

Laboratory 3: Lycophytes and Eusporangiate Ferns

This week in lab we will be examining material from the two earliest extant lineages of tracheophytes: the **Lycophytes** (containing the club mosses, spike mosses, and quillworts) and the **Pteridophytes** (containing the ferns and “fern-allies”). This time we will cover the lycophytes and the eusporangiate ferns (the basal members of the Pteridophytes); in the next lab we will cover the leptosporangiate ferns (for a distinction between eusporangiate ferns and leptosporangiate ferns, see table at end of this lab). We will see the move from **microphylls** (reduced leaves with a single vein, also called “lycophylls”) to **megaphylls** (larger leaves with multiple veins, also called “euphylls”), as well as one of the origins of **heterospory** in green plants.

• For this lab and the remainder of the labs, the goal is to learn the plant groups to the **family level** – do not concern yourself with learning genus or species names. Common names are sometimes helpful for memorization, but you will need to know only the **Latin family names**. For each family, distinctive traits are listed, followed by several representative genera. Be sure to examine all plants carefully as you will only get one lab period in which to do so. Additional information on these families is available on pages 77-87 in the Simpson textbook.

LYCOPHYTES

Lycopodiaceae – Club Moss Family (3 genera / ~380 species): **homosporous**; microphyllous leaves; only primary growth, no ligules present.

Huperzia

Lycopodium

Selaginellaceae – Spike Moss Family (1 genus / ~700 species): **heterosporous**; microphyllous leaves, often **dimorphic**; **ligule** present; only primary growth.

Selaginella

Isoetaceae – Quillwort Family (1 genus / ~150 species): **heterosporous**; microphyllous leaves; **ligule** present; cormose stem, aquatic or terrestrial; **limited secondary growth**.

Isoetes

PTERIDOPHYTES: PART I – EUSPORANGIATE FERNS

Psilotaceae – Whisk Fern Family (2 genera / ~17 species): **homosporous**; **eusporangiate**; microphyllous leaves in *Tmesipteris* or enations (poorly defined leaves, possibly highly-reduced lateral stems) in *Psilotum*; **sporangia 2-3 chambered**, subtended by forked sporophylls (spore bearing leaves); true roots lacking (anchored by stems); usually epiphytic, and often with mycorrhizal associations; dichotomously branched (in *Psilotum*); gametophyte subterranean and non-photosynthetic.

Psilotum

Tmesipteris

Ophioglossaceae – Adder's-tongue Family(3 genera/ ~80 species):

homosporous; eusporangiate; true roots present, but lacking root hairs; gametophytes bisexual and non-photosynthetic; **fertile fronds divided into fertile and sterile segments; stipe fleshy, sori embedded in tissue of the fertile spike**; terrestrial or epiphytic, often with mycorrhizal associations.

Ophioglossum

Botrychium

Equisetaceae – Horsetail Family(1 genus/ ~15 species): **homosporous** (some extinct forms possibly heterosporous); leaves reduced and **scale-like in a whorl** at each node; stems jointed; mostly primary growth (secondary growth in some); sporangia produced on sporangiophores organized into a terminal strobilus, sometimes on separate, unbranched stems.

Equisetum

Marattiaceae (4 genera/ ~600 species): – **Homosporous; eusporangiate** with sporangia united into **synangia** or $\pm$ free in *Angiopteris*; fleshy **stipules** present; **rachis often with swollen nodes (pulvini)**; fronds can reach up to 8 m in length.

Marattia

Angiopteris

Danaea

Christensenia

Eusporangia

Arise from several initial cells

Sporangium wall more than one cell layer thick

Produce many spores (generally 100+ spores per sporangia)

Various dehiscence mechanisms, no annulus

Leptosporangia

Arise from a single initial cell

Sporangium wall composed of only a single layer of cells

Produce fewer spores (generally 64 or fewer per sporangia)

Specialized dehiscence mechanism, typically with annulus



Fig. 40. LYCOPODIACEAE. A, *Lycopodium lucidulum*: Aa, fertile branch, $\times \frac{1}{6}$; Ab, branch tip, vertical section showing sporangia, $\times 1$. B, *L. obscurum*: Ba, fertile branches, $\times \frac{1}{4}$; Bb, portion of strobilus in vertical section, $\times 5$; Bc, sporophyll and sporangium, $\times 5$; C, *L. clavatum*: fertile and sterile branch, $\times \frac{1}{4}$.

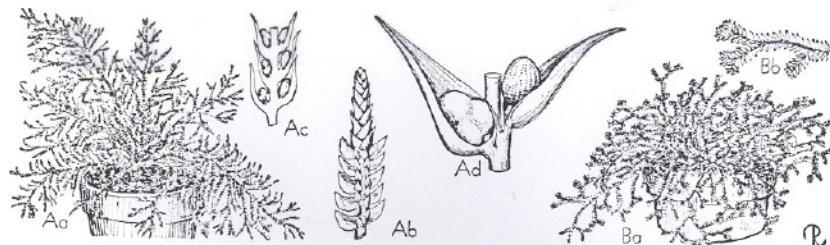


Fig. 41. SELAGINELLACEAE. A, *Selaginella pallescens*: Aa, habit of plant, $\times \frac{1}{10}$; Ab, branch tip, $\times 2$; Ac, fertile branch, vertical section, $\times 3$; Ad, same, showing megasporangium (left) and microsporangium (right), $\times 10$. B, *Selaginella Kraussiana*: Ba, habit of plant, $\times \frac{1}{10}$; Bb, branch tip, $\times 1$. (From L. H. Bailey, *Manual of cultivated plants*, The Macmillan Company, 1949. Copyright 1924 and 1949 by Liberty H. Bailey.)

ISOETACEAE. QUILLWORT FAMILY

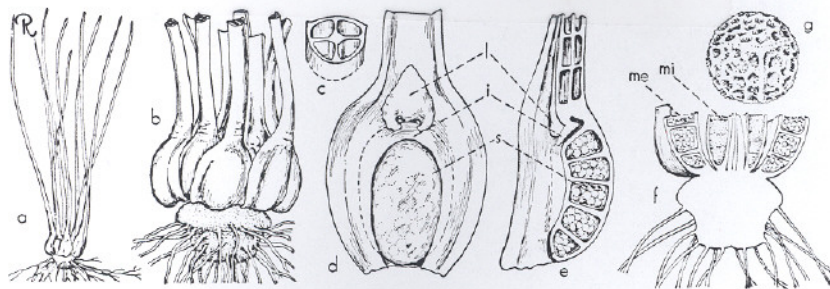


Fig. 43. ISOETACEAE. *Isoetes Engelmannii*: a, plant, habit, $\times \frac{1}{4}$; b, corm, with attached leaf bases, $\times 1$; c, leaf, cross-section, $\times 8$; d, leaf base, central side, $\times 3$; e, leaf base, vertical section, $\times 3$; f, corm with portion of leaf bases, vertical section, $\times 1$; g, megaspore, $\times 20$. (i, velum; l, ligule; me, megaspores; mi, microspores; s, sporangium.)

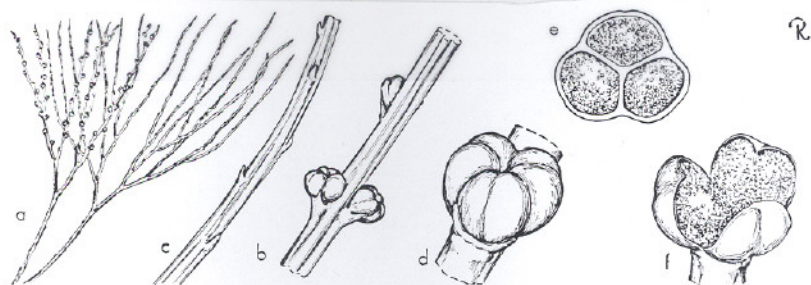


Fig. 42. PSILOTAEEAE. *Psilotum nudum*: a, fertile and sterile branches, $\times \frac{1}{8}$; b, fertile branch node with sporangia, $\times 2$; c, sterile branch portion with leaves, $\times 2$; d, sporangium, $\times 6$; e, same, cross-section, $\times 6$; f, sporangium dehiscent, $\times 6$.

EQUISETACEAE. HORSETAIL OR SCOURING RUSH FAMILY

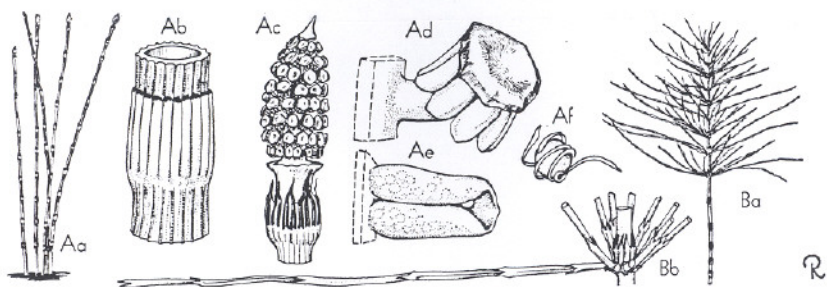


Fig. 39. EQUISETACEAE. A, *Equisetum hyemale*: Aa, fruiting stems, $\times \frac{1}{8}$; Ab, stem section, at node, $\times 3$; Ac, strobilus, $\times 1\frac{1}{2}$; Ad, sporangiophore, $\times 10$; Ae, sporangium, $\times 20$; Af, spore with elaters, $\times 80$. B, *E. arvense*: Ba, sterile stem with branches, $\times \frac{1}{6}$; Bb, node, with leaves and lateral branch, $\times 1$.

MARATTIACEAE. MARATTIA FAMILY



Fig. 45. MARATTIACEAE. *Marattia alata*: a, frond pinna, $\times \frac{1}{4}$; b, pinnule with sori, $\times 3$; c, sorus, $\times 7$; d, sorus in sectional view, $\times 12$. (c-d redrawn from Bauer.)

(Figures from Lawrence. 1951. Taxonomy of Vascular Plants)

OPHIOGLOSSACEAE. GRAPEFERN FAMILY

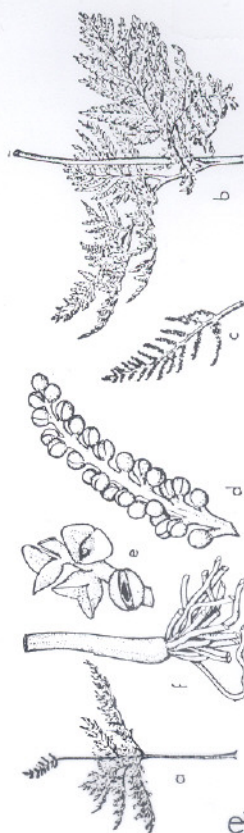


Fig. 44. OPHIOGLOSSACEAE. *Botrychium virginianum*: a, habit, $\times \frac{1}{10}$; b, sterile fronds, $\times \frac{1}{4}$; c, fertile frond, $\times \frac{1}{4}$; d, fertile pinna, $\times 2$; e, sporangia, $\times 6$; f, rootstock, $\times \frac{1}{2}$. (From L. H. Bailey, *Manual of cultivated plants*, The Macmillan Company, 1949. Copyright 1924 and 1949 by Liberty H. Bailey.)

Glossary: Lycophytes and Eusporangiate Ferns

Definitions from Simpson (2006), Plant Systematics

elater: one of the hygroscopic (=absorbing moisture from the air) appendages arising from the spores of *Equisetum*, functioning in spore dispersal

enation: a small appendage arising from the stem, resembling a rudimentary leaf but lacking vascular tissue, *e.g.* in *Psilotum*

eusporangium: a relatively large **sporangium** that is derived from several epidermal cells and having a sporangial wall composed of more than one cell layer

heterospory: the formation of two types of haploid spores, microspores and megaspores

homospory: the formation of one type of haploid spore

ligule: a small appendage on the upper (adaxial) side of the leaf, near the leaf base, found in the Selaginellaceae and Isoetaceae

megaphyll (=euphyll): the sporophytic leaf of the euphyll group, growing by means of either marginal or apical meristems, having multiple, branched veins, and having an associated leaf gap

microphyll (=lycophyll): the sporophytic leaf of the lycophytes, characterized by an intercalary meristem, having a single vein, and lacking a gap in the vasculature of the stem

pulvinus: the swollen base of a stem, *e.g.* in Marattiaceae

sporangiphore: a unit of the **strobilus** of the Equisetales, consisting of a peltate axis bearing pendant (ancestrally recurved), longitudinally dehiscent sporangia

sporangium (pl. sporangia): the spore-producing organ of the sporophyte

sporophyll: a specialized leaf that bears one or more sporangia

strobilus (pl. strobili) (=cone): a modified, determinate, reproductive shoot system, consisting of a stem axis bearing **sporophylls**

synangium: a fusion product of two or more sporangia, *e.g.* in the psilophytes and some marattioid ferns