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Outlines
of
Classification of Plants,
by
D. P. Penhallow, B.Sc., F.R.S.C.,
Professor of Botany, McGill University,

Montreal:
E. M. Renouf, Publisher.
1895.
Entered according to Act of Parliament of Canada in the Year one thousand eight hundred and ninety five by D. P. PEMFALLOW, in the Office of the Minister of Agriculture.
OUTLINES OF CLASSIFICATION.

Synopsis.

Banch I.—Protophyta.

Class 1.—Myxogastres, (Slime Moulds.)

Orders—Peritrichaeae.

Colomeli}enae.

Lathodermeae.

Calothrichaeae.

Class 2.—Schizomyces, (Fission Fungi)

Orders—Myxinacereae.

Cystiphoreae.

Neumatogoneae.

From the nature of the organisms included in the protophyta, it is improbable that many of them will ever be found in the fossil state, although Renault claims to have recognized several species of bacteria in the tissues of carboniferous plants.

Branch II.—Thallophyta.

Class 3.—Ascomycetes, (Sac Fungi)

Orders—Perisporiaceae.

Tuberaceae.

Pyrenomycetaceae.

Discomycetaceae.

Uredineae.

Ustilagineae.

Saprolegnieae.

Melanomycetaceae.

Hyphomycetaceae.

Fossil representatives occur in the carboniferous and later formations, chiefly upon leaves and in lignite.

Class 4.—Ascomycetes, (Higher Fungi)

Orders—Gasteromycetaceae.

Hyphomycetaceae.

Fossil representatives occur in the carboniferous, 

Griffa laevigata, 

Gastromycetes fomosus, etc.

Class 5.—Chlorophyceae, (Green Algae)

Orders—Protochlorophyceae.

Conjugate.

Siphonaceae.

Confervaceae.

Fossil representatives, in the form of siliceous diatom valves, are especially abundant in the Tertiary and Quaternary, often forming extensive deposits known under the name of infusorial earth.

Class 6.—Phytophyceae, (Brown Algae)

Orders—Phaeophycaceae.

Dictyochaeteae.

Fucus.

The earliest fossil representatives of the brown algae occur in the Upper Silurian, whence they pass into the Lower Devonian. They appear in these early formations as plants of great size (Acrocladophyton), indicating that they must also have flourished at much earlier periods, but the remains of the vegetation which existed prior to the Upper Silurian are now represented only by a carbonaceous residue in the form of graphite. Phytophyceae are found more or less abundantly in all the later formations, and the genus Fucus is well defined in the Cretaceous.

Class 7.—Coleochaetes.

Order—Coleochnetaeae.

No fossil representatives known.

Class 8.—Rhophyceae.

Order—Florideae.

Fossil representatives from the Silurian upward, and especially abundant in the Cretaceous.

Class 9.—Charophyceae.

Order—Characeae.

Represented by many species in the Lower Cretaceous in the Tertiary and Quaternary.
### Branch III.—Bryophyta.

**Class 10.**—**Hepaticae.**
- Orders—Jungermanniales, Ricciaceae, Anthocerotaceae, Marchantiaceae.

Fossil representatives found only in recent formations—Tertiary and Quaternary. *Archaeopteris.*

**Class 11.**—**Musci.**
- Orders—Sphagnaceae, Andreaeaceae, Phasaeaceae, Bryaceae.

Fossil representatives found only in the Tertiary and Quaternary. *Gymnosporangium, Sphagnum, Hypnum.*

### Branch IV.—Pteridophyta.

**Class 12.**—**Filicales.**
- Orders—Filices, Salviniales, Marsiliaceae, Ophioglossaceae, Marattiaceae.

Fossil representatives numerous from the Devonian (*Psilops, Neuropteris, Sphenopteris, etc.*) through the Carboniferous to recent formations.

**Class 13.**—**Equisetales.**
- Orders—Equisetaceae, Calamites, Annuliferae, Asterothallaceae.

Fossil representatives numerous from the Devonian (*Calaites, Asterophyllum, etc.*) and throughout the Carboniferous.

### Branch V.—Spermatophyta.

**Class 14.**—**Gymnospermae.**
- Orders—Cycadales, Coniferales, Taxales, Gnetales.

Fossil representatives very numerous from the Devonian (*Dadoxylon, Cordaites, etc.*) and through the Carboniferous and more recent formations.

**Class 15.**—**Angiospermae.**
- Sub Class 1.—Monocotyledons.
- Sub Class 2.—Dicotyledons.

Orders numerous.

Fossil representatives are very numerous as leaves, lignite, etc., from the Permian upward, becoming more numerous in recent formations.
Branch I—Protophyta.

Unicellular Plants often forming more or less extensive gelatinous plasmodia by confluence.

Class I.—Mycoblastes.
(Slime Moulds.)

Orders.
1. Peritriches.
2. Columelliferae.
3. Cathodermes.
4. Calotriches.

Asexual reproduction predominant.

Saprophytic plants devoid of a cell wall except in the spores. Reproduction through ameboid swarm spores, asexual by simple fission, or sexual (?) (Goebel) by conjugation and the formation of plasmodia, from which asexual spores arise.

Class II.—Schizophyceae.
(Fission Fungi.)

Orders.
1. Myxobacteriales.
2. Cystiphora.
3. Nematogae.

Asexual reproduction predominant.

Parasitic or saprophytic plants, sometimes forming gelatinous plasmodia. Reproduction wholly asexual by simple division of a mother cell, more rarely by endogenous spore formation.
**BRANCH II.—Thallophyta.**

Unicellular or multicellular plants, the latter often with a stem-like habit of growth.

Sexual generation predominant.

<table>
<thead>
<tr>
<th>III. Ascomycetes. (Sac Fungi.)</th>
<th>IV. Basidiomycetes. (Higher Fungi.)</th>
<th>V. Chlorophyceae. (Green Algae.)</th>
<th>VI. Phaeophyceae. (Brown Algae.)</th>
<th>VII. Coelorhizidae.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orders.</strong></td>
<td><strong>Orders.</strong></td>
<td><strong>Orders.</strong></td>
<td><strong>Orders.</strong></td>
<td><strong>Orders.</strong></td>
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<tr>
<td>5. Uredines.</td>
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<tr>
<td>6. Ustilaginaceae.</td>
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<tr>
<td>7. Sphacelopsis.</td>
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</tr>
<tr>
<td>8. Melanconiales.</td>
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</tbody>
</table>

Asexual reproduction commonly predominant

<table>
<thead>
<tr>
<th></th>
<th>Sexual reproduction often by conjugation with the formation of Zygospores. Asexual reproduction predominant</th>
<th>Reproduction wholly sexual in Fucaceae, asexual in Phaeosporeae and Dictyota.</th>
<th>Asexual reproduction by swarm spores often predominant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>II. Archicarps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No clearly defined sexual reproduction known.

<table>
<thead>
<tr>
<th>III. Oospores (Ovum).</th>
<th>III. Oospheres (Ova).</th>
<th>III. Oospheres (Ova).</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x IV. Oospor.</td>
<td>1 x IV. Oospore.</td>
<td>1 x IV. Oospore.</td>
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<tr>
<td>2 x IV. Oospor.</td>
<td>2 x IV. Oospore.</td>
<td>2 x IV. Oospore.</td>
</tr>
<tr>
<td>3 x IV. Oospores.</td>
<td>3 x IV. Oospore.</td>
<td>3 x IV. Oospore.</td>
</tr>
<tr>
<td>4 x IV. Spores.</td>
<td>4 x IV. Oospore.</td>
<td>4 x IV. Oospore.</td>
</tr>
<tr>
<td>5 x V. Swarm-spores</td>
<td>5 x V. Swarm-spores.</td>
<td>5 x V. Swarm-spores.</td>
</tr>
</tbody>
</table>
**Branch III - Bryophyta**

Colar plants with roots, epidermis and stomata, often with leafy stems.

Sexual generation predominant.

<table>
<thead>
<tr>
<th>X. Hepaticae</th>
<th>M. Musciæ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>Order</td>
</tr>
<tr>
<td>1. Jungermanniaceae</td>
<td>1. Sphagnaceae</td>
</tr>
<tr>
<td>2. Ricciaceae</td>
<td>2. Andreaeae</td>
</tr>
<tr>
<td>3. Anthocerotaceae</td>
<td>3. Phaseaceae</td>
</tr>
<tr>
<td>4. Marchantiaceae</td>
<td>4. Bryaceae</td>
</tr>
</tbody>
</table>

**Notes.**

As sexual reproduction often predominant by means of simple separation of the vegetative axis, by adventitious shoots or by gemmae.

1. Perfect plant \( \gamma \) or \( \delta \)
2. Anthaxia
3. Spermatozoids motile
   - Oogonium
   - Oosphere (Ovum)
   - Archegonium
   - Oosperm (Ovum)

4 x IV. Oospore
5 x V. Embryo rudimentary
6 x VI. Spermatium parasitic upon the sexual generation
7 x VII. Sperm with elaters
8 x VIII. Protonema
### XII.—Pteridophyta.
(Ferns)

| A. Leptosporangiate. | B. Eusporangiate. 
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Homosporous.</td>
<td>3. Homosporous.</td>
</tr>
<tr>
<td><strong>Orders.</strong></td>
<td><strong>Orders.</strong></td>
</tr>
<tr>
<td>1. Filices.</td>
<td>1. Ophioglossaceae.</td>
</tr>
<tr>
<td>Asexual reproduction wholly subordinate; when present, chiefly by extension and division of the main axis, more rarely by bulbs, or by stoloniferous fronds, or even by apogamy.</td>
<td>2. Marsiliaceae.</td>
</tr>
</tbody>
</table>

### XIII.—Equisetinae.
(Horse-tails)

<table>
<thead>
<tr>
<th>Homosporous.</th>
<th>Heterosporous.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orders.</strong></td>
<td><strong>Orders.</strong></td>
</tr>
<tr>
<td>1. Equisetaceae.</td>
<td>1. Annularia.</td>
</tr>
</tbody>
</table>

Represented by sil forms only. Succession as in heterosporous ferns.
**Phyla.**

Sphenophyta.

<table>
<thead>
<tr>
<th>XIV. Sphenophylaeae</th>
<th>XV. Lycophyta (Club Mosses)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heterosporous.</strong></td>
<td><strong>Homosporous.</strong></td>
</tr>
<tr>
<td>Order</td>
<td>Order</td>
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</tbody>
</table>

Asexual reproduction subordinate, by means of axillary buds, or by lateral budding of underground tubers.

<table>
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<th>XIV. Sphenophylaeae</th>
<th>XV. Lycophyta (Club Mosses)</th>
</tr>
</thead>
<tbody>
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Asexual reproduction predominant.

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</tr>
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<td>Order</td>
<td>Order</td>
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</table>

Asexual propagation subordinate, by division of the main axis, rarely by apogamy.

Referred by fossil remains. The succession as in the Heterosporous Lycophyta.
**Branch V. - Spermaphyta.**

True seed plants.

Sexual generation very subordinate, in the Dicotyledons becoming almost completely suppressed with respect to the general structure.

**XVII. - Gymnospermae.**

Carpels open, seeds naked.

Heterosporous; prothalli two.

Orders.
1. Cycadaceae.
2. Coniferae.
3. Taxaceae.
4. Gnetaceae.

Asexual propagation subordinate; sometimes by tubers.

1. Prothallus rudimentary. (Endosperm), formed before impregnation; parasitic upon the asexual generation.

2. Antheridium rudimentary. (Pollen tube.)

3. Spermatozooids none. (Protoplasm of the antheridium.)

4. Archegonium well formed.

5. Oosperm (Ovum or Germ cell.)

6. Oospore.

7. Suspensor.

8. Embryo with 2 to several cotyledons.


10. Anthophylla.

11. Trophophylla (Anthers.)

12. Microsporangia (Ovules.)

13. Tapetum.

14. Macrosperm (Embryo sac.)

15. Oospore (Embryo sac.)

16. Suspensor.

17. Embryo with two cotyledons.

18. Normal plant.


20. Antheridium rudimentary. (Pollen tube.)

21. Spermatozooids none. (Protoplasm of the antheridium.)

22. Archegonium not formed.

23. Oosperm (Ovum or Germ cell.)

24. Oospore.

25. Suspensor.

26. Embryo with one cotyledon.

27. Normal plant.


29. Microsporangia (Anthers.)

30. Microspores. (Pollen.)

31. Macrosperma (Embryo sac.)

32. Oospore (Embryo sac.)

33. Suspensor.

34. Embryo with two cotyledons.

35. Normal plant.

36. Stamens.

37. Microsporangia (Anthers.)

38. Microspores. (Pollen.)

39. Macrosperma (Embryo sac.)

40. Oospore (Embryo sac.)

41. Suspensor.

42. Embryo with one cotyledon.

43. Normal plant.

44. Stamens.

45. Microsporangia (Anthers.)

46. Microspores. (Pollen.)

47. Macrosperma (Embryo sac.)

48. Oospore (Embryo sac.)

49. Suspensor.

50. Embryo with two cotyledons.

51. Normal plant.

52. Stamens.

53. Microsporangia (Anthers.)

54. Microspores. (Pollen.)

55. Macrosperma (Embryo sac.)

56. Oospore (Embryo sac.)

57. Suspensor.

58. Embryo with one cotyledon.

59. Normal plant.

60. Stamens.

61. Microsporangia (Anthers.)

62. Microspores. (Pollen.)

63. Macrosperma (Embryo sac.)

64. Oospore (Embryo sac.)

**Notes.**

XVI. - Angiospermae.

Carpels forming closed seed vessels.

Heterosporous, the rudimentary prothalli often wanting.

1. Monocotyledons.

Orders numerous.

Asexual propagation subordinate, rarely wholly replacing the sexual; varied, by means of runners, stolons, offsets, bulbs, suckers, tubers, and rarely by parthenogenesis.