Sub-Guide to Rarely Branched (mostly acrocarpous) Mosses of the West Coast

Revised through 27 January 2010

Reminder: A dagger (†) indicates that not all of the species within the given genus have the character(s) defining that Group. Abbreviations for the distribution of taxa are found at the end of the Concordance. Abbreviations for the number of stereid bands in costa cross sections are found in the Introduction and at the end of this section.

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**Group A1 – Shoots flat or angular, not round**

Shoots flattened; leaves 2-ranked (lying in one plane).

Leaves distichous (attached in two rows on opposite sides of the stem).

Leaves clef at anterior edge and clasping posterior edge of next leaf; WS

Leaves conduplicate, crowded, and progressively larger; the “Sword” moss; WS*

Leaves flat, decurrent and confluent; protonemata luminous; “Goblin Gold”; WS*

Leaves needle-like; a roughened subula from a sheathing, shiny-white base; WS

Leaves complanate (attached all around the stem, but twisted into one plane).

Leaves with a long, single costa; cells smooth.

Leaves distant on stoloniferous shoots and bordered by linear cells; WS

Leaves crowded, unbordered and undulate; capsules plicate (dry); E

Shoots triangular; leaves 3-ranked.

Plants minute with immersed capsules; leaves broadly ovate with recurved apiculi; WS

Plants larger with exserted capsules; leaves ovate lanceolate, squarrose and decurrent.

Cells short and strongly papillose; plants on dry soils; CA

Cells intermediate and smooth; in calcareous wetlands.

Capsules with well-defined neck; endostome longer than exostome; N

Capsules short & black (golf clubs); endostome reduced to lacking; N

Stems densely tomentose; leaves squarrose recurved; in calcareous wetlands; N

Stems smooth; leaves crowded and appressed; on soil near rocks; A/A

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**Group A2 – Shoots julaceous when wet**

Stems red.

Stems freely forked; plants whitish; capsule necks extremely long; A/A, W

Stems sparsely forked; capsule necks mostly short to moderate in length.

Cells long (~8:1); N*

Cells intermediate (~4:1).

Upper leaves abruptly acuminate; capsules erect; peristome single; NW

Upper leaves apiculate; capsules pendent; peristome double; WS

Stems green.

Cells unipapillose and stellate; leaves concave-cucullate; A/A.

Cells prorulose; leaves 5-ranked and serrate; plants bluish-white; A/A

Cells smooth; leaves radially arranged.

Leaves serrulate and unbordered; immersed capsules: E

Leaves entire and bordered with longer cells; exserted capsules; WS

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**Group A3 – Stems distinctly tomentose**

Stems covered with pigmented (reddish to brownish) rhizoidal tomentum to near apex.

Leaves squarrose-recurved and heart shaped; fens; N
Leaves ovate to broadly elliptical.
Rhizoidal initials in longitudinal rows; endostome fused into a dome; N*
Leaves oblong-lanceolate to oblong-lingulate.
Cells pleuripapillose; terminal cell long and smooth; brood bodies axillary; N*
Cells unipapillose; terminal cell papillose; brood bodies terminal; WS
Leaves narrowly lanceolate from an ovate, plicate base; WC, NW
Leaves lanceolate to subulate-setaceous; WS

Stems covered with white-woolly tomentum.
Leaves with green sheets (lamellae) on their surface; bogs; N*
Leaves lacking lamellae; WS

**Group A3**

Paludella
Cinclidium
Rhizomnium†
Zygodon†
Aulacomnium†
Polytrichum†
Anacolia
Dicranum

**Group A4 – Stems red**

Plants julaceous.

Stems freely forked; leaves with distinct, ±reflexed point; cells in oblique rows; A/A, W
Stems occasionally forked; leaves ovate to ovate-lanceolate and concave.
Leaves broadly obtuse to acute; costa ending subcurrent; cells ~8:1; N*
Leaves abruptly acuminate; costa percurrent; cells ~4:1; NW
Leaves obtuse to acute; costa percurrent to excurrent; cells ~4:1; WS

Plants with stems covered with pigmented (reddish to brownish) tomentum.

Leaf cells >3:1; WS
Leaf cells <2:1.
Leaves setaceous, serrate above & recurved below; WC, NW
Leaves neither setaceous, serrate nor recurved.
Rhizoidal initials in longitudinal rows; endostome fused into a dome; N
Rhizoidal initials not in rows; endostome segments free; N*

Plants neither julaceous nor tomentose.
Leaves bordered by elongated cells.
Leaves distinctly toothed.

Cells smooth, cells up to 50µ; leaves plane; WS
Leaves entire.
Leaves +dimorphic (+distichous) lateral leaves and smaller dorsal leaves; WC
Leaves of one kind; WS

Leaves not bordered.
Leaves serrulate +throughout; cells prorulose; WS
Leaves +serrulate near the apex; cells smooth.
Leaves subulate; alar cells inflated, thick-walled and reddish; N*
Leaves not subulate; alar cells +undifferentiated; WS

**Group A4**

Plagiobryum
Anomobryum
Aongstroemia
Bryum†
Anacolia
Cinclidium
Rhizomnium
Mnium†
Epiphterygium
Bryum†
Philonotis†
Blindia
Pohlia†
Group A5 – Leaves squarrose-recurved

Leaves squarrose-recurved when **dry (or wet)**.
Leaves **5-ranked** and folded to appear **heart shaped**; stems densely **tomentose**; fens; **N**
Leaves squarrose-recurved **only** when **wet** (+appressed when dry).
Leaves **3-ranked**, long-decurrent and with papillose-crenulate margins; **CA**
Leaves **subulate-setaceous** from a **sheathing** base; disturbed soil; **N**
Leaves **lacking** the above unique characteristics.
  Cell walls irregularly **thickened**; cell lumens **stellate**; **A/A**
  Cell walls of **uniform** width; cell lumens ±**rounded**.
  Cells **intermediate** in length; **WS**
  Cells **short**.
  Leaves ±**bordered** by longer, or shorter and thick-walled cells; **1***; **WS**
  Leaves **unbordered**; **2***; **WS**

Group A5

**Paludella**

**Triquetrella**

**Trichodon**

**Geheebia**

**Dicranella**

**Tortula**

**Barbula**

Group A6 – Leaves falcate-secund

Plants **blackish**; leaves **multistratose**; capsules **valvate**; on rocks; **NW**
Plants **grayish**; costa >1/2 leaf breadth with 3(4) cell layers; green **striations** on leaves; **N**
Plants **green**; leaves unistratose and **lacking** striations; costa usually <1/5 leaf breadth.
  Alar cells clearly **differentiated**; plants **large**, mostly >1cm.
  Alar cells **pigmented**; capsules rarely strumose; **various** habitats; **2***; **WS**
  Alar cells **pale**; capsules **strumose**; on **alpine rocks**; **0***; **A/A**
  Alar cells ±**undifferentiated**; plants **small**, mostly <1cm; **WS**

Group A6

**Andreaeobryum**

**Paraleucobryum**

**Dicranum**

**Kiaeria**

**Dicranella**
Group A7 – Leaves subulate / setaceous (8:1 or greater)

Plants small to minute (mostly <5 mm high) with +immersed capsules growing on bare soil, usually as winter annuals; the "pygmy ephemerals" as defined here.
Setae straight; capsules immersed and cleistocarpous.
Capsules pyriform with a conspicuous, stomatose neck; spores small; WS Bruchia†
Capsules globose to ovoid, lacking a distinct neck.
Calytrae mitrate or cucullate; spores few and large (>100µ); E, CA

Group A7

Plants larger with exserted capsules growing on various substrates.
Leaves squarrose-recurved (wet); subula roughened throughout by cell ends; N
Leaves with bases distinctly incurved to expanded and clasping.
Cells intermediate in length and prorulose/papillose; upper cells +bistratose; WS Bartramia†

Capsules lacking a distinct neck.
Plants larger; peristome single with forked teeth.
Teeth divided to base, round and papillose; WS Ditrichum†
Teeth divided to mid-point, flat and pitted-striolate; WS Dicranella†

Cells short and smooth.
Upper cells +bistratose; capsules inclined, asymmetric and strumose; WS Oncophorus†
Leaves with a broad, single costa (>1/3 the leaf width).
Alar cells inflated and hyaline or colored (brownish to reddish).
Costa 3(4) cell layers thick (middle & dorsal layers green & "striped"); N* Paraleucobryum
Costa lacking the above unique characters.
Inner basal cells pale, enlarged and extending up along the costa; N* Dicranodontium
Inner basal cells little differentiated; WS Campylopus†
Alar cells +undifferentiated; capsules pyriform; WS Leptobryum
Leaves lacking the above unique characteristics.
Alar cells distinctly differentiated.
Capsules curved and strumose (goiter-like swellings); on rocks; A/A Kiaeria
Capsules obovoid to pyriform; on rocks.
Capsules ribbed (dry); peristome teeth wide-flaring, +split and striolate; N Arctoa
Capsules smooth (dry); peristome teeth erect, +entire and papillose; N* Blindia
Capsules lacking any of the above unique characters; substrates various.
Cells with cuticular ridges; peristome teeth +entire and papillose; N* Dicranoweisia
Cells smooth; peristome teeth forked and pitted-striolate below; WS Dicranum†
Alar cells +undifferentiated.
Stems tomentose & red; leaves serrate above & recurved below; WC, NW Anacolia
Stems lacking tomentum & green.
Cells intermediate to long; peristome teeth usually present.
Plants small (<2mm); leaves little altered (dry); on rocks; WS Seligeria†
Plants larger (>5mm); leaves twisted (dry); on wood; SA, WC Orthodontium†
Cells short; annulus compound; peristome teeth mere stubs; WS Brachydontium
Group A8 – Leaves dimorphic

Leaves costate, 4-ranked and bordered; dorsal leaves smaller; stems red; cells smooth; WC

Group A9 – Leaves with hair-points or awns

Plants minute (mostly <5 mm high) with +immersed capsules growing on bare soil, usually as winter annuals; the "pygmy ephemerals" as defined here.

Leaves with lamellae on the upper end of the costa; WS

Leaves with filaments on the upper end of the costa.

Leaves "fleshy" with involuted margins; filaments on very broad costa; WC

Leaves thin with reflexed to revolute margins; filaments on narrow costa; W

Leaves lacking lamellae or filaments.

Leaves with a revolute margin; cells pleuripapillose; WS

Leaves with reflexed tips; cells with single blunt papillae; WS

Leaves with plane margins and tips; cells smooth.

Capsules exserted & peristomate; calyptrae cucullate; NW

Capsules +emergent & operculate; calyptrae persistent. 4-angled & split; E, CA

Plants growing on dung, animal remains, or other highly nitrogenous materials; the "dung mosses".

Hypophysis greatly differentiated and colored; peristome teeth chambered; N, CP, SA

Hypophysis narrowly pyriform and +urn-colored; peristome teeth not chambered; N

Plants lacking any of the above unique characteristics.

Leaves "fleshy" from crowded lamellae covering a very broad costa; WS

Leaves with a broad (1/3 – 1/2 leaf width) single costa; WS

Leaves with distinct border.

Cells short (+isodiametric); pleuripapillose or smooth; WS

Cells intermediate in length; smooth.

Capsules pendent and pyriform; WS

Leaves with large, lax and hyaline basal cells contrasting with dense upper cells.

Basal cells pale with brown, thickened cross walls; calyptrae campanulate; WS

Basal cells thin-walled and non-pigmented throughout; calyptrae cucullate.

Peristome of 32 twisted teeth on a high basal membrane; WS

Peristome of 32 +erect teeth on a low basal membrane; WS

Leaves lacking the above unique characteristics.

Continued below at left margin
Continued from Group A9 above

Leaf cells distinctly papillose; marginal cells greener; on mountain rocks and soil; WC, SW  
*Pseudocrossidium*†

Leaf cells smooth or indistinctly ornamented.

Plants in tufts on tree trunks and branches (rarely on rocks); diplolepideous.

Leaves crisp ≤ when dry; basal cells yellow, thick-walled and in diagonal rows; WC  
*Ulota*‡

Leaves not crisp ≤ when dry; basal cells undifferentiated; WS*

Plants in tufts, cushions and mats on rocks; haplolepideous.

Leaves crisped when dry; basal cells yellow, thick-walled and in diagonal rows; WC  
*Jaffueliobryum*

Leaves not crisped when dry; basal cells undifferentiated; WS*  
*Orthotrichum*†

Plants on soil primarily.

Calyptrae large, campanulate, plicate and lacerate at base.

Leaves ovate to obovate; WS (W)  
*Jaffueliobryum*

Leaves ovate-lanceolate and biplicate; N*  
*Coscinodon*

Calyptrae small, cucullate or mitrate.

Capsules systylious; calyptrae short; in wetter habitats; WS  
*Schistidium*†

Capsules not systylious; calyptrae reaching operculum; in dryer habitats; WS  
*Grimmia*†

Plants on soil primarily.

Cells intermediate in length; capsules pendent and pyriform; WS  
*Bryum*‡

Cells short (?isodiametric); capsules mostly erect and cylindrical; WS  
*Desmatodon*†

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### Group A10 – Leaves with lamellae, ridges, or filaments

Leaves with green, sheet-like lamellae.

Leaves with a very broad costa covered by ≥20 lamellae.

Leaves mostly unistratose; peristome present.

  Lamellar apical cells papillose; capsules +terete.
  
  Leaves subtubulose; lamellar apical cells elliptic-pyriform; WS  
  *Polytrichastrum*

  Leaves oblong lanceolate; lamellar apical cells +rounded; WS  
  *Pogonatum*

  Lamellar apical cells smooth or ridged; capsules sharply 4-5 angled; WS  
  *Polytrichum*

Leaves with a narrow costa having <20 lamellae.

  Lamellae on both surfaces of leaves; leaves unbordered; 5-15 lamina; WC, NW  
  *Oligotrichum*

  Lamellae restricted to the upper surface of leaves.
  
  Leaves with awns; 2-4 lamellae; plants +bulbiform; WS  
  *Pterygoneurum*

  Leaves with cilia at leaf shoulder; 5-15 lamellae; WA, BC, AK  
  *Bartramiospis*

  Leaves bordered by hyaline, elongate cells; 2-8 lamellae; WS  
  *Atrichum*

Leaves with ridge-like lamellae on the back (dorsal side) of the costa.

  Stems tomentose (woolly; white to rusty brown); alar cells hyaline and yellow-brown; WS  
  *Dicranum*†

  Stems smooth; alar cells not pigmented.
  
  Costa broad (>1/3 leaf width); ridges weak (1-2 cells); cells short-rectangular; WS  
  *Campylopus*†

  Costa narrow (<1/3 leaf width); ridges strong (>6 cells); cells rounded-oblate; N  
  *Dryptodon*

Leaves with green, branched filaments.

Leaves “fleshy”: filaments on lamina and costa, but covered by inrolled leaf margins; WS*  
*Aloina*

Leaves thin: filaments on costa only; leaf margins reflexed to revolute; W  
*Crossidium*

Leaves with fine, white, threadlike filaments in a tangled, cobwebby weft; N*  
*Saelania*
**Group A11 – Leaves undulate**

Leaves **complanate** (attached all around the stem but twisted into one plane); E
Leaves with **lamellae** on the costa; WS
Leaves **lacking** any of the above unique characteristics; N

**Group A11**
- Aulacomnium
- Atrichum
- Dicranum

**Group A12 – Leaves involute**

Leaf margins involute wet or dry.
Leaf margins **infolded/inflexed** over **photosynthetic** lamellae or filaments.
- Leaves with green, sheet-like **lamellae**; WS
- Leaves with green, branched **filaments**; WS*
Leaf margins **inrolled** over laminae **lacking** lamellae or filaments.
- Leaf cells **papillose**.
  - Capsules **exserted** and **operculate**; WS
  - Capsules **immersed** to emergent, **cleistocarpous**; E

**Group A12**
- Polytrichum
- Aloina
- Weissia
- Astomum

**Group A13 – Leaves +all costa**

No relevant genera on the West Coast.

**Group A13**

**Group A14 – Leaves with a broad, single costa**

Leaves **bristle-like** (setaceous) or with distinct hair-points.
- Leaves with costa of 3(4) cell **layers** (middle & dorsal layers **green** & “**striped**”); N*
- Leaves **crowded** at stem tips; reddish, axillary **hairs** common; WS
- Leaves **lacking** the above unique characteristics.
  - Leaves with **strongly differentiated** alar cells (inflated and hyaline).
    - Inner basal cells **pale**, **enlarged** and **extending** up along the costa; N*
    - Inner basal cells **little** differentiated; WS
  - Leaves with alar cells **little** differentiated.
    - Leaves <3mm; upper cells rectangular to **linear**.
      - Costa **lacking** median row; brood leaves **lacking**; WS
  - Leaves **oblong-lanceolate**; capsules elongate, curved and with a conspicuous neck.
    - Upper leaf cells pale, **lax**, thin-walled and **oblong-hexagonal**; N
    - Upper leaf cells short **rectangular**, but **not** lax; N

**Group A14**
- Paraleucobryum
- Leptobryum
- Dicranodontium
- Campylopus
- Dicranella
- Amblyodon
- Meesia
Reminder: The costa in Groups A15 through A19 is long and single.

**Group A15 – Leaves with bases distinctly incurved to expanded and clasping**

Leaves **squarrose-recurved**.
Leaves **subulate / setaceous**; subula **roughened** throughout by cell ends; N
Leaves **subulate / setaceous** (needle or bristle-like).
Cells **intermediate** in length and **protrulose/papillose**; upper cells **+bistratose**; WS
Cells **intermediate** in length and **smooth**.
Capsules with **distinct**, very long **necks**; WS
Capsules **lacking** a distinct neck.
Plants **larger**; peristome **single** with **forked** teeth.
Teeth divided to **base, round** and **papillose**; WS
Teeth divided to **mid-point, flat** and **pitted-striolate**; WS
Cells **short** and **smooth**.
Upper cells **+bistratose**; capsules **inclined, asymmetric** and **strumose**; WS
Leaves with **lamellae** or **ridges** on their laminae or costa.
Leaves with a very **broad costa** covered by **>20** lamellae.
Leaves mostly **unistratose**; peristome **present**.
Lamellar apical cells **papillose**; capsules **+terete**.
Leaves **subtubulose**; lamellar apical cells **elliptic-pyriform**; WS
Leaves oblong **lanceolate**; lamellar apical cells **+rounded**; WS
Lamellar apical cells **smooth** or ridged; capsules sharply **4-5 angled**; WS
Leaves with a **narrow costa** having **5-15** lamellae.
Leaves on **both** surfaces of leaves; leaves **unbordered**; WC, NW
Lamellae on **upper** surface of leaves only; **cilia** at leaf shoulder; WA, BC, AK
Leaves **lacking** any of the above unique characteristics; cells strongly **bulging** on upper surface;
endostome of 64 papillose **filaments**; WS

**Group A16 – Leaves with long decurrencies**

Shoots **angular** in cross-section; leaves **squarrose** recurved; cells **short** and **papillose**.
Leaves **3-ranked**; stems **smooth**; CA
Leaves **5-ranked**; stems densely **tomentose**; calcareous **wetlands**; N
Shoots **terete** (round in cross-section); capsules **pyriform** or **pendulous**.
Leaves distinctly **toothed** throughout.
Marginal teeth **paired**; sterile stems **+erect** and **round**; WS
Marginal teeth **single**; sterile stems **prostrate** and **complanate**; WS
Leaves **entire** to **+serrulate** or **+toothed** at apex.
Leaves predominantly **broader** near the **middle**; capsules **pendent**.
Leaves commonly **bordered**; median cells **<4:1**; WS
Leaves **not bordered**; median cells **>4:1**; WS
Leaves predominantly **broader** at the **base**; setae very **long**; capsules **+inclined**; N
**Group A17 – Leaves with a distinct group of hyaline cells**

**Group A17**

Note: hyaline cells may not be clearly distinct in very old leaves that have lost their chlorophyll.

Hyaline cells at apex of leaves; plants whitish.

Stems often forked or branched, especially at stem apices.

- Cells papillose (simple and forked); capsules immersed; peristome lacking; WS
- Cells smooth; capsules exserted with extremely long necks; peristome: A/A, W

Stems rarely branched; leaves apicate; capsules pendent; cells smooth; WS

Hyaline cells as marginal wedges broadest at the base of leaves.

Leaves spreading and crenulate to entire.

Leaves acute to acuminate; upper cells pleuripapillose; WS

Hyaline cells in abruptly differentiated, ±oval "windows" (cancellinae) in the lower 1/3 of leaves.

Leaves lacking linear, intramarginal cells; calyptrae deciduous and cucullate.

Leaf margins revolute; peristome of 32 twisted teeth; 1*; WS

Hyaline, inflated and thin-walled cells across the lower 1/3 of leaves.#

Leaves abruptly serrate at the shoulder and whorled at branch points; 2*; WS

Leaves toothed above; 2*

- Older leaves brick-red; stems lacking a hyalodermis; WS
- Older leaves brownish-green; stems with a hyalodermis; BC

Leaves with erect, bistratose margins; 1*; WC, AZ.

Leaves revolute at least below; 1*.

Leaves ±rounded with short to long awns; cells 10-13µ; peristome present.

- Peristome of 32 twisted teeth on a high basal membrane; WS
- Peristome of 32 erect teeth on a low basal membrane; WS

Leaves acute; cells 15-20µ; peristome none or rudimentary; WS

Leaves lacking any of the above unique characteristics.

Cross walls of basal cells thick and brown; calyptrae long campanulate; 1*; WS

Cross walls of normal thickness; calyptrae cuculate.

Stems with a hyalodermis; papillae usually bifid: 2*.

- Stems with a central strand (small cells); NW, WC, GC
- Stems lacking a central strand; WS

Stems lacking a hyalodermis; papillae usually C-shaped; 1*.

- Peristome of 32 twisted teeth on a high basal membrane; WS
- Peristome of 32 erect teeth on a low basal membrane; WS

#: Note: Many taxa with short, papillose, medial cells possess basal cells that are somewhat differentiated, i.e., pale (translucent), less papillose, somewhat elongated and/or colored, especially near the insertion. The taxa in this Group A17 represent the extreme, strongly differentiated condition of a gradient while those taxa with the less differentiated basal cells are found in Group A25.
**Group A18 – Leaves with a distinct marginal border**

Leaves *ciliate* at the margins.

- Plants primarily *protonemata*; capsules inclined, ovoid and *ventricose*; WS*
- Plants *leafy*; capsules not differentiated as above.
  - Leaves with 4-9 *lamellae* on costa; cilia at leaf *shoulder*; WA, BC, AK
  - Leaves lacking *lamellae*; cilia at leaf *base*; WA, AK

Leaves with a border of *elongate* cells contrasting with *shorter* medial cells.

- Plants strongly *flattened*; leaves twisted into one plane (*complanate*); WS
- Plants with red stems.
  - Stem *tomentose*.
    - Rhizoidal initials in *longitudinal rows*; endostome fused into a *dome*; N
    - Rhizoidal initials *not* in rows; endostome segments *free*; N*
  - Stems *smooth*.
    - Leaves 4-ranked and *dimorphic* (dorsal leaves smaller); WC

Plants lacking the above unique characteristics.

- Leaves with *lamellae* on the costa; WS
- Leaves with *paired teeth* on margins; WS
- Leaves with distinct *single teeth* or serrulations on margins.
  - Leaf cells >3:1.
    - Leaves *rounded-obtuse* and apiculate; upper cells in *oblique* rows; N*
    - Leaves *acute* to awned; cells *not* in oblique rows.
  - Capsules *pendent* and *pyriform*; WS
  - Capsules *erect* and *+cylindric*; GC, SW, SA

- Leaf cells <2:1; WS
- Leaves with *entire* margins.
  - Leaf cells >3:1.
    - Capsules *pendent* and *pyriform*; WS
    - Capsules *erect*.
      - Leaves *rounded-obtuse*; upper cells in *oblique* rows; N*
      - Leaves broadly *acute*; cells *not* in oblique rows; WS

Leaves with margins differing in *color* and/or *opacity* from the medial laminae.

- Margin *darker* because 3-5 cell layers thick; plants *blackish*; on *rocks* in rivers; WC, NW
  - Margin *paler* and *yellowish* due to *thick-*walled, *less* papillose cells.
  - Leaves distinctly *toothed* above; basal membrane lacking; 2*; SE
  - Leaves *entire*; basal *membrane* present; 1*.
    - Peristome (32) *spirally* twisted above a *high* basal membrane; WS
    - Peristome (16) *obliquely* slanted above a *low* basal membrane; WS

Margin *greener* (cells *thin-*walled & *less* papillose) and *spirally* revolute; 1*; WC, SW

Leaves with an *intramarginal* "border", i.e., differentiated cells just inside short marginal cells.

- Leaves with an *intramarginal* "border", i.e., differentiated cells just inside short marginal cells.
  - "Border" of *long, narrow, pellucid* cells along leaf bases.
    - Basal cancellinae *lacking*; plants *blackish*; on *rocks* in rivers; WC, NW
  - "Border" of *enlarged, +isodiametric, yellow* to *orange, thick-*walled cells; 1*; W

*Group A18*

- *Buxbaumia*
- *Bartramiopsis*
- *Oedipodium*
- *Plagiomnium*
- *Epipterygium*
- *Atrichum*
- *Mnium†*
- *Pseudobryum*
- *Scouleria*
- *Entosthodon†*
- *Leptodontium†*
- *Tortula†*
- *Desmatodon†*
- *Crumia†*
**Group A19 – Leaves with distinct alar cells**

Stems tomentose; alar cells inflated, hyaline and yellow-brown towards the margin; WS
Stems not or indistinctly tomentose; alar cells not as above.

Costa broad, >1/3 leaf width; alar cells inflated, and hyaline to brownish to reddish.
Costa 3(4) cell layers thick (middle & dorsal layers green & “striped”); N*
Costa lacking the above unique characters.
  Inner basal cells pale, enlarged and extending up along the costa; N*
  Inner basal cells little differentiated; WS
Costa narrow, <1/3 leaf width.
  Alar cells enlarged to inflated and yellowish to brownish.
  Capsules curved and strumose (goiter-like swellings); on rocks; A/A
  Capsules obovoid to pyriform; on rocks.
    Capsules ribbed (dry); peristome teeth wide-flaring, split and striolate; N
    Capsules smooth (dry); peristome teeth erect, entire and papillose; N*
  Capsules cylindrical; substrates various.
    Cells with cuticular ridges; peristome teeth entire and papillose; N*
    Cells smooth; peristome teeth forked and pitted-striolate below; WS
  Alar cells sub-quadrate and pale; cells thick-walled and often nodulose; WS

**Group A20 – Leaves with costa extremely reduced to lacking**

Leaves in clusters of branches around a central stem and a network of green and hyaline cells; WS
Leaves distichous, decurrent and confluent; protonemata luminous; “Goblin Gold”; WS*
Leaves spinose serrate; protonemata persistent; cells smooth; pygmy ephemerals; WS
Leaves lacking the above unique characters.
  Cells papillose; capsules exserted and valvate (4x); plants reddish-black; on rocks; N*
  Cells smooth.
    Capsules exserted with 4 prominent teeth; on undersides of rock overhangs; N
    Capsules sessile and gymnostomous; pygmy ephemerals; on soil; WS
Reminder: Definitions for cell length to breadth ratios are found in the Introduction and the Overview in addition to below. Abbreviations for the number of stereid bands in costa cross sections are found in the Introduction in addition to below. An expanded explanation of the difference between "Distinct" and "Indistinct" surface ornamentation is found in the Introduction.

**Cells** = medial, laminal cells; cells ~2/3 of the way from insertion to apex, midway between the costa and the margin.

Length to breadth **ratios** of medial, laminal cells:
- **Long** cells: >5:1; commonly termed linear.
- **Intermediate** cells: 2-5:1; commonly termed elongated, rectangular, hexagonal, or rhomboidal.
- **Short** cells: <2:1; commonly termed isodiametric, quadrate, rounded-quadrate, or sub-quadrate.

Number of **stereid bands** evident in costa cross-sections:
- 2* = costa with two stereid bands
- 1* = costa with one stereid band
- 0* = costa lacking stereid bands, i.e., ±homogeneous

<table>
<thead>
<tr>
<th><strong>Group A21 – Cells long (&gt;5:1) and smooth</strong></th>
<th><strong>Group A22 – Cells intermediate (2-5:1) and distinctly papillose</strong></th>
<th><strong>Group A23 – Cells intermediate (2-5:1) and distinctly prorulose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves <strong>flexuose-twisted</strong> (dry); cell walls ±<strong>thickened</strong>; capsules mostly <strong>erect</strong>; SA, CA</td>
<td><strong>Group A21</strong> Orthodontium†</td>
<td><strong>Group A22</strong> Philonotis†</td>
</tr>
<tr>
<td>Leaves <strong>little</strong> altered (dry); cell walls <strong>not</strong> thickened; capsules inclined to <strong>pendulous</strong>; WS</td>
<td></td>
<td><strong>Bartramia†</strong></td>
</tr>
</tbody>
</table>

Leaves **ovate** and abruptly narrowed to a **short** acumen; papillae **simple**; W, VT
Leaves linear-lanceolate to **subulate** from an **erect** base; papillae **simple**; WS

**Group A23 – Cells intermediate (2-5:1) and distinctly prorulose**

Leaves **julaceous** and **5-ranked**; peristome teeth **fused** at tip; A/A
Leaves and peristome teeth **otherwise**.

Setae **flexuose**; capsules **symmetric** and **rugulose**; peristome **reduced**; NC, TN
Setae **straight**; capsules **asymmetric** and **furrowed**; peristome teeth **lanceolate**.
Leaves with **bistratose** margins and/or lamina; **mesic** habitats; WS
Leaves **unistratose**; **hydric** habitats; WS
Setae **short**, capsules **impressed**
Leaves ±**linear-lanceolate** and ±**spinulose** above; protonemata **persistent**; WS
Leaves ±**subulate** and **serrulate** above; protonemata **ephemeral**; WS

**Group A23**

**Conostomum**

**Bartramidula**

**Bartramia†**

**Philonotis†**

**Ephemerum†**

**Bruchia†**
**Group A24 – Cells intermediate and smooth (or indistinctly ornamented#)**

Leaves predominantly **broader near** or **above** the middle (±oblong or obovate).

Plants **small, winter annuals** on soil.

Capsules clearly **exserted**.

- Costa **strong**; protonemata **ephemeral**; peristome **lacking**; WS
- Costa **weak**; protonemata **persistent**; peristome **present**; WS*

Capsules +**immersed** and +**pyriform**.

- Leaves +concave-**obovate** and serrulate; capsules **operculate**; WS
- Leaves +concave-**ovate** and **entire**; capsules **cleistocarpous**; WS

Plants **otherwise**.

- Leaves commonly bordered by **linear** cells; capsules pyriform and **pendent**; WS
- Leaves **unbordered**.

  Medial cells **smooth** and >5:1 (linear rhomboidal); capsules **pendent**; WS
  Medial cells **smooth** and <4:1; capsules inclined to **erect**.
  - Peristome of 4 **massive** teeth; plants bud-like; costa **weak**; on rocks; N
  - Peristome of 16 **teeth**; costa strong; on soil.

- Capsules with well-**differentiated** necks; calyptrae **mitrate**; N*
- Capsules **lacking** a distinctive neck; calyptrae inflated **cucullate**.
  - Capsules **inclined** and **asymmetric**; WS
  - Capsules **erect** and **symmetric**; WS

- Peristome **lacking**; capsules erect and symmetric; calyptrae **mitrate**; WS

Leaves predominantly **broader** near the **base** (±lanceolate).

Plants **small, winter annuals** on soil; capsules +**immersed** and **cleistocarpous**; WS

Plants **otherwise**; capsules **exserted** and **peristomate**.

Leaves +**subulate** / setaceous.

- Capsules **ovoid**; plants minute to very **small**; on calcareous rocks; WS (N)
- Capsules long **cylindric**; peristome teeth **round**, fully **split** and **papillose**; WS
- Capsules +**oblong**, often **curved**; peristome teeth **flat**, **split** 1/2 and **pitted**; WS

Leaves flexuose-twisted (dry); cells +**thick**-walled; SA, WC

Leaves with expanded, sheathing leaf bases; WS

Leaves **lacking** any of the above unique characteristics.

Leaves >1mm; capsules **terminal**.

- Costa **percurrent**; capsules erect; peristome **single**.
  - Upper cells +**linear**; peristome teeth **long** & **split**; WS
  - Upper cells **broad**; peristome teeth **short** & **irregular**; N

- Costa **subpercurrent**; capsules ±**pendant**; peristome **double**; WS

Leaves <1mm; capsules **lateral**; peristome **single**; on Cu or S rich soils; N*

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# Cells bulging, mammilllose (cells both bulging and papillose), or with low papillae or projections.
**Group A25 – Cells short (<2:1) and distinctly papillose**

Leaves with expanded, sheathing bases; cells strongly bulging on upper surface; WS
Leaves distinctly toothed in the upper half.

Cells **pleuripapillose**: leaves +squarrose-recurved; 2*.
Leaf lamina unistratose; stem hyalodermis lacking; peristome present; SE

Cells **unipapillose** or mammillose; ventral stereid band weak or lacking.
Leaves +broad; cells mammillose; capsules smooth; WS
Leaves +narrow; cells coarsely papillose; capsules furrowed; N
Leaves with large, curved, projecting papillae at extreme apex; cells mammillose: NW
Leaves with revolute margins and smoother, greener marginal cells; 1*; WC, SW
Leaves lacking the above unique characteristics.

Cells **collenchymatous** and stellate; 2*.
Leaves squarrose-recurved (wet); cells pleuripapillose; A/A
Leaves erect (wet); cells unipapillose; A/A

Cells **pleuripapillose**: but neither collenchymatous nor stellate.

**Papillae forked**: basal cells with brown cross-walls; calyptrae long-cylindric; WS
**Papillae C-shaped**.
Basal cells with brown cross-walls; calyptrae long-cylindric; 1*; WS
Basal cell walls uncolored; calyptrae cuculate.
Peristome teeth long and twisted; 2*; WS
Peristome teeth short and erect; 1*; WS

**Papillae conical**.
Cells with 4–7 papillae; peristome reduced to lacking.
Stems repeatedly forked; capsules elongate and urn-shaped; 2*; WS
Stems sparsely forked; capsules pyriform; 1* or lacking; WS*

Cells with 1–4 papillae.
Costa with two stereid bands.
Leaf margins revolute on both sides; peristome present.

**Papillae crowded**: basal cells hyaline; peristome twisted; WS
**Papillae scattered**: basal cells green; peristome oblique; WS
Leaf margins revolute on one side only; peristome lacking; WS
Leaf margins plane; peristome lacking.
Leaves <2 mm; sporophytes terminal; WS

Costa with one stereid band; peristome lacking.
Sporophytes lateral; stem rounded-triangular; WS
Sporophytes terminal; stem round; WS
Costa lacking stereid bands; peristome present.
Basal marginal cells with thickened cross-walls; WS
Basal marginal cells undifferentiated; WS

Cells **unipapillose**: but neither collenchymatous nor stellate.

Leaves serrulate at apex; stems tomentose; gemmae on stem extensions; WS
Leaves entire.

Capsules exserted; peristome of 32 twisted teeth; plants on soil and rocks; 2*; WS
Capsules emergent and valvate (4x); blackish plants on rocks; 0*; N*
Capsules immersed with 16 reflexed teeth; plants on trees and rocks; 0*.
Basal marginal cells with thickened cross-walls; WS
Basal marginal cells undifferentiated; WS

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**Group A25**

- Timmia
- Leptodontium
- Dichodontium
- Cynodontium
- Pseudocrossidium
- Geheebia
- Aulacomnium
- Encalypta
- Barbula
- Desmatodon
- Amphidium
- Zygodon
- Hymenostylium
- Gymnostomum
- Anoectangium
- Gymnostomum
- Orthotrichum
- Ulota
- Aulacomnium
- Orthotrichum
Group A26 – Cells short (<2:1) and smooth (or indistinctly ornamented#)

Leaves ±oblong-spathulate (broad in the middle and even broader above).
Leaf margins usually revolute, at least in part; cells flat.
Leaves ±bordered with longer cells; peristome teeth short and erect; 1*; WS
Leaves ±bordered with shorter cells; peristome teeth long and twisted; 1*; WS
Leaves with intra-marginal border of enlarged, thick-walled, orange cells; 1*; W
Leaves unbordered.

Propagula axillary; peristome of 32 spirally twisted teeth; 2*; WS

Leaf margins plane; cells flat and large (>15µ); peristome none or rudimentary; 1*; WS
Leaves ±lingulate (tongue-shaped) or oblong-lingulate (strap-shaped).
Leaves ±lingulate; cells 2(3)stratose; awns on perichaetial leaves; capsules sessile; E, BC
Leaves ±ovate (broadest in lower third; egg-shaped) and revolute; peristome of 32 teeth; 2*; WS
Leaves ovate-lanceolate to lanceolate (broadest near the base; lance-shaped).

Group A26

Leaves 3-ranked; setae very long; plants of calcareous wetlands; N
Leaves falcate-secund; capsules valvate; plants saxicolous and blackish; NW
Leaves with expanded, sheathing leaf bases.

Cells bulging on upper surface; capsules symmetric and oblong-ovoid; WS
Cells smooth; capsules asymmetric and strumose (goiter-like swelling); WS
Leaves with paired teeth on bistratose margins.

Margins revolute below; cells with cuticular ridges; perichaetia terminal; N*
Leaves with an intramarginal band of long, narrow cells at base; WC and NW
Leaves bistratose, at least in part.

Leaves subtubulose (dry); cells bulging on upper surface; 2*; WC, SW, TX
Leaves curved to crisped (dry); cells bulging or flat.
Calyptrae mitrate, lobed and plicate; 2*; WS
Calyptrae cucullate, entire and smooth; 1*; WC, AZ
Leaves lacking any of the above unique characters.

Continued below at left margin
Continued from Group A26 above

Leaves lacking the above unique characteristics.
Capsules split along 4 sutures; plants saxicola and blackish; N*  

Andreaea†

Capsules with 4, massive teeth; leaves pellucid; terminal gemmae cups; WS  

Tetraphis

Capsules with 8, 16 or 32 lanceolate teeth.  

Plants in tufts on tree trunks (rarely on rocks); diplolepideous.  

Leaves crisped when dry; basal cells yellow, thick-walled; WC  

Ulota†

Leaves not crisped when dry; basal cells undifferentiated; WS*  

Orthotrichum†

Plants in tufts, cushions or mats on rocks.  

Peristomes diplolepideous (double).  

Basal cells very thick-walled, yellow and radiating from costa; WS  

Ulota†

Basal cells thick-walled, neither yellow and nor radiating; WS  

Orthotrichum†

Peristomes haplolepideous (single).  

Plants very small (<2 mm); setae cygneo (wet); N  

Seligera†

Plants larger (>2 mm).  

Capsules systylious; calyptrae short; in wetter habitats; WS  

Schistidium†

Capsules not systylious; calyptrae longer; in dryer habitats; WS  

Grimmia†

Plants on soil primarily.  

Setae cygneo.  

Capsules yellow-orange with red ribs; calyptrae cucullate; A/A  

Oreas

Capsules yellowish and smooth; calyptrae mitrate; N*  

Campylostelium

Setae bent at capsule base; capsules strumose and purple-red; leaves revolute throughout and serrate apically; upper cells square; WS  

Ceratodon

Setae straight.  

Capsules ribbed; in crevices of cliffs and boulders.  

Peristome teeth divided to half their length; N  

Cynodontium⊥

Peristome teeth undivided; E  

Rhabdoweisia

Capsules smooth (or wrinkled when dry).  

Setae very long; capsules inclined; peristome double; in fens; N  

Meesia

Setae shorter; capsules erect; peristome single; on mineral soils.  

Basal cells hyaline; peristome teeth twisted; WS  

Barbula⊥

Basal cells green; peristome teeth oblique; WS  

Didymodon⊥

# Cells bulging, mammillose (cells both bulging and papillose), or with low papillae.

End.