integument; fruit a capsule or berry; seeds small, with copious endosperm and a small embryo. Mostly herbs, sometimes shrubs or lianas; leaves alternate, rarely opposite, with or without stipules.

Most heterogamous family - intergrades
Petals in Heuchera small & disappearing

Saxifraga - rosy + irreg. flr. largest genus - mountain + Boreal
Heuchera - allium post, cliffs
Parnassia - 4 carpels - grass of Parnassus - like fl. of anemone.
Hydrangea - vines + shrubs - dimorphic flr. stamens
Deutzia - cult. shrub
Philadelphus - 1 caipellate - mock orange
Escallonia - tropical shrubs (gamopetalous)
Ribes - superior ovaries.
Grossulariaceae

Family 3. Cunoniaceae: Flowers similar to Saxifragaceae, but ovules in 2 rows in each chamber of the 2-celled ovary; woody plants with opposite or whorled, stipulate, chiefly compound leaves.

Weinmannia - chiefly S. Am. - some simple leaves.

Family 4. Pittosporaceae: Flowers similar to Saxifragaceae, but schizogenous resin canals in the cortex. Woody plants, sometimes climbing, with alternate, generally leathery, exstipulate leaves.

Pittosporum tobira

Family 5. Podostemonaceae: Flowers small, regular or irregular, bisexual, hypogynous; perianth simple, 3-many-parted, frequently greatly reduced or absent, when the flower is

Plant body a thallus or cap. thus it has a vascular system.

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Hypanthium - a fusion of sepals, with petals + stamens inserted on it.

Rosaceae
Subfamily
Spiraeoideae - w/o stipules, blet hypanthium.
Rosoideae
Pomoideae
Prunoideae
Chrysobalanoideae

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Hydrostachyaceae is an African family similar to Podostemonaceae

of Calla - fruit a berry.

subtended by a spathella; stamens 1-many; pistil 1-3-celled, the many anatropous ovules on fleshy, axile placentas; fruit a capsule; seeds very small, with a mucilaginous testa. Thalloid aquatic herbs of very diverse form.

mucilaginous seeds stick seeds to rock -

Haptera - holdfast.

in rapidly running streams.

Podostemon

Family 6. Hamamelidaceae: Flowers unisexual and monoecious, or bisexual, hypogynous or epigynous, small, united into heads of few to many; perianth absent or 4-5-merous, petals present or absent; carpels 2, united, bearing 1-many pendulous ovules on axile placentas, the styles distinct; fruit a 2-celled woody capsule; seeds often winged, with endosperm. Trees and shrubs, often aromatic; leaves usually alternate, simple, stipulate.

Waterlow subs apetalae w/ these = female -

SEMS + SEAris

Hairs occur in sessile cluster.

witch-hazel

Hamamelis - perfect fls

Liquidambar - fls unisexual monoecious - reduced staminate fls. don't count as such.

Inflorescence functions as 1 fl.

Family 7. Platanaceae: Flowers unisexual, monoecious, slightly perigynous, small, united into spherical heads; perianth double, usually 4-merous; stamens 3-8, with very short filaments and a shield-shaped connective; carpels free, 3-4, each with 1-2 pendulous orthotropous ovules; fruit a cluster of angled caryopses; seed with scanty endosperm. Trees; leaves alternate, palmately lobed, stipulate. not aromatic.

Right

possible staminodes + no perianth

Hairs branch for stalks -

Platanus

Family 8. Rosaceae: Flowers usually bisexual, regular, or rarely irregular, more or less perigynous; perianth usually with a more or less developed hypanthium which frequently is rather thickened and glandular, sepals usually 5, often with small marginal stipules; petals usually 5, free; stamens as many as the petals to indefinite, the filaments usually free, rarely united; carpels 1-5, free or united, but the styles free; ovules pendulous or ascending, anatropous, borne on axile placentas; fruit various, frequently a drupe or pome; seeds usually without endosperm. Herbs, shrubs, or trees; leaves alternate, simple or compound, stipulate.

"Rarely" refers to subfamily Amygdaloideae flowing, staminate.

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Subfamily Separation based on hypanthium.

Spiraeoideae - open hypanthium - carpels on a gynophore

Rosoideae - hypanthium - almost closed - numerous carpels at base of Hyp.

Pomoideae - No of carpels reduced to 5. Hypanthium closed at the top; fused to carpels

Prunoideae - reduction of carpels to one. fr a drupe. Hypanthium free from the carpels.

Mimosa - petals regular, united.

Caesalpinioideae - irreg., stamens dehisc by apical pores.

Papilionoideae - very irregular.

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Genus Prunus - 4 subgenera frequently separated.

1. Prunofera - true plums, prunes + apricots.
   Young leaves are convolute, coiled + twisted in bud. In flower, the ovary is longitudinally sulcate (furrowed) + glabrous.
   Apricot is Prunus armeniaca
   Plums are complex w/ 3 centers usually not free stone.
   1. P. domestica - European - smaller, clustered, bluish, firm flesh not red.
   2. P. salicyna - Japanese - largest, red, less susceptible to diseases, inferior in taste. Bloom early.
   3. P. americana + P. hortulana - American - small + red.

   Prunus - usually free stone - have a thicker flesh.

2. Amygdalus - almonds. P. amygdala. + peaches, P. persica - ovary of this subgenus is pubescent + pinkish. These are from Asia Minor. Stone is pitted.

3. Cerasus - cherries. leaves conduplicate, glabrous ovaries, stones not pitted, round. 2 species of cherry.
   extrafloral nectaries 1. sweet cherry P. avium. large tree
   w/o " " " 2. sour cherry - P. cerasus - small ".

4. Padus - frequently separate (or Laurocerasus) ~~inflorescence a corymb~~.
   inflorescence is typically racemose.
   Bird cherries -
   P. serotina P. virginiana.
   very small drupes.

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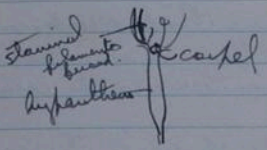
4. Prunoideae - single carpel developing into a drupe. Style terminal.

3. Chrysobalanoideae - single carpel at base of hypanthium. Style basal. Irregular fls. frequently present. Genus Hirtella is peculiar - seems to have an inferior ovary - but actually with a hollow hypanthium, the carpel not at the base, but resting upon edge of hypanthium.



All the stamens (11-20) pushed to opposite side of hypanthium from carpel, the filaments often united.

Hirtella & Licania are S. American genera of this subfamily. The carpel of Licania is basal.

The hypanthium of subfamily is often gibbous.

The hypanthium of Hirtella may be actually a spur, as in Tropaeolaceae.

Also here are found extra-floral nectaries. (Perhaps stipules became nectariferous).

The genus Pyrus - (pears, apples & quinces [frequently quinces in genus Cydonia])
Pome fruits

Sp. cydonia is quince when in Prunus.

Apples have 10 seeds, quinces have many seeds.

All apples we eat are European - crabapples are natives of Siberia or American.

Pears - P. communis. - w/ stone cells & pyriform fruit.

Apples - P. malus w/o stone cells & ovoid fruits.

Rubus - Bramble fruits - raspberries & blackberries.

Raspberries - fleshy part or cap dehisces from the convex receptacle.

Blackberries - cap or drupels adhere to receptacle - dewberries are varieties of B. berries.

loganberries also in this group.

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Rosales - Engler places after Ranales because of indefinite parts.

Rosaceae - perigynous tendency cause Rendle + Wettstein to place high in Polypetalae close to Myrtales.

Hypanthium - sny. is thalamus (Bentl. + Hooker call this order Thalamiflorae) but thalamus is actually same as receptacle, but hypanthium is the calyx tube.

Tendency for reduction in no. of carpels stronger than tendency to fusion of carpels.

Tendency toward zygomorphy, with union of staminal filaments.

Presence of stipules connected w/ sepals demonstrate floral nature of sepals.

Stamens inflexed in the bud.

Carpels 1-5-∞

Many methods of vegetative reproduction.

Runners in plums arise from adventitious buds on the roots ~~of gemmiferous roots~~ - those w/ adventitious buds (gemmiferous) producing new stems. Not confined to Rosaceae

Propensity for arching + new stems growing from tips.

Subfamilies of Rosaceae

1. Spiraeoideae - meadow sweets, bridal wreaths. - hypanthium is flat - ♀ ♂ ♀, fruit of 5 separate follicles

2. Pomoideae - torus or hypanthium urn-shaped or tubular, the carpels fused to hypanthium + to one another. No of carpels 5 or fewer. Fruit a pome.

3. Rosoideae - numerous carpels (in Alchemilla reduced to one) hypanthium tubular, enclosing many free carpels.

Tribe - Potentilleae - receptacle is convex most primitive group of Rosaceae.

" Sanguisorbeae - Alchemilla + Agrimonia essentially a little "apple" the hypanthium not fleshy, with hooks on the utricle. (over)

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Papilionatae -
Indigofera
Glycyrrhiza glabra. licorice.

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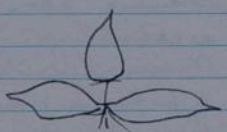
4. Galegeae - Robinia, Astragalus - diadelphous - pinnate, entire leaflets. Inflorescence a thyrsiform.

5. Hedysareae - Hedysarum - fruit a lomentum. Arachis hypogea (peanut)

6. Viceae - Vicia (vetch), Pisum (pea) sp. sativum. Lathyrus - (sweet pea) sp. odoratus. Leaves paripinnate, tendril is the twisted tips of the rachis.

7. Phaseoleae - Phaseolus, Erythrina - leaflets have stipels (diminutive of stipules). Pinnate leaf (trifoliate)



Phaseolus species vulgaris (snap bean)
" lunatus (lima bean)
" multiflorus (runner bean)
Dolichos - pole beans, also Kudzu. (sp. lablab)
Genus Dalbergia - a tree genus.

8. Dalbergeae - woody, w/ indehiscent pods or drupes.

Mimosoideae
Albizzia - woody or shrubby cultivated - bipinnately comp. tassel-like inflorescence
Inga - tree - used as a shade tree in coffee plantations

Caesalpinioideae -
Prosopis - mesquite of arid regions in SW U.S. + Argentina.
Tamarindus - spongy pericarp
Cercis - Judas tree.
Cassia - large yellow flo.
Delonix regia - royal poinciana.
Hematoxylum - [illegible]
Gleditsia - honey locust.

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Leguminosae - genus Amorpha - petals omitted.

Fruits - dehiscent legume

indehiscent - loment

rarely a drupe

Subfamilies -

1. Mimosoideae (Mimosa + Acacia) most primitive
Mimosa largely herbaceous, but typically the genera of this group are woody.
Strictly, gamopetalous. Stamens not epipetalous.
Regular fls. ~~sepals~~ petals connexent at base.
Stamens 10-∞. Filaments elongate. Inflorescence a capitulum. Leaves mostly bipinnate.
Mimosa sensitive - at base of rachis is a pulvinus, which causes thigmatropic action.
Desmodium gyrans (telegraph plant) from E. Africa - change position of leaflets every few minutes due to temperature.
Acacia - wattles of Australia - thorny, adapted to xerophytic habit.
Produce gums - gum arabic from A. senegalensis.
" phylloclads + cladophylls.

Albizzia, -cult.
Inga - coffee shade
Prosopis - Mesquite.

2. Caesalpinioideae - medianly zygomorphic. Sepals free & petals vertically equal. Stamens eccentric.
none papilionaceous.
Bauhinia - truly simple leaves. ??!!
Cassia - bipinnate
Tamarindus
Cercis, Cassia, Delonix, Haematoxylon (logwood), Gleditsia
~~3 spp~~

3. Papilionatae - tribes

1. Sophoreae - free stamens, leaves pinnate, leaflets entire, chiefly woody plants.
Amorpha fruticosa.

2. Genisteae Crotalaria, Genistia - stamens monadelphous, leaves simple or palmately compound, leaflets entire.

3. Trifoleae - Trifolium, Medicago, Melilotus. diadelphous (monadelphous) leaflets toothed (sepals)

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Prunoideae - had qf

Rosoideae

Spiraea - Spiroideae
Pyrus - sometimes appar. pome accessory.
Crataegus
Rosa
Fragaria
Rubus
Potentilla - cinque foil
Geum
Alchemilla - apetalous, 1 stamen alpine genus.
Prunus - stamen plums
Chrysobalanus - tropical

Ben P. communis offs. P. malus
Cydoffs - P. sinensis

Family 9. Connaraceae: Flowers usually bisexual, regular, hypogynous; sepals usually 5, persistent and becoming hardened about the base of the fruit as a rule; petals 5, free; stamens usually in 2 unequal 5-merous whorles, the filaments usually united at the base; carpels 5, rarely fewer, free, each with 2 collateral ovules, only 1 carpel fruiting; fruit a follicle with a solitary, erect, arillate seed. Mostly woody climbers, sometimes shrubs or trees; leaves alternate, imparipinnate, exstipulate.

Connecting series between Rosaceae + Leguminosae - pistil in Legume becomes of 5 carpels - fruit a dilate.

Connarus

Family 10. Leguminosae: Flowers bisexual, usually irregular, rarely regular, hypogynous; sepals usually 5, generally more or less united; petals isomerous with sepals, free, or united in regular flowers; stamens typically 10, free or more or less monadelphous, or diadelphous by separation of the posterior stamen; carpel 1, with the ventral suture posterior; ovules in 2 alternating series, usually numerous, amphitropous, anatropous, or sometimes campylotropous, obliquely ascending or pendulous; fruit usually a legume, sometimes indehiscent; seeds usually absent, sometimes with a funicular aril. Trees, shrubs, and herbs; leaves usually alternate, compound, and stipulate.

or slightly irregular

3rd largest family of flowering plants.
1 Calyx + Corolla + Androecium + Gynoecium - 550 genera, 13,000 species

Regular fls - gamopetalous
Irreg. " - polypets.

Legume - a follicle splitting dorsally + ventrally
Loment - schizindehiscent legume.
- the genus Desmodium (or beggarweed)

endosperm usually absent.
cf. Erythrina - red seed + blue karyt

1 Mimosoideae - bipinnate
2 Caesalpinioideae
3 Papilionoideae = butterfly-like

Royal Princess
Adonis regia

1 Brownea
1 Mimosa
1 Acacia - ferns - phyllodeids - stipules replaced by thorns.
2 Bauhinia + Cercis - have simple leaves
2 Cassia
2 Sophora - sp. japonica - deciduous tree.
3 Genista
3 Crotalaria
3 Trifolium
3 Medicago - alfalfa
3 Melilotus
3 Astragalus
3 Robinia
Prosopis - mesquit - forest regions -

or simple

Abrus precatorius
bright red + black decorative seeds
jequirity bean - contains violently poisonous substance in seed coat

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Characters which are repeated time & time again - eg. free petals, reduction of parts, etc, must not be used as emphasized characters for separation, but such characters as the hypanthium of Rosales, Myrtiflorae is important.

Rosales - styles separate -
Myrtiflorae - " fused

Family 14 = closely related - 1 - hypogynous
2 - epigynous

These families suggest a reduction -

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Arachis - peanut Glycine max = soybean.
Vicia
Pisum
Phaseolus
Erythrina
Dalbergia

Myrtales

Order 15. Myrtiflorae: Flowers regular or irregular, usually bisexual and cyclic, perigynous to epigynous, most frequently 4-merous, sometimes 5-6-merous; sepals united into a pronounced hypanthium; petals free; stamens as many as the calyx lobes, twice as many, or indefinite, rarely fewer; pistil 1-6-carpellate, usually with numerous ovules on axile placentas. Endosperm usually absent. Herbs, shrubs, and trees, usually with internal phloem; leaves usually opposite but sometimes alternate, simple, usually entire, usually exstipulate.

Wettstein - affin. to Rosales
Engler places Rosales next to Ranales but Ranales have hypanthium. Myrtales have same.

No hypogynous families, strong tendency toward perigyny. Petals have a well-developed claw.

Styles united

Family 1. Thymelaeaceae: Flowers bisexual, sometimes unisexual, regular, perigynous; hypanthium tubular, sometimes petaloid, divided at the orifice into 4-6 sepals; petals absent or scalelike; stamens usually in 2 series isomerous with the sepals and inserted at two levels within the hypanthium; pistil 1-, rarely 2-carpellate, superior, bearing a single suspended anatropous ovule; fruit a nutlet or drupe. Usually much branched shrubs, sometimes trees; leaves usually alternate, entire, usually narrow and heath-like, sometimes broad and flat.

Hutchinson Thymelales near Rutales.

cult. - Daphne - Mezereum - early bloom Cneorum - cushion shrub, fragrant.
Blooms before leaves Dirca palustris - native Daphne - leatherwood

Family 2. Elaeagnaceae: Flowers bisexual, or unisexual and monoecious or dioecious, epigynous; petals absent, the usually tubular hpanthium divided at the orifice into 4 calyx lobes; stamens borne at the mouth of the hypanthium, 4-8; pistil inferior, 1-carpellate, bearing a basal anatropous ovule, sometimes accompanied by a glandular disc at the base of the hypanthium; fruit a berry or drupe. Shrubs, densely covered on all parts with silvery, brownish, or golden scales or stellate hairs; leaves alternate or opposite, entire, without stipules.

Hutchinson places near Rhamnales.

Elaeagnus - Russian olive.
Shepherdia

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Most important family.

Family 3. Lythraceae: Flowers bisexual, regular or irregular, perigynous; hypanthium usually tubular, sometimes gibbous, often somewhat petaloid, the orifice divided into 4-6, sometimes 3-15 calyx lobes; petals usually 6, sometimes from 3-15, equal or unequal, crumpled in the bud, rarely absent; stamens as many as the petals or twice as many, rarely fewer; pistil 2-6-carpellate, the style simple; ovules anatropous and ascending; fruit a capsule with various dehiscence. Herbs and shrubs, sometimes climbing, rarely trees; leaves usually opposite, simple, entire, with very small stipules.

Lythrum - flower strip
Cuphea - fruit like a hernia, irregular fl. w/ bulbous base
Lagerstroemia - crepe myrtle, st. indica. Lawsonia - Africa - source of Henna dye

Family 4. Punicaceae: Flowers bisexual, regular, epigynous or nearly so; sepals 7-8, coriaceous-petaloid; petals 7-8, crumpled in the bud; stamens many, inserted in the hypanthium; pistil 4-8-carpellate, in the latter case the carples in 2 concentric whorls, the outer becoming superposed upon the inner in fruit, placentation axile, sometimes becoming parietal in fruit; fruit a berry, the seeds with pulpy outer testa.

Punica - pomegranate - P. granatum.

Family 5. Rhizophoraceae: Flowers bisexual or sometimes unisexual by abortion, regular, perigynous or more or less completely epigynous; sepals 4-5, fleshy or leathery, persistent; petals 4-5, usually shorter than the petals, often lobed or cut; stamens 8-many, on the outer edge of a disc, pollen-cells 4-several; pistil 2-4-carpellate, the cells sometimes incompletely separated, usually 2 pendulous ovules in each cell; fruit a berry, sometimes a dry or fleshy capsule, sometimes indehiscent and 1-seeded; seeds sometimes arillate, with endosperm, usually germinating upon the tree. Shrubs or small trees of muddy coasts and estuaries, with prop-roots; leaves usually opposite, simple, coriaceous, with caducous stipules.

Rhizophora mangrove - R. mangle - used in tanning leather.

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Family 6. Combretaceae: Flowers bisexual or unisexual by abortion, regular with a tendency toward irregularity, epigynous; perianth double, 5-4-merous, the petals sometimes absent; hypanthium prolonged above the ovary; stamens usually twice as many as the sepals, rarely indefinite or fewer, bent inward in the bud; pistil 1-carpellate, usually 4-5-angled; ovules 2-5, rarely more, anatropous and pendulous from the top of the ovary, surmounted by a disc, sometimes hairy, at the base of the hypanthium tube; fruit leathery or drupaceous, 1-seeded, 2-5-angled or -winged. Trees or shrubs, sometimes climbing. Leaves opposite, entire, without stipules.

Combretum
Terminalia

Family 7. Lecythidaceae: Flowers bisexual, often large, regular or irregular, epigynous; sepals 4-6, free, persistent; petals 4-6, free, rarely absent; stamens numerous, often staminodial in part, or unequally developed, united at the base, borne upon a basal disc of the hypanthium, inflexed in the bud; pistil 2-6-celled, with 1-many anatropous ovules in each, with a simple style; fruit a drupe, berry, or sometimes circumscissile woody capsule; seed frequently very large, without endosperm, the embryo sometimes massive and undifferentiated. Trees, often with corticle vascular bundles; leaves often very large, alternate, entire, without stipules.

Bertholletia - Brasil nut
Lecythis - substitute for vanilla
Couroupita
Napoleona - illustrates stamens often staminodial in part.
Gustavia
Holmanium - woody capsule.

Family 8. Myrtaceae: Flowers bisexual, regular, epigynous or sometimes more or less epigynous; petals and sepals 4-5, free or completely concrescent and falling at anthesis; stamens usually numerous, sometimes obdiplostemonous or 4-5, free, inflexed in the bud; pistil 2-5-carpellate, inferior or subinferior, rarely 1-celled, with a single style, bearing 2-many usually somewhat pendulous, anatropous or campylotropous ovules on axile, rarely parietal placentas; fruit a berry, drupe, or capsule. Chiefly woody plants

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intercalary inflor. - infl. succeeded by vegetative growth.

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Presence of essential oils accounts for commercial value.

bearing lysigynous oil canals or cells in all parts; leaves opposite, exstipulate, usually entire leathery leaves.

Large genera, requiring monographic study of corysoflora

Myrtus - ch. communis - Myrtle of poets.
Psidium - guaba - guava
Eugenia - pimenta - source of allspice
Eucalyptus - no of species - australian - Maiden studied
Melaleuca - bark exfoliates, thick, white - laminated

Family 9. Melastomaceae: Flowers bisexual, regular or somewhat irregular, epigynous or perigynous; sepals and petals 4-5, free, or rarely united into a caducous cap, the former frequently with marginal stipules and more or less united at the base; stamens usually in 2 4-5-merous whorls, inserted on the more or less tubular hypanthium, sometimes staminodial, typically with conspicuous appendages, the anthers dehiscing by pores; pistil 4-5-carpellate, bearing few to numerous ovules on axile, rarely parietal placentas, the style simple; fruit a loculicidal capsule or a berry. Herbs, shrubs, or trees of diverse habit, sometimes climbing or epiphytic; leaves opposite decussate, rarely whorled, without stipules, simple, the lateral secondary veins usually parallel to the midrib from the base.

Name means bonesmarts. Tropical

stamens declinate - bent in some direction

Fruits are pyxis or capsules dehiscing seed by apex.

Gleason is authority.

W/o oil glands

Decussate vs distichous (opposite, in 2 rows - decussate - arranged at 45° angles.

Rhexia - virginica - reported in Mo. - pink fl. bud
Tibouchina - cult. in greenhouses
Miconia - enormous tropical
Melastoma

Name connotes - the calyx arises after a calyptrum.

Family 10. Onagraceae: Flowers bisexual, regular or irregular, epigynous with the tubular hypanthium produced above the ovary but deciduous in fruit; sepals usually 4, rarely 2, 3, or 5, valvate; petals usually 4, rarely 2, 3, or 5, or absent; stamens usually as many as the sepals or twice as many, rarely fewer or staminodial, free, the pollen connected by viscid threads; pistil inferior, usually 4-carpellate, rarely 1-2 carpellate, usually bearing numerous anatropous ovules on axile placentas, the style simple; fruit usually a loculicidal capsule, sometimes a berry, nut, or drupe. Predominantly herbs, sometimes shrubs; leaves alternate or opposite simple.

Evening primrose

long style with ~~colored~~ 4 parted stigma.

Godetia - silky flowers.
Oenothera
Epilobium - willow herbs - fire weed.
Jussieua - aquatic - water plant
Circaea - dimerous (2 stamens)
Fuchsia -

seeds comose

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Family 11. ~~Halarrhogidaceae~~ Halarrhogidaceae - dimerous, double perianth - 2-4 petals,

Genera: Myriophyllum - aquatic - inflorescence compd spicate -
Gunnera - ovary 1-carpellate - Largest herbs in world

Family 12 - Hippuridaceae

Hippuris - aquatic - flower borne in axil of bract - no perianth, 1 One stamen.

Wetstein places Callitrichaceae between

Rendle - characters relating to Me

Subfamilies
1. Saxifragaceae + adaptation to xerophytic environment
Aizoaceae - poor differentiation of parts
Includes some inferior ovary -
1. Seeds of Cactaceae often (parietal) absent, or when present flashy.
2. One style Portulacaceae in Aizoaceae, sep. styles.
3. Definite hypanthium in which stamens inserted.

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Fuchsia
Trapa (Hydrocaryaceae)
Circaea "enchanter's nightshade" - dimerous/plum

Family 11. Haloragaceae: Flowers bisexual or unisexual, inconspicuous, regular, epigynous; sepals 4-2, free; petals 4-2, or absent; stamens 2, 4, or 8, free; pistil 2-4 carpellate, with free styles, 1-4-celled, each with a solitary pendulous, anatropous ovule; fruit a nut or drupe; seed with copious endosperm. Herbs of very diverse habit, usually more or less aquatic, internal phloem lacking; leaves usually whorled, sometimes alternate or opposite, lobed to finely pinnatisect, with or without stipules.

These 2 families here because of inferior ovary and basically 2-merous structure.

Myriophyllum - strict aquatic
Gunnera - polystelic

Family 12. Hippuridaceae: Flowers bisexual or unisexual through abortion, epigynous, inconspicuous; perianth reduced to a 4-lobed rim above the ovary; stamen 1; pistil 1-celled, with a simple feathery stigma, bearing a single pendulous ovule; fruit a nut; seed with endosperm. Aquatic herbs with sympodial, jointed stems; leaves whorled, narrow, entire, sessile. w/o internal phloem.

Hippuris - mare's tale

Order 16. Opuntiales. - might be related to Aizoaceae + placed in Centrospermae

Family 1. Cactaceae: Flowers bisexual, regular or irregular by position, epigynous; sepals and petals not clearly differentiated, usually indefinite and more or less united into a tube, sometimes free; stamens indefinite, united to the perianth tube or upon the top of the ovary; ovary inferior, 3-many-carpellate, 1-celled, with many ovules upon parietal placentae; fruit usually a fleshy berry with many seeds; endosperm present or absent. Succulent plants of diverse forms, simple or branched; leaves usually reduced to caducous scales or awls, rarely broad and laminate, the axils often with spines and more or less hairy.

American, largely.

Differentiating character of Opuntiales

Spines often represent the blade, or stipules, or gut spines.

Stem jointed + flat,

Fruit usually large. Lanuginous. Stamens indef. of many fls. of bloo

Pereskia - Rhodocactus
Opuntia - Prickly pear - only one native in Mt. - ofte
Cereus - night blooming cereus sometimes the fol. genera.
Phyllocactus - christmas cactus

Fruit may itself take root.

Spines called [illegible] Rosa.

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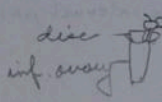
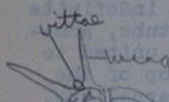
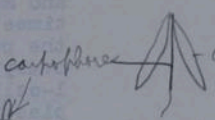
Homogamy - the typical case in the lower representatives or primitive forms.

Leaf traces are of phylogenic significance
1. The 3-leaf trace, is considered primitive
2. The multi-lacunar trace is advanced.



Schizocarp - may bear a carpophore from which the carpels separate





vascular trace may be absent -

Shives or mericarp help in discrimination

Oil cells in fruit - "vittae" - alternate with (canals) useful in identification

The 5 vascular bundles - for mericarp

Essential oils economic

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Mamillaria - hedgehog cactus, small desert plants.
Rhipsalis - mistletoe cactus - epiphytic[al] cacti

Order 17. Umbelliflorae: Flowers typically bisexual, regular, sometimes irregular, cyclic, epigynous; perianth double, the calyx frequently much reduced, 4-5-merous; stamens 4-5, sometimes 8-10; pistil 2-5-carpellate, each cell bearing 1 pendulous, anatropous ovule with 1 integument; fruit usually a schizocarp or berry; endosperm copious, embryo small; inflorescence usually an umbel (except Cornaceae).

Family 1. Araliaceae: Flowers bisexual, rarely unisexual, regular pentamerous; calyx usually reduced to an inconspicuous rim; stamens 5, rarely 10; pistil usually 5-, rarely 10-celled, surmounted by a glandular disc; fruit usually a 5-celled berry or drupe. Trees or shrubs, rarely perennial herbs, with schizogenous resin or gum canals; leaves usually crowded at the ends of the branches, alternate or sometimes opposite, with a broad sheathing base, often very large, simple or compound, or pinnately or palmately divided.

Aralia - spinosa - Hercules club
Panax - quinquefolium - American ginseng
Hedera Helix - English ivy

Family 2. Umbelliferae: Flowers usually bisexual and regular, or the peripheral florets of the umbel irregular, predimonantly 5-merous; stamens predominantly 5; pistil 2-celled, surmounted by a disc or stylopodium, styles 2; fruit a dry schizocarp. Herbs, usually with hollow internodes, with oil cells generally distributed; leaves alternate, compound, rarely simple, the petiole with a broad sheathing base; inflorescence umbellate, sometimes capituliform. Predominantly temperate

Sanicula - marilandica - snakeroot
Eryngium - yuccifolium - rattlesnake master
Chaerophyllum - chervil - a frequent herb
Conium maculatum - the hemlock which Socrates drank
Carum - caraway seed
Cicuta - water hemlock - largest plants of family
Pastinaca - parsnip - sp. sativa
Heracleum
Daucus carota - queen Anne's lace
Apium - celery sp. graveolens
Petroselinum - parsley sp. sativum

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Cucurbitaceae, the sympetalous placed in Polypetalae, Parietales because of the outstanding character.

Classification of Sympetalae easier, more distinct

Pentacyclicae - two cycles of stamens
+ or - same no. of calyx + corolla.
smaller of 2 groups

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B OTANY 460 January 26, 1948

I. Enumerate, in order according to Rendle, 10 orders of Archichlamydeae, briefly indicating the characteristic tendencies of each.

II. Give an example of what you consider to be a relatively "unnatural" order of Archichlamydeae, and contrast with one more natural. Discuss.

III. What two aspects of floral structure do you consider to be of most general use in the establishment of "natural" families and orders of Archichlamydeae? Discuss.

IV. Diagnose to family or order the fragments in each dish provided, (a) without the aid of the syllabus, and (b) with the syllabus. Families of some may not be included in the syllabus; indicate such cases together with what you consider to be their closest affinity. This question should be answered in the form of an annotated list.

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2/3/50 - Sympetalae

Pentacyclicae - obdiplostemonous - derived from Geraniales

1. Ericales - usually free stamens - Rayner - authority on mycorrhiza. Diapensiaceae has epipetalous stamens. Theaceae divergent + frequently appendaged. "Reconstruction" of Wettstein. 4-5 celled w/ 2 ovules.

each theaceae of this group has its own opening or slit.

a. Clethraceae - monogeneric - N. American + into Columbia, also SE Asia.
Pistil 3 celled.
Disc absent.
Petals free.

b. Ericaceae - heath family - most important family.
Petals mostly united (similar to Melastomaceae).
Stamens obdiplost. Axile placentation.
Disc present Pollen in tetrads.
Differentiated embryo

Subfamilies:
(1) Rhododendroideae - most primitive - superior ovary stamens w/o basal appendages - petals deciduous, septicidal capsule.
(2) Arbutoideae - sup. ovary, st append., pet. decid. - fruit a loculicidal capsule or berry.
(3) Ericoideae - ovary sup., stamens appended or not., corolla persistent, fr. a drupe or a capsule.
(4) Vaccinioideae - ovary inferior - fr. a berry. stamens appendaged or not.

Family important in N. temperate regions

c. Pyrolaceae - reg, hypog. petals united.
Disc present
Pistil sup - incompletely 4-5-celled, 1-celled above,
Placenta central, thick + fleshy.
Fr. a capsule - ovule w/ oily endosperm + undifferentiated ovules.
Mycorrhizal hubs.

Primulaceae has central placenta.

Pyroloideae - autotrophic - pollen in tetrads

Monotropoideae - [illegible] fr. a [illegible]

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Epacridaceae – heath of Australia.
1. Stamens epipetalous.
2. Confluent pollen slits.

Diapensiaceae – Diapensia lapponica – circumboreal.
Galax – flowers use evergreen flabelliform leaves.
Shortia – 4 species – 3 in Asia, in the
N. Carolina mountains – found 1st by Bartram
then lost for years – the sp. is S. galacifolia.

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leaves w/o a sheathing base, + w/o a unilacunar trace

Family 3. Cornaceae: Flowers bisexual, rarely unisexual, usually 4-merous, but sometimes 3-5-merous; stamens in 1 whorl; pistil usually 2-celled, rarely 1-5-celled, surmounted by a disc, the style simple; fruit usually a drupe, rarely a berry. Chiefly shrubs, sometimes trees or climbers, rarely rhizomatous herbs; leaves opposite, sometimes alternate, simple; inflorescence cymose, usually corymbiform, rarely capituliform.

Cornus florida; Baileyi - cymes rifb., shrub, swift, Ont. Canada - Newfoundland

SYMPETALAE: Flowers typically bisexual and dichlamydeous, unisexual or monochlamydeous only in derived forms; petals typically coherent at least at the base, frequently polypetalous in the lower families; ovules typically with 1 integument.

Pentacyclicae: Flowers usually with 2 staminal whorls, sometimes with one or with more, when with but one, the stamens opposite the petals; petals sometimes separate.

Order 1. Ericales: Flowers bisexual, regular or somewhat irregular through (displacement) 5-4-merous and usually obdiplostemonous; stamens usually free from the petals and hypogynous; the anthers usually dehiscing by apical pores; petals sometimes free; pistil superior to inferior, usually 4-5-celled with numerous ovules on axile placentas. Usually shrubby plants with coriaceous, persistent leaves.

Family 1. Clethraceae: Flowers regular hypogynous; petals free; stamens obdiplostemonous, the anthers dehiscing by apical pores; disc absent; pistil 3-celled. Shrubs and small trees; leaves alternate.

Clethra

Family 2. Ericaceae: Flowers usually regular, hypogynous or epigynous; petals sometimes free, usually united; stamens obdiplostemonous, the anthers dehiscing by apical pores, the hamules more or less free and spreading, frequently appendaged; disc present; pistil superior or inferior, 5-4-celled, the style simple; fruit a capsule, berry, or drupe; seeds small, sometimes winged, with endosperm and differentiated embryo. Woody plants; leaves alternate, opposite, or whorled, usually leathery and evergreen, often needle like.

Rhododendron

Ledum

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Calluna
Erica
Arbutus
Pyrola
Androsace
Primula

Urceolate - urn

Rotate - wheel-shaped.

Salverform

Infundibuliform

Campanulate

Tubular - funnel-shaped

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Primulales - polyphyletic
= last two families probably allied to Ericales.
Primulaceae + Plumbaginaceae from Centrospermae

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Kalmia

Befaria tar-flower

Gaultheria
Arbutus - fruit appendages of stamens - Wetstein "unicornis"
Epigaea - Basidiospore -
Vaccinium - inferior - stamens on receptacle.
Erica - heathers or heath
Calluna

sp macrocarpon in cranberry

In Britain sometimes a vine.

Family 3. Pyrolaceae: Flowers usually regular, hypogynous; petals free or united; stamens obdilpostemonous, the anthers dehiscing by apical pores, or by longitudinal slits; disc present, rarely absent; pistil superior, 5-4-celled at the base, 1-celled above, the style simple, the placenta thick and fleshy; fruit a capsule; seeds minute with oily endosperm and few-celled undifferentiated embryo. Perennial herbs or saprophytic (mycorrhizal) herbs without chlorophyll. not really so.

Pyrola - Shinleaf
Chimaphila -
Monotropa - mycorrhizal - Indian Pipe. Hypocumacaceae
Sarcodes - snow plant -

red or white

Family 4. Diapensiaceae: Flowers regular, hypogynous; perianth 5-merous, the corolla sometimes divided almost to the base; stamens 5, epipalous, sometimes with alternating staminodes, the anthers dehiscing longitudinally; pistil superior, 3-celled, with many anatropous ovules; fruit a capsule; disc absent. Low evergreen shrubs or perennial herbs; leaves in dense or loose rosettes.

Diapensia - very characteristic in arctic zone
Shortia - galacifolia - disc in shot - dimorphic - Asa Gray
Evergreen rosettes

Order 2. Primulales: Flowers regular, bisexual or unisexual by abortion, usually 5-merous, hypogynous, rarely epigynous; petals usually united, rarely free; stamens epipetalous, as many as the petals and usually opposite them, rarely alternate; pistil superior, rarely inferior, 1-celled, with indefinite ovules with 2-integuments upon a basal or free-central placenta; style simple. Sequoiaceae Eucalyptus only.

1 celled ovaries, central placentation, indef ovules, almost by abortion
a few w/ wing fls.

Family 1. Theophrastaceae: Flowers bisexual or unisexual, regular, hypogynous, 5-merous; corolla rotate, urceolate, or funiform; stamens 5, antepetalous, alternating with 5 antesepalous staminodes, the filaments sometimes united into a tube; pistil superior, with indefinite ovules immersed in mucilage on a central placenta, the

Tropical woody

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Get Bibliog of main contrib. to phylogeny
1. Indicate reference giving quickest idea of phylogeny.

Bessey's system—
Hemsley—Hall.

Plumbaginales closely related to Primulales
Sep. because of vegetative character
Have same central placentas. Endosperm mealy
Stipitate glands.
In Plumbago, triseria reduction in embryo sac from 8 to 4 cells.
1 is egg, 1 is antipodal, synergids absent.

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style simple; fruit a drupe or berry. Trees or shrubs; leaves alternate, simple, without stipules, usually crowded at the ends of branches, with long strands of sclerenchyma beneath the epidermis.

Theophrasta
Jacquinia

Family 2. Myrsinaceae: Flowers bisexual or unisexual, regular, 4-5-merous, hypogynous or rarely epigynous; stamens 4-5, antepetalous, without staminodes, the filaments sometimes united into a tube; pistil superior, rarely inferior, the ovules almost always immersed in the central placenta; fruit a drupe or few-seeded berry. Trees and shrubs with shizogenous resin-cells in stem, leaves, and frequently petals; leaves alternate, entire, often leathery.

Myrsine
Ardisia
Maesa
Aegiceras

Family 3. Primulaceae: Flowers bisexual, regular or rarely irregular, hypogynous or perigynous, 5-merous; stamens antepetalous, usually with alternating staminodial scales, free; pistil superior, rarely subinferior, with indefinite ovules upon a free-central placenta; fruit a capsule. Herbs; leaves alternate, simple; inflorescence without bracteoles.

Primula
Androsace
Dodecatheon
Cyclamen
Lysimachia
Anagallis
Glaux
Hottonia

Order 3. Plumbaginales

Family 1. Plumbaginaceae: Flowers bisexual, regular, hypogynous, 5-merous; sepals more or less tubular, sometimes spurred, often glandular; petals sometimes scarious and persistent; stamens 5, antepetalous, without alternate staminodes; pistil superior, 1-celled, bearing 1 basal anatropous ovule; fruit usually a circumscissile capsule with 1 seed; endosperm mealy. Perennial herbs or shrubs bearing epidermal water - or chalk-glands; leaves often radical.

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Elaeocarpaceae derived from Malvales or Gentiflorales
due to tendency of multiplication of stamens

haplostemonous = basic no - betterway monostemonous

Carpels freq. divided by false partitions

Sapotaceae

The scales of the corolla may be interpeted as
interpetiolar stipules when between 2 corolla lobes,
or intrapetiolar stipules when scales are opposite
the corolla lobes.

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P. cerastiqua - succulent digital notes of family, entire Plum

Frequently "halophytic"

Plumbago - old world - 2 cult. P. capensis + fluminensis (cultivated)
Armeria "sea thrift" capitate heads.
Statice hardy, tufts, scarious pale lavender
Limonium "sea lavender"

P. lundens - isolecithal mesophytic

Order 4. Ebenales: Flowers bisexual or unisexual, regular, hypogynous, perigynous, or epigynous; petals united, stamens diplostemonous or triplostemonous, sometimes haplostemonous by abortion, often staminodial; pistil superior to inferior, multilocular or 1-celled above; seeds with endosperm. Woody plants with simple, often leathery, leaves.

Reverse trend of obdip stamens to diplostemony

Predominantly tropical.

Family 1. Sapotaceae: Flowers usually bisexual, hypogynous; sepals 4-8 in 2 whorls, or 5 in 1 whorl; petals more or less united, as many as the sepals but in 1 whorl, rarely double as many in 2 whorls, sometimes with lateral or dorsal appendages; stamens usually in 2-3 whorls, the outer frequently staminodial; pistil superior, 4-many-celled, each with 1 anatropous ovule with 1 integument, the style simple; fruit a berry. Mostly trees with latex canals in stem and leaves; leaves alternate, leathery, sometimes stipulate.

Frequently hairs simple, branched hairs, as in Malphigiaceae. Frequently caulifloral, + fasciculate.

B. laxinginosa - "false buckthorn" for "star apple" - 2 whorls of petals

Achras - zapota - source of chicle. Delicious fr - "sapodilla"
Bumelia - only 1 which is temperate.
Chrysophyllum "golden leaf" indumentum yellowish or golden
Mimusops - "marmalade tree" - M. globosa - source of gum balata.

Family 2. Ebenaceae: Flowers usually dioecious, rarely bisexual or polygamous, hypogynous, regular, 3-7-merous; calyx deeply lobed, persistent; corolla gamopetalous, contorted; stamens isomerous with corolla, twice as many, or more numerous, usually staminoidal in pistillate flowers; pistil 2-16-celled, each with 1-2 pendulous ovules, the style 2-8, free or united at the base; fruit fleshy or leathery, usually indehiscent; endosperm cartilaginous, often ruminate. Chiefly trees; leaves usually alternate, rarely opposite or whorled, entire, usually leathery, without stipules. W/O Latex

Seeds demonstrate plasmodesmata in cartilaginous endosperm

Diospyros - 400 species - 1 is Ebony - also persimmon

Family 3. Styracaceae: Flowers bisexual, regular, hypogynous to somewhat perigynous; calyx tubular, with 5-4 inconspicuous lobes; petals free nearly to the base, 5-4, valvate or imbricate; stamens 8-10, rarely 5-4, the filaments united below; pistil superior or subinferior, rarely almost completely inferior, usually 3-5 celled below, 1 celled above

Genus Styrax - yields a gum "storax"

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Fam 4 Symplocaceae - anomalously like Styracaceae
fruit a drupe w lobes of calyx persistent
Symplocus - tropical, 300 sp.
of veluting - leathery

5-merous - in compact cymes
Leaves like Ilex
stamens numerous in 5 bundles

Tetracyclaceae - when stamens red. to 2, accompanied by zygomorphy (Ericales (Oleaceae)

Compd leaves uncommon in Gamopetalae. Bignoniaceae also compd.

Fraxinus, Chionanthus + Forestiera show good reduction series

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3-5-celled below, 1-celled above, the ovules 1-few in each cell, anatropous, with 1-2 integuments, the style simple; fruit usually a drupe, rarely dehiscent by 3 valves; trees or shrubs, often with yellowish or brownish stellate hairs; leaves alternate, membranaceous or leathery.

Styrax sp. officinalis - drug for inhalants "gum benzoin";
Halesia sp. carolina

Family 4. Symplocaceae: Flowers bisexual, regular, epigynous; perianth typically 5-merous, but the petals ranging from 3-11, divided almost to the base; stamens usually numverous in 2 or more series, but often arranged in 5 bundles, the filaments more or less united; pistil inferior, completely 5-celled, the ovules with 1 integument; fruit a drupe. Trees and shrubs usually with alternate, leathery leaves.

Seeds have peculiar sulfur-yellow tinge to them
Fr. an oblongoid or ellipsoid, crowned w/ 5 lobes of the persistent calyx.

Symplocos 200 sp. S. tinctoria - "horse-sugar" or "sweet leaf"

Tetracyclicae: Flowers with one staminal whorl isomerous with the corolla lobes, or frequently with fewer stamens, commonly but 2 and alternate with the corolla lobes; corolla almost invariably sympetalous.

Superae: Flowers with a superior ovary, or very rarely somewhat subinferior.

Sequence of families essentially same as Engler

Does not a natural separation

Order 1. Oleales.

Family 1. Oleaceae: Flowers bisexual, rarely unisexual and monoecious or polygamous, regular, hypogynous, typically 2-merous; calyx small, usually 4-5-, rarely 3-6-lobed, rarely absent; petals united or sometimes free or absent, 4-5, rarely 3-6-lobed, imbricate or valvate, rarely contorted; stamens usually 2, rarely 3-6; pistil superior, 2-celled, usually with 2 anatorpous ovules in each, the style simple; fruit usually a capsule or berry; endosperm present or absent. Trees or shrubs, rarely herbs, without internal phloem; leaves usually opposite, simple or imparipinnate, without stipules.

Wettstein - Not family in Contortae

sometimes more than 4-5 lobed, 12, lobes.

ovules pendulous or erect.

Reason for Salvadoraceae here " in considering as relative of Celastrales. Ole all, entomophilous & seeds similar to Loganiales ash

Fraxinus - quantiferous Oleaceae of Flex. + stamens + fruit
Syringa - Lilac common sp. S. vulgaris - Stigma funiform
Forsythia -
Ligustrum - Privet
Olea
Jasminum - Deciduous or frequent w/ 6-8 lobes of calyx + corolla.
Menodora - Julian Steyermark monograph.

but largely old world taxa

Chionanthus - large shrub w/ long spikes of flowers "Fringe tree".

Sometimes

Fam. 2. Salvadoraceae - rather doubtful. Have by Wettstein. Others

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Contrastae frequently divided.

1. Sentionales - carpels always united, never have latex

2. Apocynales - carpels mostly free, usually with latex.

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Order 2. Contortae: Flowers bisexual, regular, hypogynous, gamopetalous; sepals 4-5; petals 4-5, usually contorted; stamens 4-5, epipetalous, antesepalous; disc frequently present; pistil 2-carpellate, the carpels united, or free below the united styles, bearing few to numerous ovules on axile or parietal placentas; embryo with endosperm. Herbs, trees, and shrubs, with internal phloem; leaves usually opposite and simple.

Family 1. Loganiaceae: Flowers usually bisexual, regular, rarely slightly irregular, 4-5-merous (rarely pleiomerous), hypogynous; calyx imbricate; corolla gamopetalous, valvate, imbricate, or contorted; stamens as many as the corolla lobes; disc absent or small; carpels 2, completely united, superior, usually 2-celled, rarely 1-celled, the style usually simple with a capitate or 2-lobed stigma; fruit a capsule, berry, or drupe, seed with endosperm. Herbs, shrubs, or trees, with or without internal phloem, latex absent; leaves opposite, stipulate, simple.

Gelsemium
Strychnos
Spigelia
Buddleia

Family 2. Gentianaceae: Flowers bisexual, regular, 4-5-merous, hypogynous; calyx usually imbricate; corolla generally contorted, sometimes spurred or bearing foveae or glands; stamens isomerous, the anthers sometimes spirally twisted; ovary superior, rarely subinferior usually 1-celled with parietal placentation, sometimes incompletely 2-celled; fruit usually a capsule. Herbs, rarely slightly woody below, with internal phloem; leaves opposite, without stipules. Sometimes chlorophyll-less saprophytes (mycorrhizal).

Gentiana
Sabbatia
Swertia
Halenia
Symbolanthus
Menyanthes
Leiphaimos
Eustoma

Family 3. Apocynaceae: Flowers bisexual, regular, usually 5-merous, hypogynous or very rarely somewhat perigynous; calyx usually divided almost to the base; corolla usually salverform or funiform, contorted, the throat often with

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internal appendages; stamens epipetalous, free, or the anthers (often appendaged) more or less connivent about the stigma, the pollen granular or in persistent tetrads; disc usually present, usually 5-lobed; carpels 2, very rarely more, usually free and united only by the simple style, less often completely fused and 1-celled with parietal placentas or 2-celled with axile placentas, the style or stigma typically thickened and the stigmatic surfaces lateral; fruit usually a fair of free follicles, less frequently a berry; seeds often winged or comose. Herbs, shrubs, trees, or climbers, usually with milky latex; leaves usually opposite, less frequently alternate or whorled, stipular vestiges present or absent.

Vinca minor-creeping myrtle
Plumeria - frangi-pani - Mexico used for altar decoration.
Allamanda
Nerium - oleander
Amsonia - native of the herb.
Apocynum - dog bane - roadside weed. Source of fiber for Indians.
Strophanthus

Family 4. Asclepiadaceae: Flowers bisexual, regular, hypogynous, 5-merous; calyx deeply divided; corolla usually rotate, contorted or valvate; stamens 5, separate or the filaments united and the anthers connivent about the stigma, the filaments usually bearing more or less complicated appendages (corona), the pollen in granular tetrads or more frequently cohering in waxy pollinia which are united in pairs, rarely in 4s by a yoke-mechanism (translator); carpels superior, free except at the common style and stigma, bearing numerous anatropous ovules on axile placentas, the stigma massive and usually quite sessile, 5-angular, the 5 receptive surfaces lateral; fruit a pair of follicles, dry or fleshy; seeds usually comose. Herbs, shrubs, or woody climbers, almost invariably with milky latex, sometimes succulent and cactus-like; leaves usually opposite-decussate, rarely alternate or whorled.

gynostegium.

Eastern hemisphere
western hemisphere
in pollen in pollinia

Periploca - vine, old world - pollinia in tetrads held in "spoon"
Asclepias - in Mo.
Stapelia - cactus like (carrion odor) succulent
Matelea - in Mo. - vine
(Gonolobus)
Cynanchum laeve - vine in Mo.

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Order 3. Convolvulales.

Family 1. Convolvulaceae: Flowers bisexual, rarely dioecious by abortion, regular, hypogynous; sepals 5, rarely 4, usually free, the outer often somewhat largest, persistent; corolla gamopetalous, usually funiform and entire or slightly lobed, infrequently salverform or tubiform, induplicate-valvate and contorted; stamens 5-4, 2-celled, 5-4; disc usually present; pistil usually 2-carpellate, rarely 3-5-carpellate, cells equal to the carpels or incompletely divided, sometimes redivided by false septa, each carpel with 2 collateral, basal ovules, the style simple, rarely divided to the base; fruit usually a capsule with loculicidal dehiscence, sometimes circumscissile or indehiscent; seeds with cartilaginous endosperm, the embryo commonly with large, folded coyyledons. Commonly twining herbs, rarely parasitic, sometimes shrubby, rarely arborescent; leaves simple, alternate, without stipules, commonly lobed or divided.

Convolvulus - bindweeds sp. armenis.
Ipomaea
Calonictyon "moonvine" sp. aculeatum
Dichondra - sp. latifolia
Cuscuta -

Order 4. Tubiflorae: Flowers bisexual, very rarely polygamous by abortion, regular or more often irregular, hypogynous, rarely epigynous; stamens usually 4-2 by reduction, sometimes 5; pistil usually 2-celled, sometimes 3-5-celled, very rarely 1-celled with parietal placen tation. Usually herbs, rarely woody plants; leaves alternate or opposite, predominantly simple.

Suborder 1. Polemonineae: Flowers usually regular; pistil usually 3-celled with many-1 anatropous voules with inferior micropyle; fruit usually a loculicidal capsule.

Family 1. Polemoniaceae: Flowers bisexual, regular or slightly irregular; calyx 5-lobed, imbricate or valvate; corolla usually salverform or companulate, 5-lobed, the lobes usually regular, contorted;; stamens 5, inserted at various levels in the corolla tube, the anthers 2-celled; disc usually present; Pistil superior, 3-celled, rarely 2- or

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5-celled, the style terminal, filiform; ovules 1-many in each cell, sessile, anatropous; fruit usually a loculicidal capsule. Herbs, rarely shrubby, very rarely climbing; leaves usually alternate, sometimes opposite, simple and entire or divided, rarely compound, without stipules.

Phlox pilosa, divaricata, paniculata, bifida -
Polemonium - Jacob's ladder - pinnately divided leaves
Gilia
Cobaea - vine, tropics - of academ - large campanulate with
Bonplandia - corolla slightly bilabiate

Suborder 2. Boraginineae: Flowers usually regular in unilateral cymes; carpels 2; ovules many-2 in each carpel, anatropous with upwardly directed micropyle; fruit a capsule or drupe, or splitting into 4 1-seeded mericarps.

Family 2. Hydrophyllaceae: Flowers bisexual, regular, usually 5-merous, rarely pleiomerous; sepals united at the base, imbricate; corolla rotate, campanulate, or funiform, imbricate, seldom contorted; stamens 5, the filaments equal or unequal, scale-like appendages of the corolla frequently alternating with the stamens; pistil superior, usually 1- sometimes 2-celled, the style simple or 2, terminal; ovules many or few, sessile or pendulous, anatropous or orthotropous; fruit usually a loculicidal capsule; seed with fleshy or cartilaginous endosperm and small axial embryo, herbs or undershrubs; leaves entire or divided, alternate or opposite, without stipules.

Hydrophyllum with leaf-inflorescence in a dichasium
Phacelia -
Ellisia

Family 3. Boraginaceae: Flowers bisexual, regular, rarely irregular, hypogynous, 5-merous; sepals free or united below, imbricate or open; corolla tubular or funiform usually with a spreading limb, imbricate or rarely contorted, the lobes rarely unequal, the throat often with scale-like appendages; stamens 5, inserted equally or unequally; narrow hypogynous disc beneath the ovary; pistil superior, 2-carpellate, originally 2-celled but dividing into 4 1-ovuled mericarps by false septation; ovules erect, basal; style usually (gynobasic), rarely terminal; fruit usually of 4 nutlets,

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Subfamilies of Borag.

woody
1. Cordioideae - woody habit - style terminal, fr a dr.
2. Ehretioideae
3. Heliotropioideae
4. Boraginoideae - style basal gynobasic fr. of 4 nutlets

Cordioideae - style deeply 4 lobed, drupe has 1 stone, w/4 seeds.

Ehretioideae - 2 kinds of drupe (2 2-seeded stones, or 1 stone w/4 seeds. Style not deeply lobed, or w/2 styles.

Heliotropioideae - drupe w/4 stones. Style w/a hairy ring just below the style.

Boraginoideae - all herbs

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more rarely a 4-1-seeded drupe; endosperm usually absent. Herbs, infrequently shrubs or trees, usually bullate-hispid; leaves usually alternate, simple, without stipules.

1 Cordia
2 Ehretia
3 Heliotropium
4 Tournefortia
Mertensia
Myosotis
Cynoglossum
Lithospermum
Anchusa

Suborder 3. Verbenineae: Flowers usually medianly irregular; stamens usually 4-2; carpels usually 2, each with 2 anatropous ovules with downwardly directed micropyle; fruit usually dividing into 4 1-seeded mericarps or drupaceous.

Family 4. Verbenaceae: Flowers zyogmorphic, rarely actinomorphic, bisexual or polygamous by abortion; calyx campanulate or tubular, 5-4- rarely 6-8-parted; corolla tubular, often curved, with a 5-4-parted limb, rarely multifid, equal or more or less 2-lipped; stamens 4 and didynamous, or 2, rarely 5, 1-3 staminodes frequently present, the filaments free; hypogynous disc often inconspicuous; carpels 2, rarely 5, pistil 2-4-celled, rarely 4-5 carpels with an 8-10-celled ovary; style terminal; ovules 4 or several; fruit usually a drupe, sometimes 2 2-celled mericarps, rarely a capsule; endosperm present or absent. Herbs, shrubs, or trees; leaves usually opposite or whorled, simple or rarely compound, without stipules

Verbena
Lantana
Clerodendron
Vitex
Tectona

Family 5. Labiatae: Flowers bisexual, zygomorphic, hypogynous; Calyx campanulate or tubular, with free teeth or lobes, sometimes 2-lipped, persistent; corolla tubular, the limb variously bilabiate, imbricate; stamens usually 4 and didynamous, sometimes 2 with or without accompanying staminodes, anthers usually 2-celled; hypogynous disc usually fleshy; pistil 2-carpellate, soon 4-celled by a false septum with 1 erect basal ovule in each, the micropyle directed downward; style usually gynobasic, simple;

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fruit of 4 1-seeded nutlets enclosed within the persistent calyx; endosperm absent or scanty. Herbs or shrubs, very rarely small trees or climbers, usually with a 4-angled stem and volatile oil cells in all parts; leaves opposite and simple, without stipules; inflorescence frequently composed of vertillasters.

Teucrium
Rosmarinus
Scutellaria
Lavandula
Marrubium
Nepeta
Prunella
Lamium
Salvia
Thymus
Mentha
Coleus
Monarda

Suborder 4. Solanineae: Flowers usually medianly zygomorphic with 4 or 2 fertile stamens, sometimes regular with 5 fertile stamens; carpels usually 2, with indefinite ovules; fruit usually a capsule.

Family 6. Nolanaceae: Flowers bisexual, regular, hypogynous; calyx and corolla 5-merous, the latter funiform or campanulate; stamens 5, all fertile and equal; pistil 5-carpellary, divided into a longitudinal series of 5-10 segments, or transversely into 10-30 segments, each forming a 1-7-seeded mericarp usually with a stony endocarp; embryo curved and surrounded by endosperm. Herbs or shrubs; leaves alternate, simple, often fleshy.

Nolana

Family 7. Solanaceae: Flowers bisexual, regular or sometimes irregular, hypogynous, 5-merous; sepals persistent, often accrescent; corolla usually regular, sometimes irregular, rarely 2-lipped, usually plicate, sometimes convolute; stamens equal or unequal, sometimes 1 staminodial, anthers 2-celled, dehiscing by slits or pores; disc usually present; pistil 2-celled or 3-5-celled by false septa, the carpels usually oblique, the ovules usually numerous on swollen axile placentas, usually anatropous, the style simple, stigma 2-lobed; fruit a many-seeded capsule or berry; seeds often with a pitted testa, the embryo bent or straight, embedded in endosperm.

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Herbs, shrubs, or trees, with internal phloem; leaves various; inflorescence often extra-axillary.

Nicandra
Lycium
Atropa
Physalis
Capsicum
Solanum
Mandragora
Datura
Nicotiana
Cestrum
Petunia
Salpiglossis
Schizanthus
Solandra

Family 8. Scrophulariaceae: Flowers bisexual, irregular, hypogynous; calyx more or less deeply 4-5-parted; corolla medianly zygomorphic, frequently 2-lipped, imbricate; stamens usually 4, with or without a staminode, rarely 2 or 5 fertile; disc annular or unilateral; pistil 2-celled, rarely 1-celled, the carpels median, the ovules usually numerous on a thick axile placenta, anatropous; fruit a capsule, sometimes a berry; embryo straight or slightly curved, with endosperm. Herbs, sometimes parasites or hemiparasitues, sometimes undershrubs, rarely shrubs or trees, without internal phloem; leaves alternate, opposite, or whorled, without stipules.

Verbascum
Calceolaria
Linaria
Antirrhinum
Collinsia
Scrophularia
Pentstemon
Paulownia
Mimulus
Gratiola
Veronica
Digitalis
Gerardia
Pedicularis

Family 9. Orobanchaceae: Flowers bisexual, medianly zygomorphic, hypogynous; calyx 2-5-parted; corolla 2-lipped, 5-parted; stamens 4, didynamous; pistil 2-carpellate, rarely 3-carpellate, 1-celled with 2-6 parietal

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placentas; ovules indefinite, anatropous, the style terminal, simple; fruit a capsule dehiscing loculicidally; seeds minute, containing a few-celled undifferentiated embryo in oily endosperm, the testa pitted or rough. Parasitic herbs, usually without chlrophyll; leaves scalely.

Orobanche

Family 10. Gesneriaceae: Flowers bisexual, usually zygomorphic, hypogynous or somewhat perigynous; calyx usually 5-merous with short teeth, valvate; corolla rarely rotate and nearly regular, usually irregular and with a well-developed tube, often 2-lipped, imbricate; stamens usually 4, sometimes 2, didynamous, rarely 5; disc obvious; pistil usually superior, sometimes subinferior, 1-celled; ovules indefinite, anatropous, on parietal placentas; fruit a berry or a 2-4-valved capsule; seed small, endosperm present or absent, embryo straight. Usually herbaceous, some times slightly woody plants, erect or climbing by roots, frequently rather viscid-pubescent; leaves opposite, exstipulate.

Ramondia
Streptocarpus
Columnea
Achimenes
Sinningia

Family 11. Martyniaceae: Similar to Gesneriaceae, but fruit a horned capsule which becomes 4-celled by false septa; the outer layers of soft pericarp disintegrate leaving a horned, woody endocarp.

Martynia

Family 12. Bignoniaceae: Flowers bisexual, irregular, hypogynous; calyx usually 5-parted; corolla usually campanulate or funiform, irregular, sometimes 2-lipped, usually 5-lobed; stamens usually 4, with or without a staminode, didynamous, the anthers 2-celled, the cells usually superposed; hypogynous disc present; pistil 2-carpellary, usually 2-celled, infrequently 1-celled; ovules numerous, anatropous and usually erect on axile, rarely parietal, placentas; style terminal, simple; fruit usually

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Combd. leaves rare in sympetals.

Leaves may be (1. voluble (of Bignons).
2. adventitious roots
3. tendrils.

The interfascicular cambium does not develop, producing a mosaic of tissue.

a capsule dehiscing by 2 valves from the central septum, rarely more or less fleshy and indehiscent; seeds usually large and winged, endosperm absent. Trees or shrubs, often climbers, very rarely herbs often with anomalous stele; leaves opposite, usually compound, without stipules.

9 marvilles - genus of herbs.

Campsis radicans - trumpet vine - sometimes genus Tecoma.
Catalpa
Jacaranda
cauliflorum - Crescentia - calabash gourd - fruit a berry w/ pulpy endocarp - thy eugets.
Tabebuia.

Family 13. Lentibulariaceae: Flowers bisexual, irregular, hypogynous; calyx 5-parted, often 2-lipped; corolla 2-lipped, the lower saccate or spurred, 5-parted; stamens 2, anterior, 1-celled; pistil 2-carpellate, 1-celled, the numerous anatropous ovules borne on a free-central placenta, rarely only 2 ovules, the stigma sessile, unequally 2-lobed; fruit a capsule dehiscing by 2-4 valves, circumscissily, or irregularly; seeds usually small, without endosperm. Insectivorous herbs, often aquatic.

aspect of Scrophulariaceae

Dr. Barnhart - My Bot. Mod

J. E. Lloyd - auth. on insectivorous plants. Bull. Insectivorous Plants.

Utricularia - bladderwort - no primary root.
Pinguicula - Butterwort - leaves fold for insectivory - true roots/leaves
Dionaea - 2 valves fused.

Family 14. Acanthaceae: Flowers bisexual, medianly zygomorphic, hypogynous; calyx more or less deeply 5-, sometimes 3-4-parted; corolla irregular, often 2-labiate; stamens rarely 5, usually 4-2, with or without complementary staminodes, didynamous, usually 2-celled, the thecae often inserted at different levels, sometimes 1-celled, dehiscence usually longitudinal; disc usually present; pistil 2-celled, with 2-many, rarely 1, anatropous or amphitropous ovules, the style simple, usually long, the stigma 2-lobed, the posterior sometimes reduced; fruit usually a stalked, more or less compressed capsule with 4-many seeds usually supported by a retinaculum, rarely a drupe; endosperm usually absent. Herbs or shrubs, rarely climbing, very rarely trees; leaves opposite-decussate, simple, without stipules; cystoliths often present in epidermis or parenchyma of stem and leaves. gives the leaves a white mottling.

Unequal bilobing

Lindau - German auth. used characters of pollen
Pres. authority - E. C. Leonard - Smithsonian

Brennkanal in Salpa

(retinaculum - "ejaculator") - hooks

Testa of seeds forms tentacular processes which are adhesive.

Bracts often conspicuous.

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Acanthaceae

Acanthus - Medit. inflorescence is imitated for Corinthian column.

Thunbergia - includes vines. 'Black-eyed Susan' sp. grandiflora is vine w/ white corrug. flr.

Aphelandra

Ruellia - native, most strongly zygomorphic

Graptophyllum

Dianthera - Willdenbrook.

Justicia - largest genus.

~~Jacobinia~~

Strobilanthes - conspicuous bracts which give appearance of

V. large trop. family - usu. well-defined genera, poorly defined species -

best family character is (in addition to flr.) the intrapetiolar stipules.

Subfamilies

Cinchonoideae - 2 ovules in each cell

Coffeoideae - 1 ovule in " "

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Ruellia
Dianthera
Acanthus
Justicia
Thunbergia
Mendoncia

Family 15. Plantaginaceae: Flowers usually bisexual, regular, hypogynous, 4-merous; pistil superior, 2-carpellate, usually 1-celled with several to 1 ovule on a central placenta, rarely 2-celled or 4-celled through false septa; fruit a circumsicissile capsule or a 1-seeded nut; embryo straight, surrounded by fleshy endosperm. Usually scapose herbs, sometimes somewhat shrubby; leaves radical or alternate, without stipules.

Plantago
Litorella

Inferae: Flowers with inferior ovary.

Order 1. Rubiales: Flowers typically bisexual, regular or irregular, epigynous or somewhat perigynous, typically 4-5-merous; stamens isomerous with corolla or sometimes fewer, free; carpels usually 2-3, sometimes 4-5, the ovary inferior, sometimes subinferior, usually several-celled, infrequently 1-celled, with many-1 anatropous ovules.

Family 1. Rubiaceae: Flowers bisexual, rarely unisexual, regular, rarely irregular; calyx lobes usually open in aestivation, sometimes 1 or more enlarged and petaloid; corolla infundibuliform, salverform, tubular, or rotate, valvate, imbricate or contorted; stamens as many as the corolla lobes, free, anthers 2-celled; pistil surmounted by a disc, usually 2-celled, rarely 1-several-celled, the style filiform, sometimes 2-fid or multifid; fruit a capsule, berry, or drupe; seeds with a straight, rarely curved embryo at the base or in the axis of the endosperm. Shrubs or trees, sometimes herbs; leaves opposite or whorled, simple, with inter- or intra-petiolar stipules.

Houstonia
Rondeletia
Cinchona
Gardenia
Coffea arabica, liberica
Ixora
Psychotria
Galium
Rubia tinctorum - madder
Warscewiczia
Mitchella - Partridge berry

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Family 2. Caprifoliaceae: Flowers bisexual, regular or irregular, epigynous; calyx often greatly reduced; corolla usually 5-merous, regular or irregular; stamens free, 5-4; pistil inferior, usually 3-celled, sometimes 1-5-celled, the styles free or united; fruit a berry or 1-several-stoned drupe, rarely a capsule; seeds with fleshy endosperm and usually small, straight embryo. Usually woody plants, sometimes herbs; leaves decussate, usually simple, usually without stipules.

Genera:
- Sambucus
- Viburnum
- Lonicera
- Symphoricarpus
- Diervilla
- Linnaea
- Mitchella
- Triosteum

Family 3. Valerianaceae: Flowers bisexual or unisexual by abortion, irregular, epigynous; calyx an epigynous ring in flower, becoming enlarged and frequently pappus-like in fruit; corolla usually tubular and 5-lobed, often saccate or spurred at the base; stamens 1-4, free; pistil usually 3-celled, but only 1 fertile, and containing 1 pendulous anatropous ovule, the style simple, with a simple or 2-3-lobed stigma; fruit an achene crowned by the pappus as a rule; seed without endosperm, the embryo straight. Herbs, rarely shrubs; leaves opposite, simple or divided, without stipules.

Genera:
- Valeriana
- Valerianella
- Centranthus

Family 4. Dipsacaceae: Flowers small, bisexual, usually medianly irregular, epigynous, aggregated into dense involucrate heads, each flower enveloped by a persistent epicalyx formed of 2 bracteoles; calyx small, various; corolla usually irregular, tubular or tubular-funiform, 5-4-lobed, imbricate; stamens 4, sometimes fewer an accompanied by small staminodes; pistil 2-carpellate, but 1-celled, with a single apical, pendulous ovule, the style filiform, with stimple or 2-fid stigma; fruit an achene enclosed by the persistent epicalyx and often surmounted by the persistent calyx; seed with a straight embryo surrounded by endosperm. Herbs, rarely shrubs; leaves opposite, without stipules.

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cyphela — a dry indehiscent 1 celled fruit, from an inferior ovary as differentiated from caryopsis of gramineae from a sup. ovary - outlines

Phyllaries - involucral bracts - sometimes glabrous.
Bracts - chaff. may be simple, toothed or more.

Types of florets - ray (ligulate), tubular, and bilabiate.

Heads are homogamous - all florets perfect.
or heterogamous - not all florets perfect.
(usually disc florets perfect + ray florets are pistillate, or tube or + ray perfect, or tube perfect + ray neuter.

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most common in Eastern U.S. - Dipsacus sylvestris - "Cardin Teasel" - brought over by wool carders.
Scabiosa - garden plant, heads of lavender or white

Order 2. Campanulales: Flowers bisexual or unisexual by abortion, regular or irregular, epigynous; stamens more or less united by anthers or filaments, sometimes merely connivent; pistil inferior, rarely subinferior 1-several-celled.

Stalen - Synantherae
Synantherae - anthers fused by connivent

Family 1. Campanulaceae: Flowers usually bisexual, regular or medianly zygomorphic, epigynous, rarely somewhat perigynous, usually 5-merous; calyx usually open in aestivation, sometimes appendiculate at the base; corolla usually gamopetalous, rarely polypetalous, regular to 2-lipped, typically valvate; stamens free or united, the broadened filaments usually forming a chamber at the base; pistil inferior, rarely subinferior, 2-5-carpellate, usually 2-5-(rarely 6-10) celled, rarely 1-celled, the style simple, the stigma variously lobed which usually are appresse at anthesis; fruit a capsule, rarely fleshy and indehiscent; seeds usually small with fleshy endosperm and straight embryo. Herbs, rarely shrubs or trees, usually with articulated latex canals; leaves usually alternate, exstipulate.

Roger McVaugh - authority.
Campanulaceae - fls reg. + anthers free
Lobeliaceae - irreg. fl. + anthers connivent.

Campanulaceae fls regular
Lobeliaceae fls irregular
Campanula - deliniscence in valvate - garden plants "Canterbury Bells" of India
Specularia - Venus looking glass.
Jasione
Lobelia - latex canals. some - woody

Family 2. Compositae: Flowers (florets) aggregated into heads, usually sessile and subtended by scalelike bracts, or bracts absent, the head surrounded by an involucre; florets bisexual or unisexual (monoecious or dioecious), frequently differentiated into disc florets and ray florets, the latter pistillate or sterile; florets regular or irregular, the latter 2-lipped or ligular; calyx absent or represented by pappus, bristles, or scales, sometimes merely an apigynous ring; stamens isomerous, the filaments usually free, the anthers united, the connective usually prolonged; pistil inferior, 2-carpellate, 1-celled, with a single ascending anatropous ovule, the style simple, usually with 2-lobed stigma; fruit an achene (cypsela) often crowned by the persistent pappus, bristles, or awns; seed with straight embryo, without endosperm. Herbs or shrubs, rarely arborescent, frequently with latex or oil ducts; leaves usually alternate, without stipules.

Synsepal + most successful of fls.
Dutfan Oligomerous not recall.
head: capitulum - indeterminate, sessile reduced to 1 fl.
Receptacle of indiv. fl. reduced of capitulum comes flat or concave.
Eleiosis - single fl. in capit. each fl. has its own involucre.
Branching of inflorescence similar to other families, in fact the capitulum acts as an individual fl. (aggregated into endosynfon.
Florets may be homogamous (uniform) or heterogamous. ? or ♂
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Dim. of Cent.

Tubuliflorae — rarely have latex canals, but resin cells.

Liguliflorae (Ridd. Asteroideae) — all florets ligulate — all have latex canals in phloem — no resin canals.

Pappus — calyx of bristles, capillary, scales, sometimes 5 in no. When absent usually 2 or 3, (same)

(English — pappus could be merely hairs or thickness, with no morph. signif.)

Coker (Univ. of Kansas) says pappus just hairs. May be absent, or represented by ring.

Elongate leaf gaps in monocots causes the appearance of "scattered" vascular bundles. Bundles tend to be amphicribral. Endodermis much more frequent in monocots.

Reduction — 2, or 4

Separation ppd by John Ray

Endogen — interfascicular cambium (if any) outside of stele — exogen.

Endogen — monocots primitive because of fewer no. of parts

Later woody shows reduction — perhaps because of aquatic habit & wet families close to aquatic

Rendle's monocots easy sim. to Bentham & Hooker

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Liatris . copious pappus "Inverted"

Vernonieae — Vernonia — [illegible] stamens united sides of connective.

Eupatorieae — Eupatorium — entirely of disc florets, homogamous

Ageratum — [illegible] head, anthers basified, pappus bristle, stem short,

Aster — heterogamous fls - disc yellow, ray white

Solidago — ray fls numerous, ligule - anthers basified, pappus various

Asteroideae — Bellis - head solitary, summit infl.

Erigeron - fleabane

Baccharis - woody shrub.

Inuleae — Gnaphalium — resin, homogamous (usually) anthers base 2 tails

Leontopodium - Edelweiss

Helianthus

Tickweed — Bidens — heterogamous, disc perf., ray ♀, involucre dist. heterom. inner + outer involucre (caliculate)

Cosmos

Galinsoga — parviflora — flowers subt. by bracts or chaff. anthers basified, no tails. Pappus of 2-3 awns or scales.

Xanthium — cocklebur

Ambrosia — Ragweed (bur-podded sumac)

Zinnia

Heliantheae — Coreopsis

Dahlia

sneezeweed — Helenium — disc. ascent. ramose above, but no chaff.

Helenieae — Gaillardia — blanket flower

Tagetes - French marigolds

finely divided leaves — Anthemis - bitter weed — involucral bracts bear scarious margins

Chrysanthemum — ox-eyed daisy

Achillea - milfoil, yarrow

Artemisia - wormwoods, sages

Anthemideae — Tanacetum - Tansy, medicinal.

Senecioneae — Senecio - stinking Willy - Largest genus of fl. plants 2500 sp. — heads heterom.

Cineraria - grown [illegible]

Calendulaceae — Calendula - English marigold — heterogamous, but disc florets staminate.

Cirsium — American thistle — anthers tailed, pappus abs.

Burdy tarmont

Carduus — English — fls. not ligulate - bilabiate - mostly many series,

Cynareae — Centaurea — cornflower, bachelor's button, knapweed, — Receptacle of Hyleae increasing inward

Mutisieae — Gerbera - Hawaiian bilabiate

Cichorium - chicory

Lactuceae — Lactuca - lettuce — flowers all perfect, homogamous

Taraxacum - dandelion — latex, pappus borne on a stalk.

Hieracium - hawkweed

Cichoreae — Crepis

Tragopogon - goat's beard + artichoke - oyster plant

Wetstein's System:

MONOCOTYLEDONES: Flowers 3-merous or reduced; cauline stele scattered, closed; leaf venation parallel; radicle usually of very limited existence, early superceded by secondary or adventitious roots forming a fibrous system; cotyledons solitary.

(Alismales) (a swamp weed)

Order 1. Helobieae: Flowers unisexual or bisexual, regular, naked or with a simple or double perianth; stamens 1-indefinite; carpels 1-indefinite, superior and free, or inferior (Hydrocharitaceae); embryo large, with a prominent hypocotyl, endosperm absent. Aquatic and marsh herbs.

Family 1. Alismaceae: Flowers bisexual or unisexual, regular, hypogynous; perianth double, 3-merous, the calyx green or petaloid, sepals and petals free;

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Subf -
Butomoideae - 3 Gs hermaphrodite, fruit a follicle
Alismoideae - 3 Gs, unisex, mono or dioecious
unites, fr an achene

Aspec. Arber - Leaves of Monocots or stem structures which have become flattened.

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stamens 3-many; carpels 6-many, free, the ovule 1-many on axile placentas; fruit a head of achenes or follicles; seed with a large, usually bent embryo. Marsh and water plants usually with stout rhizomes, radical leaves, and large, compound inflorescences.

Butomus - Limnocharis - Alisma - Sagittaria

Family 2. Hydrocharitaceae: Flowers unisexual, regular, epigynous, associated with a spathe; perianth double, 3-merous, more or less differentiated into sepals and petals; stamens 3-merous, in 1-5 whorls, the inner whorl often staminodial; pistil inferior, 2-15-carpellate, 1-celled, with numerous ovules on parietal placentas; fruit leathery or fleshy, dehiscing irregularly. Aquatic herbs, floating or submerged.

Hydrocharis
Stratiotes
Vallisneria
Anacharis - Elodea

Family 3. Scheuchzeriaceae: Flowers bisexual, sometimes unisexual, regular, hypogynous; perianth double, 3-merous, sepaloid; stamens 6; carpels 6, free or united, the outer whorl usually sterile, each containing 1-2 anatropous ovules; fruit a schizocarp. Marsh herbs with narrow radical leaves and spicate or racemose inflorescence.

Triglochin

Family 4. Potamogetonaceae: Flowers unisexual or bisexual, regular, hypogynous; perianth usually absent, when present simple, sepaloid, of 4-1 tepals; stamens 4-1, the anthers sessile; carpels 4-1, free, with 1 pendulous, orthotropous ovule; fruit a drupe or achene. Aquatic herbs, usually submerged inflorescence racemose or sometimes solitary.

Potamogeton - pondweed - fresh water
Zostera
Ruppia
Zannichellia

Potamogetonaceae - European, fls. 3-merous, bracts petaloid. - sp. fenestralis, the net of veins is all that is left, the parenchyma is all gone giving a

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Separation between Polypetalæ + gamopetalæ doesn't hold in monocots.
Ebipetalæ not significant.

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Family 5. Najadaceae: Flowers unisexual, the staminate consisting of 1 terminal stamen enveloped in a close, saccate perianth, the whole enclosed in a bottle-shaped spathe, the pistillate consisting of a naked, 1-celled ovary with 2-3 stigmas and a single basal anatropous ovule, with or without an enveloping spathe; fruit a minute berry, the single seed with a large straight embryo. Small submerged water herbs with opposite, small, narrow leaves.

Najas

Family 6. Triuridaceae: Flowers unisexual, regular, hypogynous; perianth simple, petaloid, 3-9-parted; staminate flowers with 3-6, usually sessile anthers, more or less united at the base; pistillate flowers with numerous free carpels with basal styles, each containing 1 ovule. Small yellowish or reddish, "saprophytic" (mycorrhizal) herbs.

Triuris
Sciaphila

Order 2. Liliales: Flowers bisexual, rarely unisexual, usually regular, hypogynous to epigynous; perianth double, wholly petaloid or consisting of sepals and petals, rarely wholly sepaloid; stamens usually 6, rarely more or fewer; pistil superior to inferior, usually 3-carpellate and 3-celled, the few to numerous ovules anatropous; embryo surrounded by endosperm.

Family 1. Liliaceae: Flowers bisexual, rarely unisexual, regular, hypogynous, rarely slightly perigynous, predominantly 3-merous; perianth of 2 3-merous whorls, rarely 2-, 4-, or 5-merous, all petaloid, rarely all sepaloid or consisting of sepals and petals, free or more or less united; stamens nearly always as many as the perianth lobes; pistil superior, rarely subinferior, 3-carpellate, rarely 2-, 4-, or 5-carpellate, usually with as many cells and axile placentation, rarely 1-celled with parietal placentation; ovules anatropous; fruit a capsule or berry; endosperm oily or albuminous. Herbs, rarely shrubbry, climbing, or arborescent, usually from a bulb or rhizome; leaves alternate or whorled.

Melanthium
Veratrum
Colchicum
Anthericum
Hosta
Kniphofia
Aloe
Allium

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Convallaria
Agapanthus
Brodiaea
Lilium
Fritillaria
Tulipa
Scilla
Ornithogalum
Muscari
Yucca
Dracaena
Asparagus
Ruscus
Polygonatum
Aspidistra
Paris
Trillium
Ophiopogon
Sanseviera
Smilax

Family 2. Amaryllidaceae: Flowers bisexual, regular or medianly zygomorphic, epigynous; perianth petaloid, occasionally accompanied by a faucal corona, usually united into a long or short tube, rarely free, in 2 3-merous whorls; stamens epipetalous, 6, rarely in multiples of 6; pistil inferior, 3-celled, rarely 1-celled, placentation axile, rarely parietal fruit a capsule, rarely a berry; endosperm oily. Usually bulbous herbs with distichous radical leaves, rarely rhizomatous, shrubby, or arborescent, sometimes climbing

Galanthus
Leucojum
Amaryllis
Crinum
Eucharis
Hymenocallis
Narcissus
Agave
Alstroemeria
Hypoxis
Vellozia
Lycoris

Family 3. Iridaceae: Flowers bisexual, regular or medianly zygomorphic, epigynous; perianth of 2 3-merous whorls, the outer and inner sometimes of very different shape or position, more or less united into a tube; stamens 3; pistil inferior, 3-carpellate, 3-celled or 1-celled; ovules numerous as a rule, anatropous; style often with petaloid branches; fruit a capsule; endosperm oily or albuminous. Usually perennial herbs from rhizomes, corms, or bulbs, rarely shrubby; leaves usually equitant.

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Crocoideae
Crocus - Corm not equitant, spathe contains single leaf
Iris - Corm equitant, spathe in 2's
Sisyrinchium
Belamcanda - blackberry lily
Gladioleae
Gladiolus
Freesia

Family 4. Juncaceae: Flowers bisexual, regular, hypogynous; perianth inconspicuous, scarious or herbaceous, rarely somewhat petaloid, of 2 3-merous whorls; stamens 6, rarely 3, the pollen in tetrads; pistil 3-carpellate, 3-1-celled with axile or parietal placentation, the style simple, with 3 papillose branches; fruit a capsule; seeds small, the embryo straight in starchy endosperm. Grass-like, rhizomatous herbs with erect, unbranched stems; inflorescence cymose, usually monochasial.

Juncus - leaf sheath open, (grass), ovary 3-celled (1) ovules; seeds glabrous
Luzula - leaf sheath united, ovary 1-celled, 3 ovules; seeds pulpous

Family 5. Dioscoreaceae: Flowers unisexual, rarely bisexual, inconspicuous, regular, epigynous, 6-merous; perianth of 6 more or less united, equal, somewhat petaloid segments; stamens 6; pistil inferior, 3-carpellate, 3-celled with axile placentation, rarely only 1 cell fertile, or 1-celled with parietal placentation; ovules anatropous, usually 2 superposed on each placenta; fruit a capsule or berry, the capsule usually winged. Climbing plants, sometimes rather shrubby, from a thick, often tuberous rhizome; leaves usually alternate, often cordate and palmately veined; inflorescence a spike or raceme.

Dioscorea - yams

Family 6. Burmanniaceae: Flowers bisexual, regular, rarely irregular, epigynous; perianth usually united, of 2 3-merous whorls, the inner usually smaller, sometimes absent, petaloid; stamens 6-3, often with enlarged connective; pistil inferior, 3-carpellate, usually 1-celled, sometimes 3-celled; fruit a capsule; seeds minute, without endosperm, the embryo undifferentiated. Small herbs from corms or rhizomes, usually mycorrhizal saprohpytes, rarely autotrophic; inflorescence cymose, sometimes subcapitate.

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Hutchinson breaks Rosinosae into 4 orders, depending on characters of corolla -

1. Calyciflorae + Corolliflorae

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Burmannia
Thismia
Gymnosiphon

Order 3. Farinosae: Flowers bisexual or unisexual, regular or irregular, hypogynous, epigynous, or perigynous, 3-merous or rarely 2-merous; perianth petaloid, membranaceous, or scarious, free or united; stamens usually as many as the perianth segments, sometimes reduced; pistil superior to inferior, 3, rarely 2-carpellate, 3-1-celled with axile or parietal placentation; ovules usually orthotropous; endosperm copious, mealy; embryo mostly excentric.

Family 1. Bromeliaceae: Flowers bisexual, regular or slightly irregular, hypogynous to epigynous; perianth of 3 sepals and 3 petals, the lobes free or more or less united; stamens 6; pistil superior to inferior, 3-celled; ovules anatropous on axile placentas; style usually filiform with 3 stigmas; fruit a berry or capsule surrounded or crowned by the persistent calyx; seeds small, often comose; embryo small, near the hylum, surrounded by endosperm. Usually acaulescent herbs, often epiphytes with a close rosette of radical leaves, often with epidermal bloom; inflorescence spicate or paniculate, the bracts often brightly colored.

Billbergia
Ananas
Aechmea
Tillandsia

Family 2. Pontederiaceae: Flowers bisexual, usually medianly zygomorphic, hypogynous; perianth petaloid, united below, 6-parted, persisting in fruit; stamens 6-3, united to the perianth at different levels; pistil 3-celled with numerous anatropous ovules, rarely 1-celled or with but 1 ovule; fruit a capsule, rarely an achene, the embryo surrounded by endosperm. Herbaceous water plants, erect or floating, often with the leaf sheath inflated as air-bladders.

Pontederia
Heteranthera
Eichhornia

Family 3. Commelinaceae: Flowers bisexual, regular or irregular, hypogynous; perianth of 3 sepals and 3 petals, the petals equal or unequal, free or united at the base; stamens 6, all

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The seed of Commelinas - have an embryostegium & micropilar pit on opposite side of seed from hilum, the embryo sticking up in middle of pit, forming a little cone.

micropilar pit — cone

Wettstein - 2 orders, Ff grasses + sedges, because of 2 evolutionary trends.
Cyperaceae (Wats) are primitive, Graminae adv.
Some sedges have determinate (cymose) inflorescence.

O. Stapf Kew Bul. 1906 - good monograph of oil grasses - Cymbopogon - Cymbopogon -
Vetiveria - only oil from the ster Andropogon

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fertile and equal or unequal, free or united at the base; stamens 6, all fertile and equal or unequal, or 3 fertile with 3 staminodes, the filaments usually hairy; pistil superior, 3-2-celled, the ovules few, orthotropous; fruit a capsule, sometimes indehiscent, rarely a berry; seeds rather large and few, usually with a prominent micropylar pit, the embryo excentric to the endosperm, opposite the hilum. More or less succulent herbs with jointed stems and sheathing, alternate leaves; flowers in monochasial cymes.

6 stamens Tradescantia
w/staminodes 3 fert. " Commelina
3 " " Zebrina
3 " " Rhoeo

Family 4. Xyridaceae: Flowers bisexual, regular, hypogynous; perianth of 3 sepals and 3 petals; stamens 3 fertile, sometimes with 3 staminodes; pistil 3-carpellate, superior, 1-celled or 3-celled, with numerous (atropous or anatropous ovules on axile or central placentas; fruit a capsule. Small herbs with radical or equitant leaves; inflorescence racemose, sometimes condensed.

Xyris

Family 5. Eriocaulaceae: Flowers minute, unisexual, densely crowded into small involucrate heads, regular or medianly irregular, hypogynous, 2-3-merous; perianth of 2 2-3-merous whorls, free or united, hyaline or membranaceous, one or both whorls sometimes absent; stamens 6-2; pistil 3-2-celled, with a single pendulous ovule in each cell; fruit a small capsule; embryo small, excentric to the endosperm opposite the hylum. Small, usually tufted, more or less farinose marsh herbs with grass-like, radical leaves.

Eriocaulon

Order 4. Glumiflorae: Flowers bisexual or unisexual, hypogynous, small, naked or with scale-like or hair-like perianth, enclosed in scale-like bracts and forming large, compound, indeterminate inflorescences; stamens usually in 1, rarely 2, 3-2-merous whorls; pistil superior, 3-2-carpellate, 1-celled, with 1 basal or parietal ovule; fruit a caryopsis or nut.

Family 1. Gramineae: Flowers 1-several in spikelets, each subtended by a bract (fertile glume) and an opposite,

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Stigmas sessile.
Seed w/embryo to one side -
Cotyledon hypogeal.
Fruit of grass is Caryopsis -

Cyperoideae - fls perfect, spikelets many flowered, rhizelet indeterminate - fruit of sedges or bur-bills.

Rhynchosporoideae - Spikelet 2-many - 3-5 florets in rhizelet (compound cyme) hermaphrodite, monoecious or dioecious. Fruit a fea.

Caricoideae - fls. always imperfect, rhizelet indeterminate, fls naked, spikelets 1 flowered

Embryo median-basal.
Cotyledon emerges on germination.
In many Cyperaceae, the testa is separate from the pericarp.

Carex -

perigynium utricle rests.
It is sessile.

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Cymbopogon Schoenanthus – "Camel Hay"
confused with C. nardus – "citronella" – widely used
in perfume industries, soaps, insect repellent etc.
Cymbopogon martini – geranium oil grass – chief
source of rose scent.
Cymbopogon citratus – Lemon oil grass – usually
doesn't fl. – small area in trop. Africa, where fl. parts
used as perfume ingredient, beverage

Fl. of Trop. Africa – by Prain – Vol. 9, 1934.
Gramineae by O. Stapf.

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Genitals + N. grasses
Fl. + fruit breaking from pedicellate in
dist. the glumes

Tribes.

1 Subfam. - Festucoideae - spikelet laterally compress, glumes conduplicate
2 " - Panicoideae " lat. ventrally compl. " concavo-convex
Glumes stay on fruit. Bisexuate below
the glumes. Genitals + stripped grasses.

Tribe: Bambuseae - Thorny grasses.

Hordeae - infl a spike, distichous, spikes 1-2-3
at a node, sessile. Spikelets usually >1 flowered.

Festuceae - spikelets at least 2 fl, usually 5-15-20.
caming always from tip of lemma usually perf., inflor a panicle, glumes smaller (shorter) than 1st floret, as 1st floret to stand out from glumes; 83 genera.

Aveneae - glumes very long, enclosing florets
coming from middle or base of lemma otherwise same as Festuceae

Agrostideae - 1 flowered only, inflor a spike.
glumes short to long, w/ or w/o

Zizanieae - Monoecious, ♂ + ♀ in same inflor
Paniculate

Oryzeae - spikelets extremely flat,

Zoysieae -

Chlorideae - spikelets in 2 rows on same side of continuous rachis.

Paniceae

Paniceae - bisex. floret either ♂ or neuter, lower glume small or absent,

Andropogoneae - spikelets always in pairs, 1 pedicellate, 1 sessile, sessile spikelet usually ♂ or neuter

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Separation into subfamilies.

1. Based on reduction of fls.

A. Festucoideae - all fls perfect, 3 fls in each
retain four characters for separation.
Spikelets laterally compressed, lemmas + paleas + glumes folded.

B. Panicoideae - upper fl only perfect, lower reduced.
Only 1 seed per spikelet. Always 2 fls. / spikelet.
Good characters for separation.
Compression is dorsi-ventral + paleas, glumes etc. are flat.

Festucoideae	Panicoideae
Spikelet disarticulates above glumes,	Spikelet disarticulates below glumes + florets permanently attached to spikelet
Temperate + arctic tribes	Warm temperate + tropical plants

Tribes of Festucoideae
Traditionally 10 tribes, + half-a-dozen for anomalies

1. Bambusae, Festuceae, Hordeae, Avenae, Agrostideae, Chlorideae, Phalarideae, Zoysieae, Zizanieae, + Oryzeae.

Bambuseae - most primitive. 6 stamens, 3 lodicules. nearest approach to Liliaceae. woody, only perenial, very much branched, flower seldom, + in many cases die after flowering.
Arundinaria only genus native to U.S.
Separated by woody habit + flowers w/ liliaceous tendency.
Genera sep. by no. of fls., rel. size of glumes + lemmas, + on type of inflorescence.

Festuceae - 2-4 fls per spikelet, mainly in open panicles. Glumes short, florets extending Separation on awning of lemma, hairiness of rachilla.
Represent. Bromus (laterally flattened, stiffness from [illegible] Botanical Documentation, [illegible]

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between 2 teeth. All fls perfect.
Festuca - styles from top of ovary. Glumes short.
Poa - lemmas not awned, strongly keeled, webbed at base, provided w/ hairs. Nerves converge toward top of lemma
Eragrostis - 3 prominent nerves (doubtful in this tribe).

Hordeae - all cereals except oats + rice.
Separated by inflorescence - spikelets sessile on axis + always flat on axis.
Genera sep. on no. of florets at a node, glumes + or −.
Wheats - Triticum - 1 fl. at a node.
Elymus - 2 spikelets at a node.
barley - Hordeum - 3 " " "
Secale - spikelet edwise to rachis, inner glume suppressed. Hybridizes w/ festuca - doesn't belong here.

Aveneae - similar to Festuceae - 2-5 flowered, inflorescence panicles, glumes long, not short, at least as long as lowest lemma.
Separation on basis of no. of fls. (less than Festuceae.

Agrostideae - one fl. per spikelet, rachilla frequently prolonged beyond 1st fl. Large open panicles, spike like racemes.
Genera sep. on rel. size + text. of glumes, hairiness lemma hard, glumes soft.

Chloridoae - 1-5 fld. spikelets in 2 rows on 1 side of rachis.

Phalaridae - always 3 fls per spikelet, terminal one only perfect, the lower rather reduced.

Zoysieae - spikelets in groups of 2-5, at maturity, the whole group falling off.

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Zizanieae - monoecious, pistillate spikelets long + terete.
Oryzeae - glumes red. + obs., spikelet 1-fld. + extremely flattened.

Paniceae - separation into tribes:
1. Glumes membranaceous, lemma + palea of fert. fl. may be thinner than glumes Melinideae.
Lemmas of fertile floret indurate Paniceae.

2. Glumes indurate, essentially hyaline lemmas in fertile flr.
Andropogoneae - spikelets always in pairs, one fertile + sessile, the other pedicellate + ♂ or neuter.
Maydeae - spikelets unisexual, ~~neuter~~

Melinideae - small tribe (10 genera) confined to tropics. Not in port except. Melinus nudiflorus - a widespread pasture grass.
~~Tr~~ Trichloris rosea - " " .

Paniceae - 125 genera - separated by subtending bristles (red. branchlets) or not, whether spikelets sunken in rachis, or whether spikelets in racemes or panicles.
Always ♂ or ♀. Lemma hard + index or flexible.

Andropogoneae - glumes indurate, lemmas hyaline.
Sep. on whether both spikelets ♂ or not.
Subtending bracts + hairs.

Maydeae - sep. on spikelets in ~~separate~~ inflores or not.

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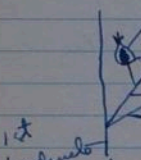
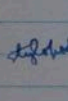
Cyperaceae - more closely allied to Liliales. 65-70 genera
Often have a definite perianth. 3-5000 sp.
Fls. bisex or monoecious, the ♂ above the ♀.
Cotyledon functional, leaves seed + becomes green.

Tribes
Scirpeae - Rhynchosporeae } fls. hermaphrodite.
Sclerieae Cariceae } unisex. fls.

Scirpeae - ~~fls~~ inflorescences (spikelets) many-flowered.
perigynium or utricle ♀ fl. of (one) spikelet + ♀ fl.



♀ fl surrounded by bracts, or perianth, called perigynium



Rhynchosporeae - fruit + ovary horn beneath the stylopodium, called a tuberle.
Spikelets 1-2 flowered.

Sclerieae - seeds very hard, achenes perfectly spherical, supported on a disc (gynobase)?

Cariceae - perigynium is charact. enlarges w/ fruit + is persistent in fr.

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2-keeled bracteole (Palea); petals typically 2, anterior, minute (lodicules); stamens usually in 1 3-2-merous whorl, sometimes with an inner whorl; pistil 1-celled, usually with 2 lateral stigmas; ovule 1, slightly campylotropous with micropyle downward, parietal on the ventral suture; fruit a caryopsis; embryo excentric at the base of the endosperm. Plants herbaceous, sometimes woody and arborescent, the stems jointed and frequently hollow; leaves distichous, with an open or closed sheath and an internal ligule at the conjuction of blade and sheath.

Panicoideae
- Maydeae
  - Zea
  - Coix
- Andropogoneae
  - Andropogon
  - Saccharum
  - Miscanthus – sugar cane
  - Erianthus – ornamental
- Paniceae
  - Panicum – inflo. a panicle
  - Paspalum – spikelets in 2's + rarely on 1 side of rachis
  - Digitaria – spike inflo. – crab grass
  - Setaria

Festucoideae
- Oryzeae
  - Oryza – rice
- Zizanieae
  - Zizania
- Agrostideae
  - Agrostis
  - Phleum – timothy
- Aveneae
  - Avena – oats
- Festuceae
  - Festuca
  - Phragmites
  - Dactylis
  - Poa – bluegrass
- Hordeae
  - Hordeum – Barley
  - Secale – Rye
  - Triticum – Wheat
- Bambuseae
  - Bambusa – fruit sometimes a nut or berry

Family 2. Cyperaceae: Flowers in the axil of a bract (glume), naked or with a perianth of scales, bristles, or hairs; stamens usually in 1 whorl of 3; pistil 3-2-carpellate, 1-celled, with a simple style with 3-2-feathery stigmas; ovule 1, basal, anatropous; fruit an achene or nut; embryo basal, surrounded by endosperm. Usually rhizomatous herbs with solid, (usually?) 3-angled stems; leaves usually in 3 rows, with a closed sheath, eligulate.

- Cyperoideae
  - Cyperus
  - Scirpus
  - Eleocharis – culms leafless
  - Eriophorum
- Rhynchosporoideae
  - Rhynchospora
- Caricoideae
  - Scleria
  - Carex – flower in a flask shaped bract "utricle", "perigynium"

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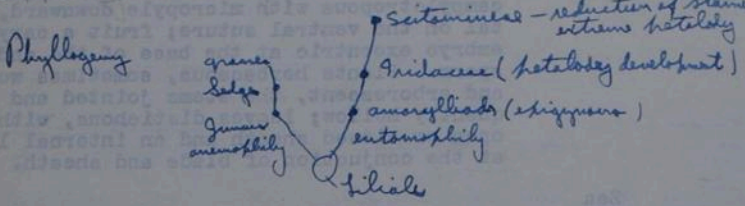
J + DC
B+H-E
W + Perr



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Order 5. Scitamineae: Flowers bisexual or rarely unisexual, irregular, epigynous; perianth of 2 3-merous whorls, more or less united, usually all petaloid, or the outer sepaloid; fertile stamen usually 1 and accompanied by varying petaloid staminodes, rarely 6-5, free; pistil inferior, 3-carpellate, usually 3-celled with many, rarely 1, ovules in each cell; style simple, stigma usually capitate; fruit a capsule or berry; endosperm small or absent, perisperm copious; embryo straight or curved. Usually large perennial herbs from stout rhizomes; leaves usually large, with a well-developed sheath.

Family 1. Musaceae: Flowers bisexual, rarely unisexual; fertile stamens 5, rarely 6; pistil 3-celled, usually with numerous anatropous, sometimes solitary and basal, ovules; fruit a capsule or berry; seeds often with an aril; perisperm mealy. Leaves without a ligule.

- Musa
- Heliconia
- Ravenala
- Strelitzia

Family 2. Zingiberaceae: Flowers bisexual; fertile stamen 1, staminodes 2-4, more or less united and petaloid; pistil usually 3-celled, rarely 1-celled, the style slender, lying in a channel of the fertile stamen; seeds usually arillate, with or without endosperm, mealy perisperm. Leaves with a ligular development of the sheath.

- Zingiber
- Hedychium
- Costus
- Alpinia
- Curcuma
- Renealmia

Family 3. Cannaceae: Flowers bisexual; androecium of a varying number of staminodes, one of which bears a half anther, the largest the "labellum"; pistil 3-celled, each with 2 rows of anatropous ovules, the style petaloid with an oblique stigma; fruit a warty or spinose capsule; seed with starchy perisperm.

Canna

Family 4. Marantaceae: Flowers bisexual; androecium of 2 whorls, the outer usually of 2-1 petaloid staminodes, sometimes suppressed, the inner whorl usually of 2 small hooded structures, plus a larger staminode bearing a half anther; pistil 3-celled or 1-celled by abortion, each cell bearing 1 anatropous ovule, the style

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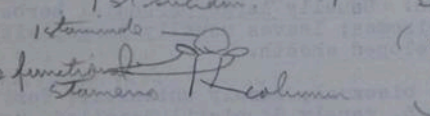
Theory that stamens form 2 staminal whorls from fact that 1 subdiv. of fam has 2 functional stamens + the other subdivision has 1 functional stamen.



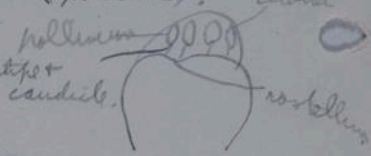
In 1st subdiv., the 2 functional stamens are in outer whorl, w/ 1 stamen absent, + the inner staminode represents inner whorl of stamens.

Vice versa for subdivision 2.

Anthers 2, 4, 8-celled, the 8-celled w/ granular pollen. If 2, or 4-celled, pollen in waxy masses (pollinia).

Orchidales are resupinate 180° twist.

Rostellum exudes a very viscid fluid



Sub-subfamilies resp. lacking anthers

Burtonieae - rostellum frequently a spike or spur, with anther absent, + without anther, pollinia (2) are erect. Caudicle is stalk or base of pollinia

Gland of pollinia is basal,

Actinidieae

Aceratoneae -

Subdivisions of Aceratoneae resp. on whether pollen is waxy or granular.

Polychondreae - granular pollen - small group

Rhoiphaereae - waxy pollen

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strongly developed, bent, with an oblique stigma-chamber; seed usually arillate, without endosperm. Leaves with a prominent pulvinus-like callus beneath the blade.

Maranta - arrowroot starch sf. arundinaceae.
Thalia - only one into SE Missouri - sf. dealbata
Calathea - longest genus of plants - has 3-celled ovary.

2-3 sp. - scarce all the way from SE MO. to Rio Plata in Paraguay.

Order 6. Microspermae. Reed includes Burmanniaceae, but. stuck off allies them to Amaryllidaceae

Family 1. Orchidaceae: Flowers bisexual or rarely unisexual, medianly zygomorphic, epigynous; perianth of 2 3-merous whorls, usually both petaloid, the median member of each usually differing from the lateral, particularly in the inner whorl where it forms the labellum; androecium and style usually concrescent (column); fertile stamens usually 1, rarely 2, accompanied frequently by staminodial lobes of the column; pollen usually united into pollinia of various forms, very rarely granular; pistil inferior, 3-carpellary, usually 1-celled, the numerous minute ovules on parietal placentas, stigmas 3 but usually only 2 receptive, the third sometimes being produced as the rostellum; fruit a capsule; seeds minute, without endosperm, the embryo undifferentiated,. Herbs of diverse habit, frequently with pseudobulbs, sometimes climbing, terrestrial or epiphytic; autotrophic, sometimes saprophytic mycorrhizal.

Mycorhizal fungi important in fertilization.

Odd member larger or smaller than the 2 lateral members

Genera of Orchids had 2 staminal whorls, + staminode of Orch in some species

Monandreae - 1 functional stamen
Diandreae - 2 functional stamen

pseudobulbs are enlargements of some internodes

Inflorescence in general is terminal

Diandreae
- Cypripedium - lady's slipper
- Selenipedium - long lateral petals (sometimes 4' long)

Monandreae
Basitonae
- Orchis - means testicle
- Habenaria - large genus - fringed
- Spiranthes - ladies tresses

Acrotonae
- Goodyera - Rattlesnake Plantain

Polychondreae
- Vanilla
- Liparis
- Corallorhiza - coralroot
- Masdevallia - sepals are conspicuous petals
- Pleurothallis
- Laelia
- Cattleya
- Epidendrum
- Calanthe - terrestrial
- Catasetum - unisexual "Monkey hood".
- Coryanthes - bucket orchid
- Dendrobium
- Bulbophyllum
- Cymbidium
- Maxillaria
- Oncidium - dancing girl orchids
- Vanda - good ones!

Karyotaceae

Often 2 sp. of diff genera

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Stamens - indeterminate, or in some cases Thyrso (mean axis indeter, but branches deter.)

Floral struct nearly same as Liliflorae

P. 3+3, S 1+5 (3+3)

cyclanthineae tetramerous, most distinct of all families

7-8 tribes of Palmaceae - dist by leaves.
Leaves ordinarily compd

cyclanthus - flo concurrent

Carludovica -

source of Panama Hats fibers

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Order 7. Arales: Flowers usually unisexual, frequently bisexual, small, crowded on a simple or branched spike or spadix, which is subtended by 1-several usually large bracts or spathes; perianth absent or dry or fleshy, never petaloid; stamens 1-many; ovary superior, sometimes inferior or subinferior (Cyclanthaceae), 1-3-celled; fruit various, never a capsule ; embryo usually minute, embedded in copious endosperm.

Family 1. Palmaceae: Spadix simple or compound; flowers usually small and unisexual; perianth inconspicuous, in 2 3-merous whorls; stamens 6, rarely 3; carpels 3, free or united into a 3- or 1-celled ovary; fruit a berry, drupe, or nut. Trees and shrubs, sometimes clabbering, with stout, usually unbranched stem ending in a crown of large, palmately or pinnately divided, sheathed leaves.

Phoenix
Sabal
Raphia
Roystonea
Cocos
Phytelephas

Family 2. Cyclanthaceae: Spadix simple; flowers unisexual; perianth of 4 inconspicuous sepaloid lobes, or absent; stamens 4-many; pistil inferior or subinferior and more or less sunken in the spadix axis, 4-2-carpellate, 1-celled, with 4-2-parietal placentas and numerous ovules, usually accompanied by conspicuous staminodes at anthesis; fruit a berry or fleshy syncarp. Shrubs or woody root-climbers of palm-like aspect, with palmately divided or 2-fid plicate leaves.

Cyclanthus
Carludovica

Family 3. Araceae: Spadix simple, often sterile and enlarged at the tip (appendix); flowers extremely variable, bisexual or unisexual, hypogynous; perianth absent, or present with 1-2 whorls of free or united segments; stamens 4-6 in 2 whorls, 2-3 in 1 whorl, or reduced to 1, filaments free or united, the anthers dehiscing by apical pores; pistil superior, 3-1 celled with great variety or placentation and number and position of ovules; fruit a berry. Herbs from rhizomes or corms, often climbing by adventitious roots, sometimes shrubby or arborescent, frequently epiphytic; leaves simple or divided, often very large, with or without stipules.

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Aroles + Pandanales make a good reduction series - with loss of floral organs
in Fam. of Aroles, have a bilabiate flower,

Pandanales sep from Aroles by following
1. Aroles - small + o cuspidate bract spike.
Pandanales (except Pandaneae) have larger bracts + axial position.
2. ♂ ♀ ♂s reduced in Pandanals.
3. No later alls in "
4. Diff in habit -

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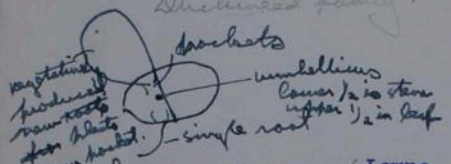
Dasyhalia - dumb cane
- 63 -
Sp calamus

Acorus
S. E. Asia —
Acrous - sweet flag - simplest fl. structure in family.
Monstera - largest inflorescence
Richardia (Calla)
Amorphophallus - largest known corm - stink of Rafflesia
Philodendron
Caladium - variated leaves - elephant ears
Arum - Eu
Arisaema - jack-in-the-pulpit
Pistia - water-cabbage - water plant
Pothos - represents only tribe that is shrubby

Family 4. Lemnaceae: Flowers unisexual, naked, the pistillate of a single 1-celled pistil with 1-6 basal, erect, orthotropous or anatropous ovules, the staminate of a single stamen, with or without a much reduced spathe (pocket); fruit a minute berry. Small floating water plants with minute dorsiventral thalloid shoot, roots present or absent.

Duckweed family.



Lemna
Spirodela
Wolffia - no root
Wolffiella
1 root
>1 root - to several roots
Largest in genus - looks like a liverwort
tongue like thallus shaped - plant body

Order 8. Pandanales: Flowers unisexual, naked or with simple and inconspicuous perianth, the staminate with 1-indefinite stamens and rarely a vestigial pistil, the pistillate with 1-indefinite carpels rarely associated with staminodes, flowers monoecious or dioecious but always aggregated separately in heads or spikes; seeds with copious endosperm.

Obliteration of bracteoles so that flo last completely
Chief tendency is complete loss of perianth.

Family 1. Pandanaceae: Flowers dioecious, usually naked; staminate flowers usually with indefinite stamens, forming a dense panicle or cluster of spikes; pistillate flowers of 1-indefinate carpels, naked and more or less connate usually in spherical heads subtended by a spathe-like bract, each carpel with a sessile stigma and 1-many anatropous ovules, sometimes associated with staminodes; fruit a syncarp, the carpels containing copious oily endosperm and a small basal embryo. Trees or shrubs, sometimes root-climbers, branching rarely; leaves spiral, persistent, narrow, spiny-margined.

Screw pines
Most elaborate in order, perhaps 12 genera
Distinguished by habit
Some have carpels also assoc with stamens + staminodes assoc with carpels.

Freycinetia - root climbers
Pandanus
Sararanga - has a slight perianth - carpels also associated with staminate fl.

Family 2. Sparganiaceae: Flowers monoecious in interrupted, globose heads on a geniculate peduncle, the lower pistillate and usually subtended by a more or less leafy spathe, the upper staminate and without spathes; staminate flowers with 3-6 narrow perianth lobes and 3-6 shortly filamented stamens with apically enlarged connectives; pistillate flowers

Burreeds -

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most have 1 carpel with ventral ovule from axis.

with 3-6 perianth lobes and a 1-3-celled pistil with 1-3 style branches; ovule 1 in each cell, pendulous, anatropous; fruit a 1-seeded drupe or nut; embryo straight in the axis of the endosperm. Water or marsh herbs with creeping rhizomes, erect or floating shoots, and distichous, entire, sheathing leaves.

Sparganium

Family 3. Typhaceae: Flowers monoecious, naked, aggregated in dense terminal, superposed spikes, the lower pistillate, the upper staminate; staminate flowers usually of 3, rarely of 1-7 stamens associated with simple or branched hairs or membranaceous scales; pistillate flowers of a small 1-celled ovary on a long gynophore bearing numerous filiform hairs, the slender terminal style terminating in a unilateral-fusiform stigma; ovule 1, pendulous, anatropous, parietal; fruit a tiny follicle disseminated by the hypogynous hairs and dehiscing longitudinally; seed with a mealy or fleshy endosperm and a straight embryo. Water or marsh herbs with extensive rhizomes bearing the flowering shoots and distichous, narrow, entire, sheathing leaves.

Cat-tails.

Typha

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tonyma - repetition of ~~the~~ generic name for specific name. American code

1753 - beginning date for binomials

G.R made descriptive the basis for

Synonym - another name for a plant.

Basionym - name bringing species

Electotype - no name originally selected as type, so some other author picks one as the type.

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